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YELLOWKNIFE - BACK BAY STUDY ON METAL AND TRACE ELEMENT CONTAMINATION OF WATER, SEDIMENT and FISH

FRANCIS J. JACKSON[1]
CAROLINE N. LAFONTAINE[2]
JACK KLAVERKAMP[3]

[1]DEPARTMENT OF INDIAN AND NORTHERN AFFAIRS CANADA
YELLOWKNIFE, N.W.T.

[2]DEPARTMENT OF FISHERIES AND OCEANS
YELLOWKNIFE, N.W.T.

[3]FRESHWATER INSTITUTE
WINNIPEG, MANITOBA

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ABSTRACT

At a meeting in March 1992, two N.W.T. communities, Dettah and Ndilo, expressed concerns about the water and fish quality in the Yellowknife-Back Bay areas. At a follow up meeting in April 1992, representatives from the Department of Fisheries and Oceans, Mackenzie Regional Health Services and DIAND Water Resources Division came to an agreement with the two communities that a two year joint study would be initiated in an attempt to provide definitive answers to their concerns. The concerns were expressed as three questions: 1. Is the water safe to drink? 2. Is the water safe to swim in? and 3. Are the fish safe to eat? The present study looks at the water, sediment and fish quality in the two bay areas. A health risk assessment on the water data is included but for fish it is pending. In addition, a dietary study was conducted by the Mackenzie Regional Health Services in order to correlate store bought food intake versus country food intake. This study is a separate report.

The water, sediment and fish study was started in the August 1992 and completed in March 1994. The dietary study was started in February 1993 and completed in August 1994.

Water was analysed for 25 physical, chemical and biological parameters and results were compared to the Canadian Water Quality Guidelines (CWQG) set for the protection of freshwater aquatic life, raw drinking water and recreational uses. 28 chemical parameters were analysed in the sediment samples, for organic and inorganic concentrations.

Most of water quality results are well within the Canadian Water Quality Guidelines for raw drinking water usage except for site #2, Baker Creek outlet at Great Slave Lake. Mackenzie Regional Health Services deemed the water at community use areas safe to drink and swim in but still recommended that the water be treated for bacteria (boiled/chlorinated) prior to consumption.

The sediment results showed the sites near Giant mine had noticeably higher values in most of the 16 elements analysed with other sites showing occasional higher values.

Six species of fish consisting of 1) lake whitefish, 2) longnose suckers, 3) burbot, 4) walleye, 5) northern pike and 6) lake trout were analysed for eight heavy metals. Tissue analysis included the muscle, liver, kidney, stomach and eggs. Although elevated concentrations of As, Hg, Cd, and Se were observed in various tissues of fish collected from sites downstream of the mine sites, preliminary analysis indicated that these concentrations might be well below limits set for human consumption. A complete health risk assessment will be provided by Health and Welfare Canada some time in the future.

In addition to the metal analyses of the fish tissues, a final section summarizes the following: biological descriptions (length, weight, age and condition factor) for the six species of fish caught; an estimate of the annual loading of metals by Royal Oak Mines Inc. (Giant mine) and Miramar-

Miramar-Con Mine; and a description of the shoreline (littoral zones) for the two bays likely to be impacted by the future expansion of the City of Yellowknife.

All the funding for the study was provided by the Action on Water Component of the Arctic Environmental Strategy, administered by the Water Resources Division of the Department of Indian Affairs and Northern Development in Yellowknife. The work was planned and coordinated by a working group consisting of representatives from the Yellowknives Dene Band, Dene Nation, Metis Nation, Department of Fisheries and Oceans, Mackenzie Regional Health Services and DIAND.

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Shared Knowledge of Yellowknife/Back Bay

Frank Lemouel (Yellowknife), George Goulet (Ndilo), George Low (DFO), Robert Luke (DFO)

Study Design

All the working group members: Frank Lemouel-Denendeh National Office, Bill Carpenter-Metis Nation, Chief Jonas Sangris, Chief Darrell Beaulieu, Jack Poitras, Band Manager, George Goulet-Yellowknives Dene Band, Jill Christensen-Mackenzie Regional Health Services, Steve Harbicht-Department of Fisheries Oceans, Juanetta Peddle-Water Resources Division

Technical Reviewing of the document

Brian Latham, Erik Madsen-Water Resources Division
Chris Baron-Freshwater Institute, Winnipeg, Manitoba

Laboratory Analysis

All the staff at the Northern Analytical Laboratory in Yellowknife, NT

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

SECTION ONE: Study Overview

1.1 STUDY AREA

The Yellowknife Bay water, sediment and fish study area is located on the north arm of Great Slave Lake, Northwest Territories, Canada (Figure 1). The study area includes both the Yellowknife and Back Bay areas (Figure 2). The northern limit is the Yellowknife River, near the mouth (Site #1), and the furthest southern point is the outlet of Peg Lake on Great Slave Lake (Site #10) (Figure 3).

1.2 BACKGROUND

1.2.1 Past Loading in the Study Area.

Gold exploitation in the vicinity of Yellowknife Bay began in 1938. During the first decades of operation of Con mine (1938 to 1968) and Giant mine (1949 to mid 1960s), gold was separated by mercury amalgamation (Moore et al., 1978; 1979). Roasting of the ore contributed to the release of arsenic from the gold bearing rocks (Mudroch et al., 1989). To date, only Giant mine continues to roast its ore. The Con mine discontinued roasting in 1971.

The Yellowknife-Back Bay areas are surrounded by mineral formations containing arsenic and associated metals such as copper, zinc, lead and nickel; consequently weathering of the bedrock also contributes to the level of arsenic in the environment (Boyles, 1960).

Arsenic and mercury are two major pollutants that have been released from the liquid and gaseous output of the gold mines in the last sixty years. Concerns about these elements arise from the fact that they bioaccumulate in living organisms and mercury biomagnifies through the successive trophic levels of the food chain.

The old tailings from the Negus mine operation, the treated liquid effluent of Con and Giant Mine and city storm drains seem to be the main anthropogenic sources of pollution to have chronically entered the waters and sediments of the Yellowknife/Back Bay areas. The history of occasional spills and intentional loading of tailings directly into the bays is poorly documented before water licences became mandatory in 1978. Because there were no defined tailings containment areas in the early days (1930s, 40s and 50s) the tailings were directly deposited to the surrounding areas near the mine sites (ie. Kam Lake, Meg-Keg-Peg Lakes and Baker Creek) (Figures 4 & 5). Those tailings eventually ended up in Great Slave Lake by either surface run-off (eg. spring run-off, after rainfall) or deliberate discharge.

In the early 1960s some tailings from Giant Mine activities were deposited directly into Yellowknife Bay (Mudroch et al., 1989). Decantation basins are more strictly regulated and since

1975, a decant structure facilitates extended retention of contaminated effluent and permits the control of discharges. The last major incident occurred in 1991 when three thousand gallons of sludge containing arsenic, cyanide, copper, lead, nickel, zinc and other chemicals were accidentally discharged into Baker Creek (Yellowknifer, 1992 and also see Spill line documents).

Con mine discharges their treated waste water through the Meg-Keg-Peg system which contains old tailings, thereby picking up some of these on the way to Great Slave Lake. This means that any water samples collected at the outlet of Peg Lake would have higher concentrations of industrial by-products than those samples collected from the water treatment plant.

Niven Lake (abandoned sewage lagoon) was another source for pollutants that entered Back Bay. Niven Lake was operational between 1950 and 1981 and since then it has received only urban area and local watershed storm runoff. At the present time the sediments contain decomposing sludge and plant materials. The concentrations of arsenic and mercury in the sediments are reported to be in excess of that in typical municipal sludge, but residual heavy metals are considered relatively immobile via ground water transport. Although the magnitude is not quantifiable, various inputs from Niven Lake likely contributed to changes in the Yellowknife-Back Bay ecosystem.

1.2.2 Past work

Water quality research has taken place in the Yellowknife-Back Bay areas since the late 1940s. Other areas of research have included air quality, soil quality, sediment quality and snow coring surveys. Biotic populations (benthos, fish) have also been investigated. Most of the research work conducted seemed to be looking at the stack emissions from Giant Mine and the industrial waste waters from both Giant mine and Con mine for possible health hazards and environmental impacts.

Giant mine has produced lethal effluent (Moore et al., 1978). Studies conducted in Back Bay and Yellowknife Bay evidenced the impacts of the chronic inputs of contaminants. Tailings from Giant mine are piped to decantation ponds which drained directly into Baker Creek from the water treatment plants and the latter were severely polluted in the vicinity of the discharge into Yellowknife Bay. The sediments of Yellowknife Bay were shown to contain high levels of toxicants (arsenic, mercury, lead, copper and zinc) as far as three kilometres from the mouth of Baker Creek (Moore et al., 1978). Falk et al. (1973) found that the degree of pollution is correlated to the counter-clockwise current in the vicinity of Back Bay.

Moore et al. (1979) investigated the benthic fauna of Yellowknife Bay. As a general trend, the diversity increased progressively with distance from the mouth of Baker Creek. Density of the benthic fauna was very sparse near the mine (<200 animals /m^2). Benthic populations showed signs of recovery at a distance of 1000-1200 m from the mouth of Baker Creek.

Stations further downstream appeared to be in equilibrium and relatively unaffected by the discharges from Baker Creek (Falk et al.,1973). Moore et al. (1978) correlated over 90% of the variability of the invertebrate population to the metal concentrations in sediment. Moore et al. (1978) suggested that the reduction in density of bottom fauna probably reduced the food supply for bottom feeding fish such as lake whitefish but the real impacts have never been investigated.

Further, mayflies, a pollution sensitive species, were not present in the shallow portion of the bay (Falk et al., 1973). According to Rawson (1953) Ephemeropteran (mayflies) were common at a depth of four metres in Yellowknife Bay. Their absence is likely related to their sensitivity to the pollutants present.

The impact of the tailings from Con Mine on Yellowknife Bay is attenuated due to dilution; tailings ponds drain through a series of three lakes (Meg-Keg-Peg) before emptying into Great Slave Lake (Figure 4). Falk et al. (1973) analyzed the effluent entering Great Slave Lake. Discharges from Miramar-Con Mine had substantially lower levels of arsenic in the water (As 0.02 -0.038 ppm) than those from Royal Oak-Giant Mine (2.9 to 12.8 ppm). The diversity and the relative abundance of benthic organisms in the Sub Islands (nearest to site #10) area was similar to that from Yellowknife Bay, such that the Sub Islands region was considered relatively unaffected on the basis of diversity. However, Moore et al. (1979) mentioned the possibility of the contamination from Con Mine tailings extending farther downstream with time and affecting fish habitat in a portion of Great Slave Lake.

Previous analyses of metals (As, Cu, Pb, Zn, Cd, Ni, Hg) in the muscle tissues of fish from Yellowknife Bay revealed low concentrations (Moore et al.,1978; Falk et al., 1973) but arsenic and mercury were found to increase with the age and the weight of the fish (Fisheries and Marine Service cited by Moore et al., 1979). In addition, mercury tends to biomagnify through the successive trophic levels of the food chain. The food web of Great Slave Lake fish is presented in Figure 6.

Figure 1. Study Location Map (North Arm of Great Slave Lake).

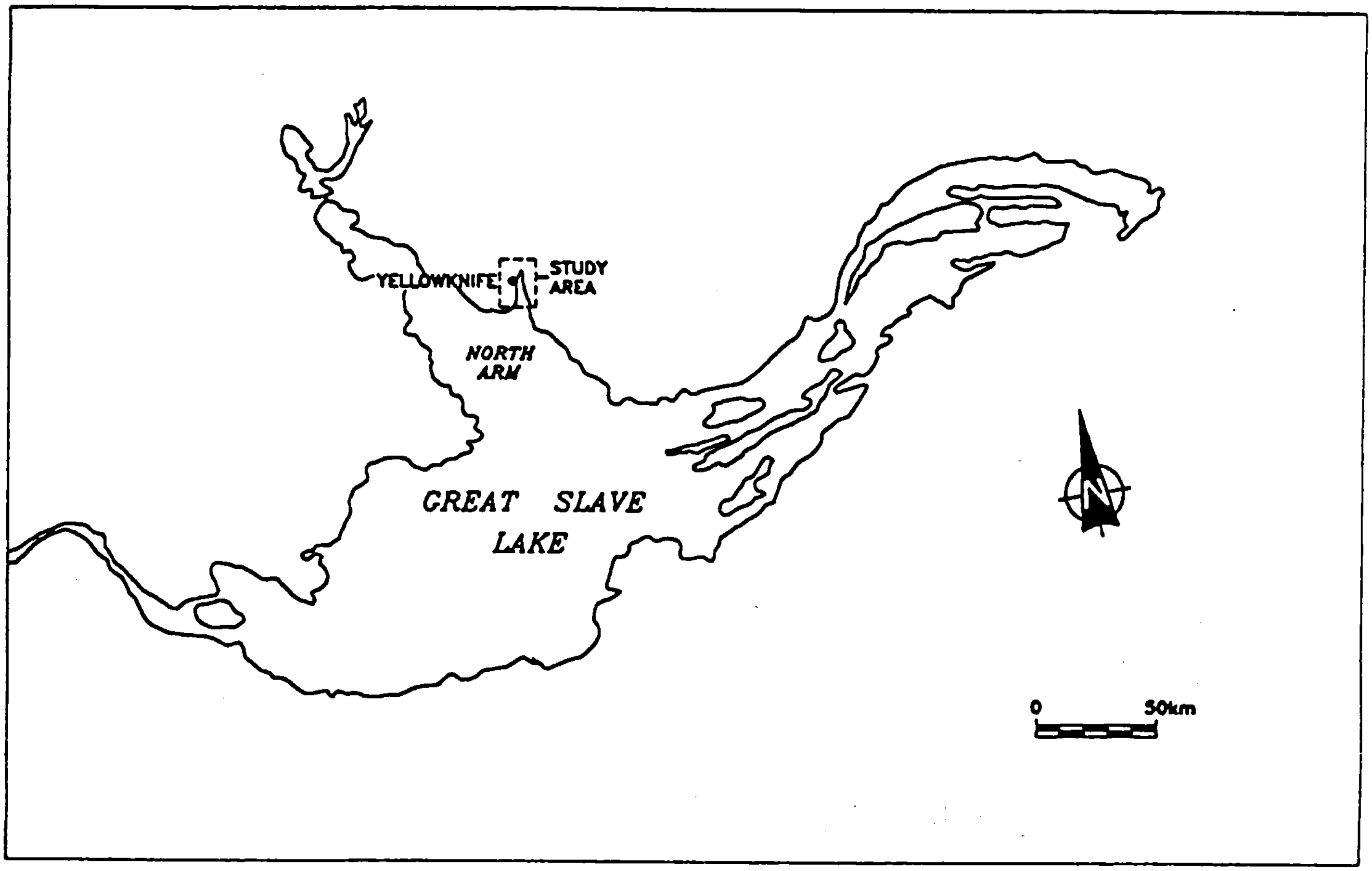


Figure 2. Yellowknife - Back Bay Study Area Map.

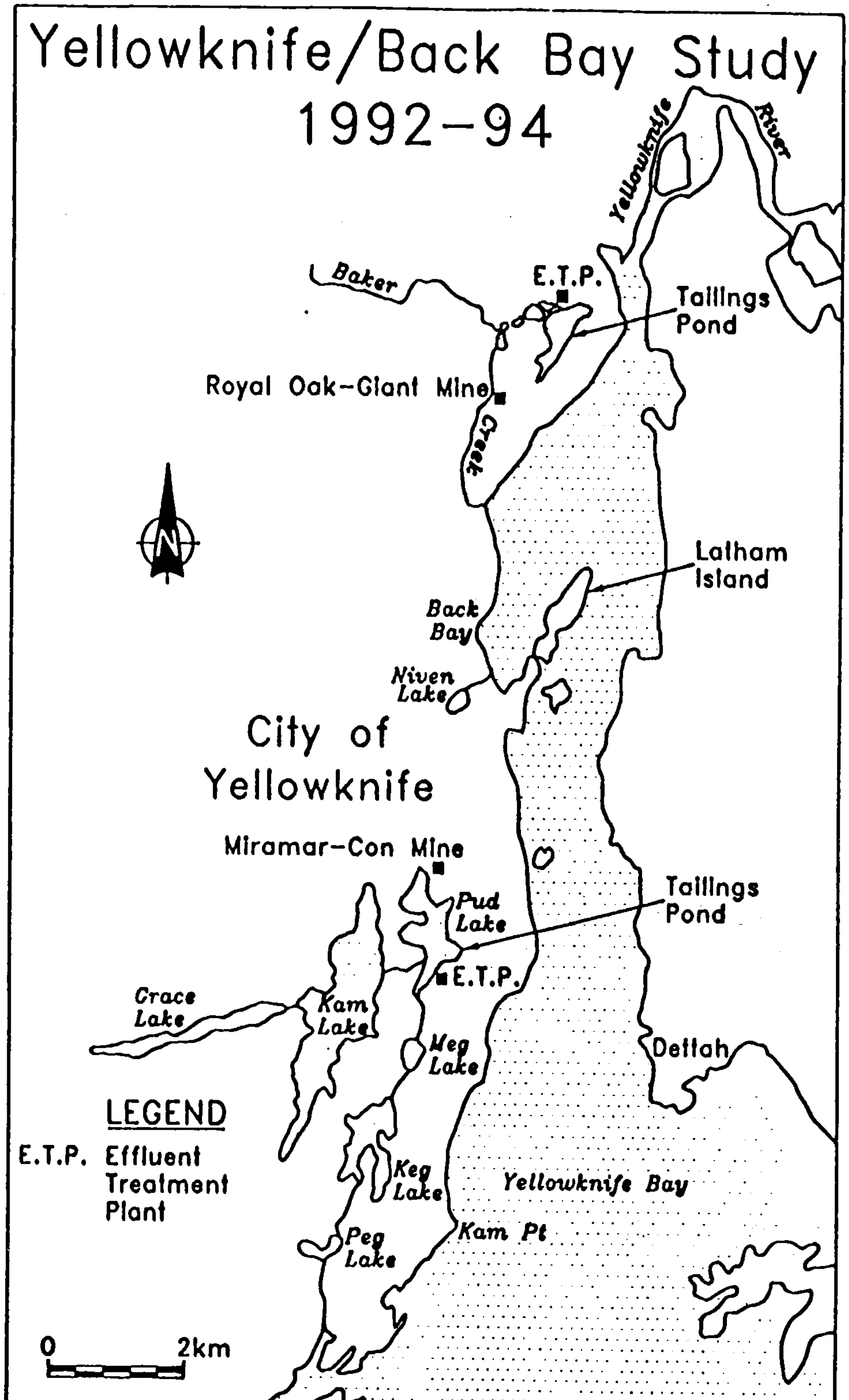
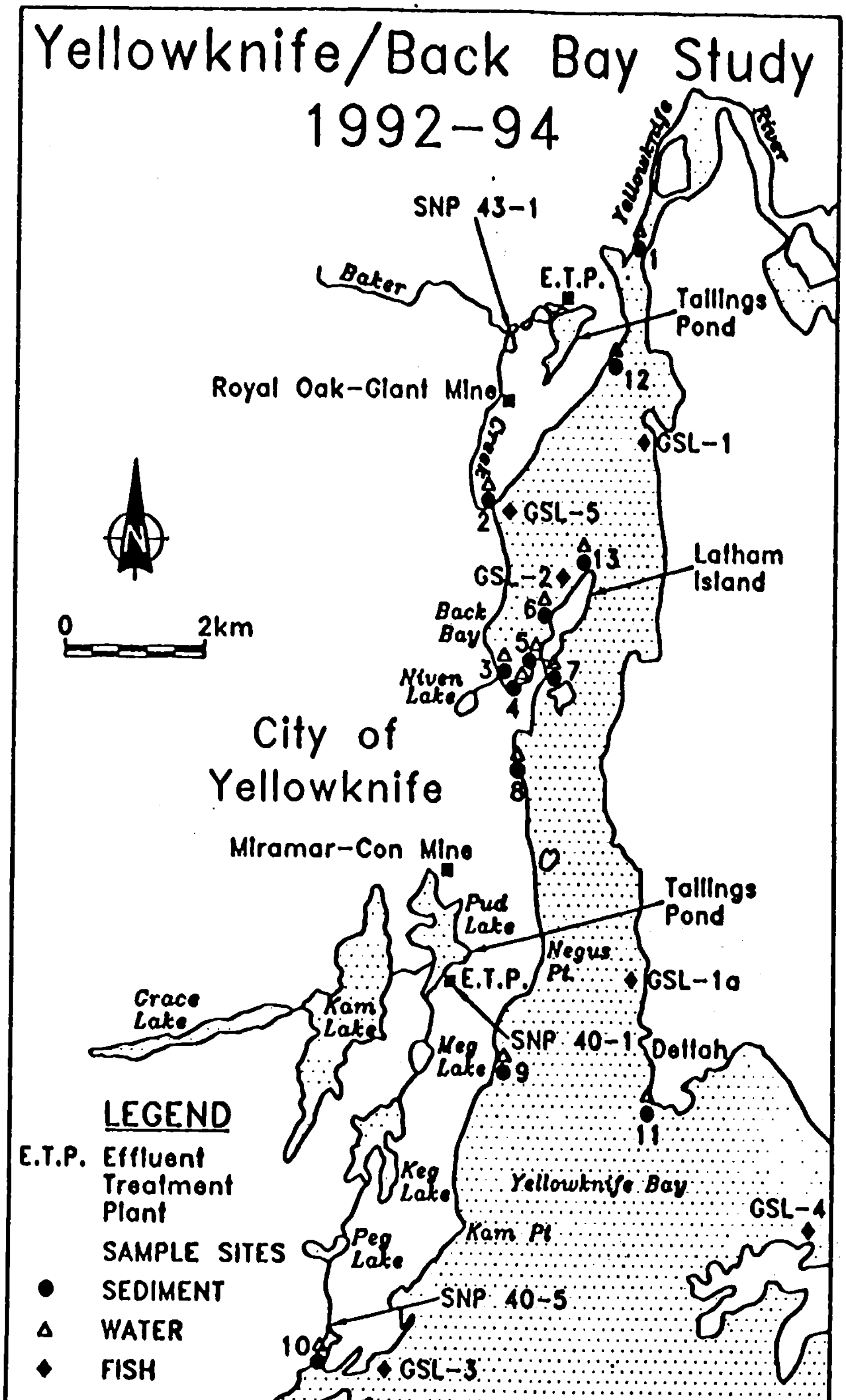


Figure 3. Sampling Sites for water, sediment and fish.



1.2.3 Current Loading in the Study Area.

Giant and Con Mines discharge their treated waste water during the open water season which is usually from June to September. At Giant mine, the treated waste waters are released into Baker Creek, after going through a settling and polishing pond system (7 day retention time). At Con mine, treated effluents are released in the Meg-Keg-Peg lake system which drains into Great Slave Lake. Figures 4 and 5 describe the path of effluent from both mining companies.

To comply with its water licence, Giant mine is required to evaluate the concentration of arsenic, cyanide, copper, lead, nickel and zinc **four times/week** at Station SNP 43-1 (Figure 3), the site where the treated mine and mill waters enter Baker Creek. On the other hand, Con mine samples **daily** during the periods of effluent discharge. Site SNP 40-1 corresponds to the site where the treated effluent from Pud Lake tailings containment area is discharged into Meg Lake. Water samples are also collected at Peg outlet (SNP 40-5). See Figure 3.

The allowable licence concentration limits for the various parameters discharged to the environment by Giant mine (licence effective May 1, 1993) and Con mine (licence effective June 1, 1990) are shown in Table 1.

Annual loading of metals was estimated from the annual activity reports of the two mining companies, the results are presented in Tables 2 and 3. The monthly loading of metallic elements, as well as suspended solids, was estimated by multiplying the monthly average concentration at the point of discharge by the total volume of water discharged during the corresponding month, see formula below. The summation of the monthly results yielded the annual loading.

<u>**MONTHLY LOADING FORMULA:**</u>

Loading (Kg/month) = Concentration (mg/L) * Volume (m^3) * (1/1000)

Figure 4. The Meg-Keg-Peg Discharge System for the Miramar-Con Mine property.

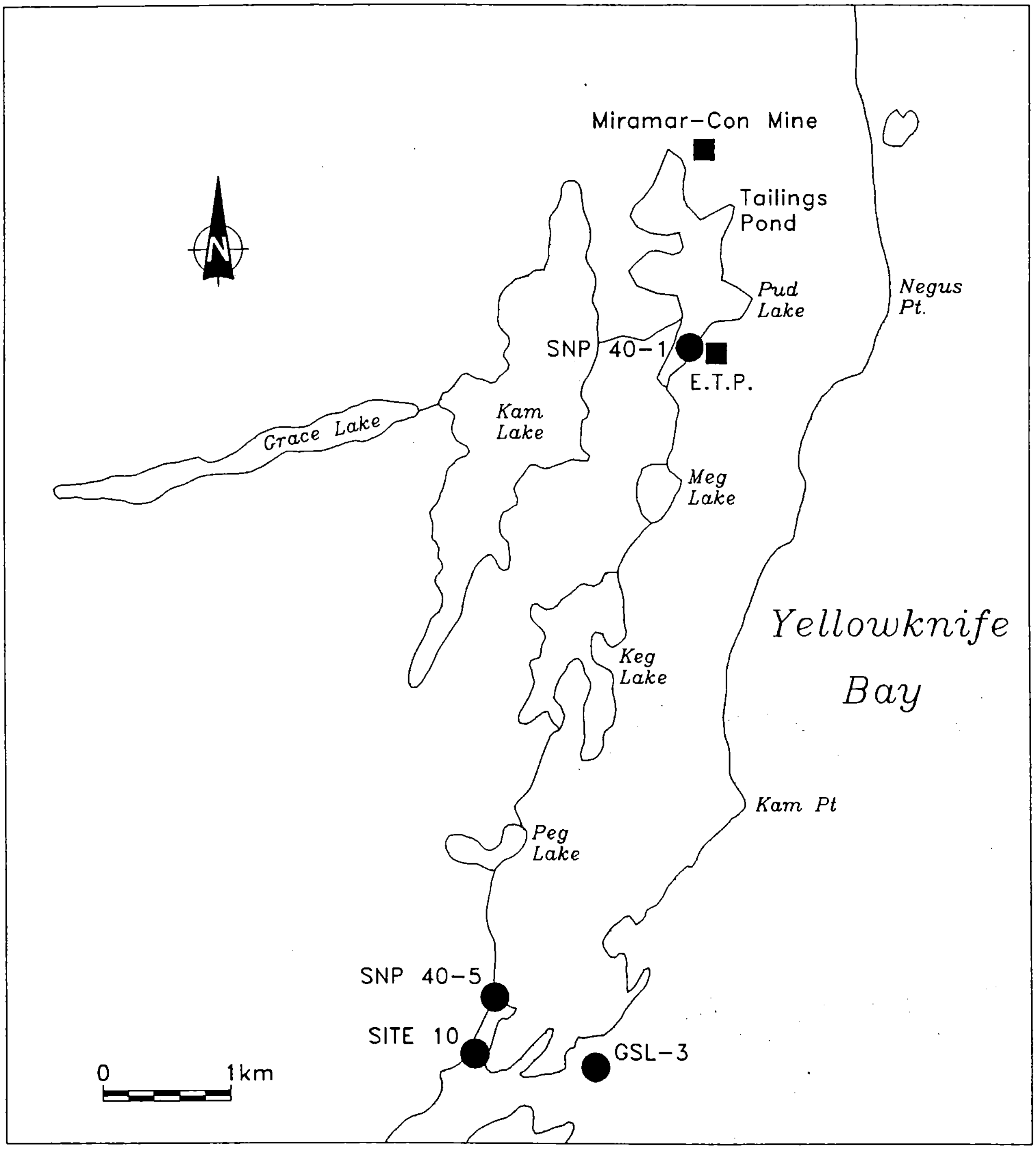


Figure 5. The Baker Creek Discharge System for the Royal Oak-Giant Mine property.

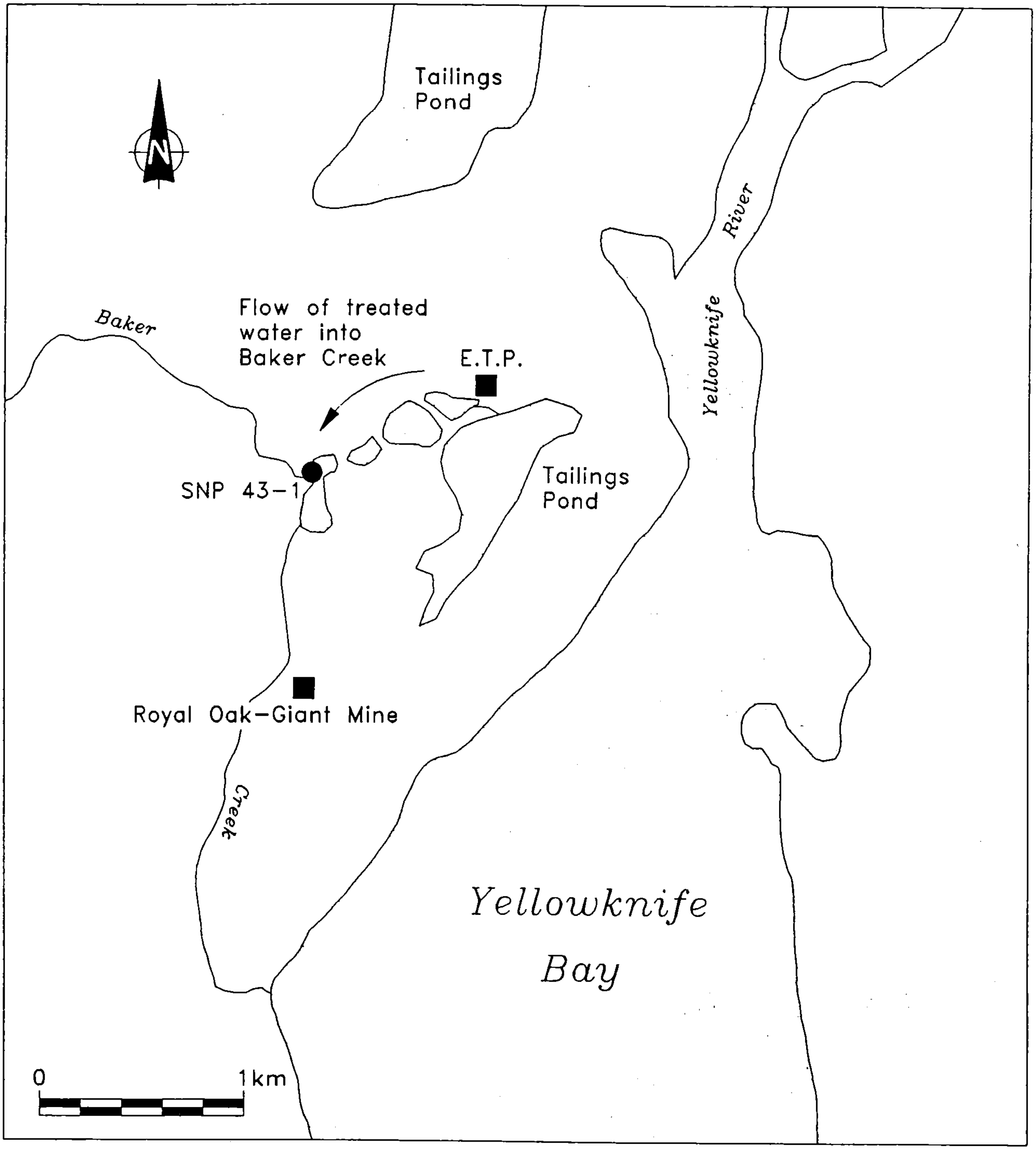


Table 1. Industrial Water Licence limits for the various parameters discharged into the environment by Giant and Con Mines.

	Con Mine	Con Mine	Giant Mine	Giant Mine
	Max. Mean Concentration (mg/L)	Max. Concentration of any grab sample (mg/L)	Max. Mean Concentration (mg/L)	Max. Concentration of any grab sample (mg/L)
Total Arsenic	0.50	1.00	0.80	1.6
Total Copper	0.30	0.60	0.30	0.60
Total Cyanide	0.80	1.60	0.80	1.6
Total Lead	0.20	0.40	0.20	0.40
Total Nickel	0.50	1.00	0.50	1.0
Total Zinc	0.20	0.40	0.20	0.40
Suspended Solids	20	40	15	30

Table 2. Monthly and annual loading (Kg) as estimated by the concentration of metal in samples collected from Baker Creek during thc decant season. Concentrations [ ] are expressed as mg/L. Volumes are expressed in cubic metres.

Month	Volume Discharged	Total arsenic [ ]	Total arsenic Loading	Total cyanide [ ]	Total cyanide Loading	Total copper [ ]	Total copper Loading	Total lead [ ]	Total lead Loading	Total nickel [ ]	Total nickel Loading	Total Zinc [ ]	Total Zinc Loading	Suspended solids [ ]	Suspended solids Loading
1991															
May	131823	0.14	17.80	0.03	3.95	0.04	5.27	0.05	6.92	0.06	8.24	0.03	3.95	95.48	12585.80
June	538685	0.17	92.65	0.05	24.78	0.10	53.87	0.06	31.24	0.15	79.73	0.03	16.16	8.47	4560.51
July	697140	0.39	269.10	0.13	93.42	0.14	100.39	0.05	36.25	0.18	122.70	0.05	33.46	6.84	4768.44
August	682816	0.54	365.31	0.12	83.64	0.08	54.63	0.06	39.26	0.21	139.98	0.02	13.66	3.73	2543.49
September	290276	0.73	211.90	0.08	23.22	0.16	46.44	0.05	14.51	0.17	49.35	0.04	11.61	2.00	580.55
Total:	2340740	0.39	956.75	0.08	229.02	0.10	260.60	0.05	128.19	0.15	399.99	0.03	78.85	23.30	25038.79
1992															
July	787188	0.45	354.23	0.11	83.44	0.05	36.21	0.02	14.17	0.10	75.57	0.02	14.17	6.80	5352.88
August	665726	0.61	402.76	0.09	58.25	0.05	33.29	0.01	8.32	0.16	103.19	0.01	8.32	5.68	3778.00
September	602547	0.68	410.94	0.09	53.02	0.05	31.33	0.01	6.03	0.18	106.05	0.01	6.03	5.34	3217.60
October	119697	0.58	69.13	0.09	10.17	0.05	5.39	0.01	1.20	0.24	28.13	0.01	1.20	3.65	436.89
Total:	2175158	0.58	1237.06	0.09	204.89	0.05	106.22	0.01	29.71	0.17	312.93	0.01	29.71	5.37	12785.37
1993															
May	104420	0.06	5.74	0.03	3.13	0.02	2.09	0.01	1.04	0.01	1.04	0.01	1.04	17.75	1853.46
June	202907	0.10	20.97	0.04	8.79	0.02	4.73	0.01	2.03	0.02	4.06	0.01	2.03	4.80	973.95
July	358735	0.28	98.65	0.05	17.94	0.05	17.94	0.02	5.38	0.08	26.91	0.02	5.38	3.00	1076.21
August	760897	0.59	445.12	0.29	220.66	0.24	182.62	0.01	7.61	0.35	266.31	0.01	7.61	3.05	2320.74
September	738678	0.72	528.15	0.18	129.27	0.16	114.50	0.01	7.39	0.47	347.18	0.01	7.39	1.40	1034.15
	2165637	0.35	1098.64	0.12	379.79	0.10	321.87	0.01	23.45	0.19	645.50	0.01	23.45	6.00	7258.50

Table 3. Monthly and annual loading (Kg) at SNP site 40-1 for 1992 and 1993, expressed in mg/L while loadings are in Kg. And monthly mean concentrations of metals (mg/L) at Peg outlet for 1992 and 1993.

SITE 40-1 (1993)

Month	Volume Discharged m3	Total Arsenic		Copper Unfilter		Copper Filter		Total Cyanide		Suspended Solids		pH
		Mean	Loading	Mean	Loading	Mean	Loading	Mean	Loading	Mean (ppm)	Loading	
May	41600	0.016	0.67	0.22	9.15	0.16	6.49	0.21	8.57	3.62	150.59	8.18
June	212650	0.013	2.81	0.24	51.87	0.21	44.88	0.29	60.83	9.06	1927.52	8.52
July	352150	0.011	3.89	0.19	66.79	0.13	45.17	0.25	86.46	10.19	3587.07	8.63
August	407020	0.01	4.07	0.23	91.87	0.11	42.74	0.27	110.77	8.24	3355.81	8.52
September	300430	0.01	3.00	0.17	50.56	0.13	38.23	0.34	101.73	6.00	1802.58	8.06
October	218710	0.01	2.19	0.18	39.08	0.11	23.77	0.33	71.89	3.76	822.54	7.34
Total:	1532560	0.012	16.62	0.204	309.32	0.139	201.28	0.280	440.25	6.813	11646.11	8.206

SITE 40-1 (1992)

Month	Volume Discharged m3	Total Arsenic		Copper Unfilter		Copper Filter		Total Cyanide		Suspended Solids		pH
		Mean	Loading	Mean	Loading	Mean	Loading	Mean	Loading	Mean (ppm)	Loading	
April	54200	0.021	1.13	0.27	14.44	0.16	8.59	0.68	37.03	8.92	483	9.14
May	128200	0.028	3.54	0.19	24.52	0.14	18.57	0.58	74.52	6.36	815.00	9.03
June	339900	0.023	7.75	0.11	38.98	0.05	18.35	0.09	29.12	7.31	2486.00	9.02
July	389500	0.012	4.52	0.17	65.44	0.09	35.44	0.11	41.68	7.37	2872.00	8.42
August	333400	0.01	3.47	0.23	77.26	0.11	36.56	0.25	81.74	7.82	2606.00	7.85
September	199600	0.024	4.82	0.18	36.43	0.05	9.81	0.21	42.42	7.09	1415.00	8.27
Total:	1444800	0.0197	25.23	0.192	257.07	0.10	127.32	0.32	306.51	7.48	10677	8.62

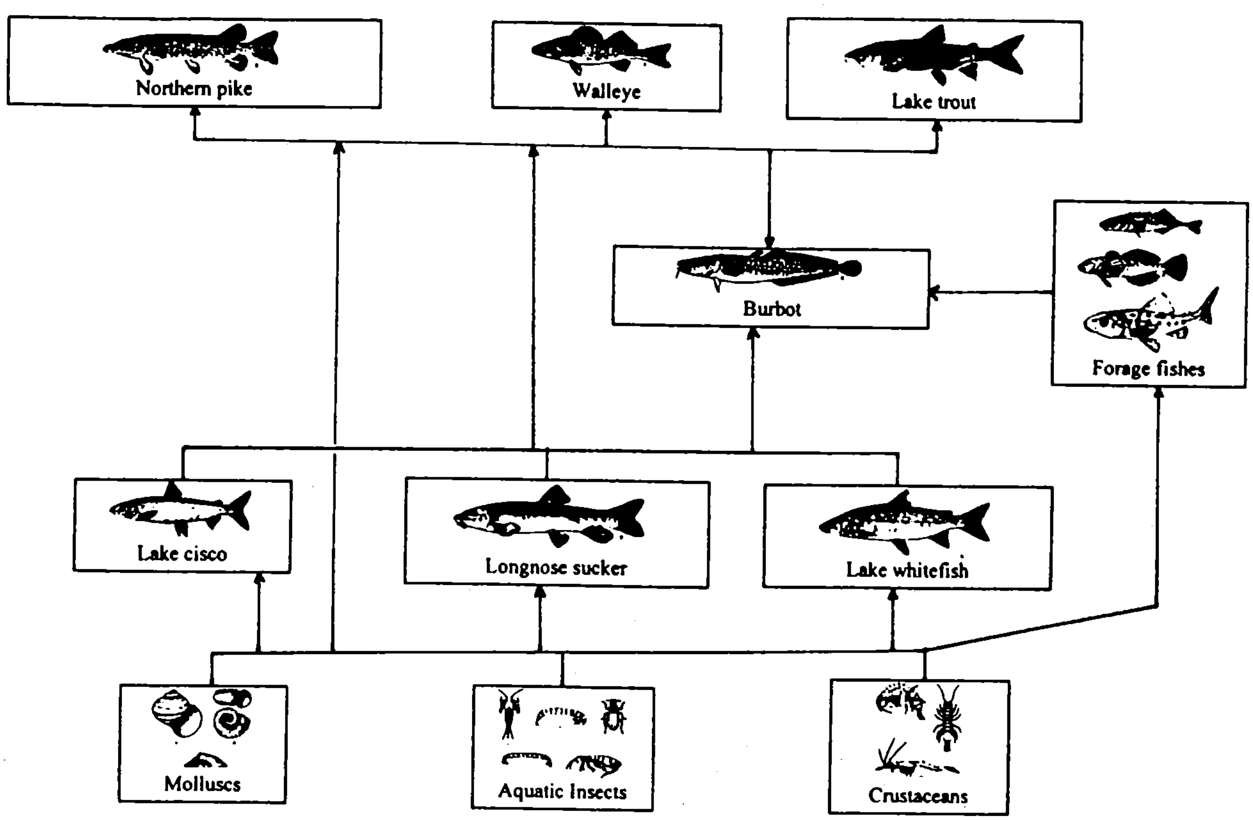
Peg Outlet (1993)

	Total As	Total Cu	Total Cn	Suspended Solids	pH
July	0.12	<0.05	0.03	8	7.07
August	<0.01	<0.05	0.01	1.07	8.01
September 2nd	<0.01	<0.05	<0.02	1.33	7.83
September 17th	0.12	<0.05	0.05	3.870	6.94

Peg Outlet (1992)

	Total As	Total Cu	Total Cn	Suspended Solids	pH
June	0.11	<0.05	0.02	17.20	7.49
July	0.08	<0.05	0.02	8.07	7.82
August	0.15	<0.05	0.03	6.07	7.70
September	0.03	<0.05	0.02	3.47	7.59

Figure 6. The Food Web showing the various trophic levels in the fish community.



Source: Adapted from Scott and Crossman, 1973; Thorp and Covich, 1991

1.3 INITIATION OF THE PRESENT STUDY

The fish populations of Yellowknife Bay play an important role in the diet of the residents of Ndilo and Dettah. This study was initiated when concerns came from the resource users of Ndilo and Dettah. The chief from Dettah, Jonas Sangris and the chief from Ndilo, Darrell Beaulieu asked the following questions in March 1992: "Is the water safe to drink?", "Are the fish safe to eat?" and "Is the water safe to swim in?"

The two communities had specific concerns with the water quality in the Back Bay area ever since the time the "public warning signs" were posted in the Back Bay area to warn the general public about the risk of drinking the water or swimming in Back Bay. It appears the signs were put up to advise the public that the effluent coming from Niven Lake and Giant mine may have altered the state of the water in the Back Bay area. It was the absence of those signs that rekindled the concerns and questions: "Where did the signs go?" and "Why are they not posted today?" These questions were asked in the initial meetings and no answers were provided at that time. A complete answer has not been provided, although it is believed that the signs merely deteriorated and were not replaced.

Because of these concerns a working group was formed shortly after the second meeting to address all the specific concerns. The main concern was with fish and water contamination because of the mining activity in the area. The areas in question are where industrial/municipal effluent enter the Yellowknife Bay via the Meg-Keg-Peg system (Miramar-Con mine) (Figure 4) and Back Bay through the Baker Creek system (Royal Oak-Giant mine) (Figure 5). Municipal waste water is mentioned because both mines release their sewage into their tailing ponds for treatment before it is released to the receiving waters which is Great Slave Lake via Yellowknife and Back Bay areas. The working group agreed that a proposal would be put together in the form of a joint study plan. This plan was formulated in the spring of 1992 and the actual study was started in August 1992.

There were separate proposals from DIAND-Water Resources Division, Environment Canada-Department of Fisheries and Oceans, and Mackenzie Regional Health Services (MRHS). The three proposals were submitted to the Yellowknives Dene Band representatives at a working group meeting indicating this study was designed in an attempt to provide answers concerning the water and fish quality in the Yellowknife-Back Bay areas.

After the final meeting (a total of eight meetings were held) with the community working group members from Dettah, Ndilo, Water Resources, Fisheries and Oceans Canada and MRHS, an agreement at the working group level to establish the following was accomplished: 1) Pinpoint locations for sampling sites on 1:250,000 NTS topographical maps. (In this case there were 13 water/sediment and five fish sampling sites chosen); and 2) Come to an agreement that the study designs were appropriate and therefore proceed with the study.

It was important that this collaboration took place in order to have consensus on the final decisions by all members on the working group.

These decisions enabled the researchers to choose the proper parameters for water, sediments and fish components of the study in order to properly investigate the concerns. The parameters chosen for water, sediments and fish are listed in the Appendices.

After coming to an agreement that the study designs were appropriate, the sampling programs were started in August 1992 (first collection of fish) and September 1992 (first water/sediment samples collected).

During the 6th meeting (August 27, 1992) Dettah band manager, Jack Poitras, provided the working group with the names of two community people; Albert Doctor (Ndilo) and George Tatsiechele (Dettah) who were available for assisting the researchers in the water sampling program. They operated/navigated the boats and assisted in the collections of water quality and sediment samples during the summer months and provide the snowmobiles and sleighs for the winter work. This worked out well because it also addressed objectives of the Arctic Environment Strategy by involving the community and having the community representatives directly involved in the study design and field work.

1.4 OBJECTIVES

The main objective of this joint project was to attempt to provide definitive answers to the following questions:

1. Is the water safe to drink?
2. Are the fish safe to eat?
3. Is the water safe to swim in?

Because many people from Dettah, Ndilo and the Yellowknife utilize the Yellowknife/Back Bay area for recreational and country food use, it was important to answer these specific questions with direct input from the resource users.

Note: The water and sediment sections were written by the principal author, fish sections other than the statistics and recommendations were written by Caroline Lafontaine, the ageing section was written by Mario Paris and the statistical and recommendation section was written by Jack Klaverkamp. As a result a number of writing styles were employed and may be evident in this report. Of particular note is the Fish Sampling Program section which is of a more technical nature.

SECTION TWO: Water Sampling Program

2.1 METHODOLOGY
2.1.1 Sample Locations

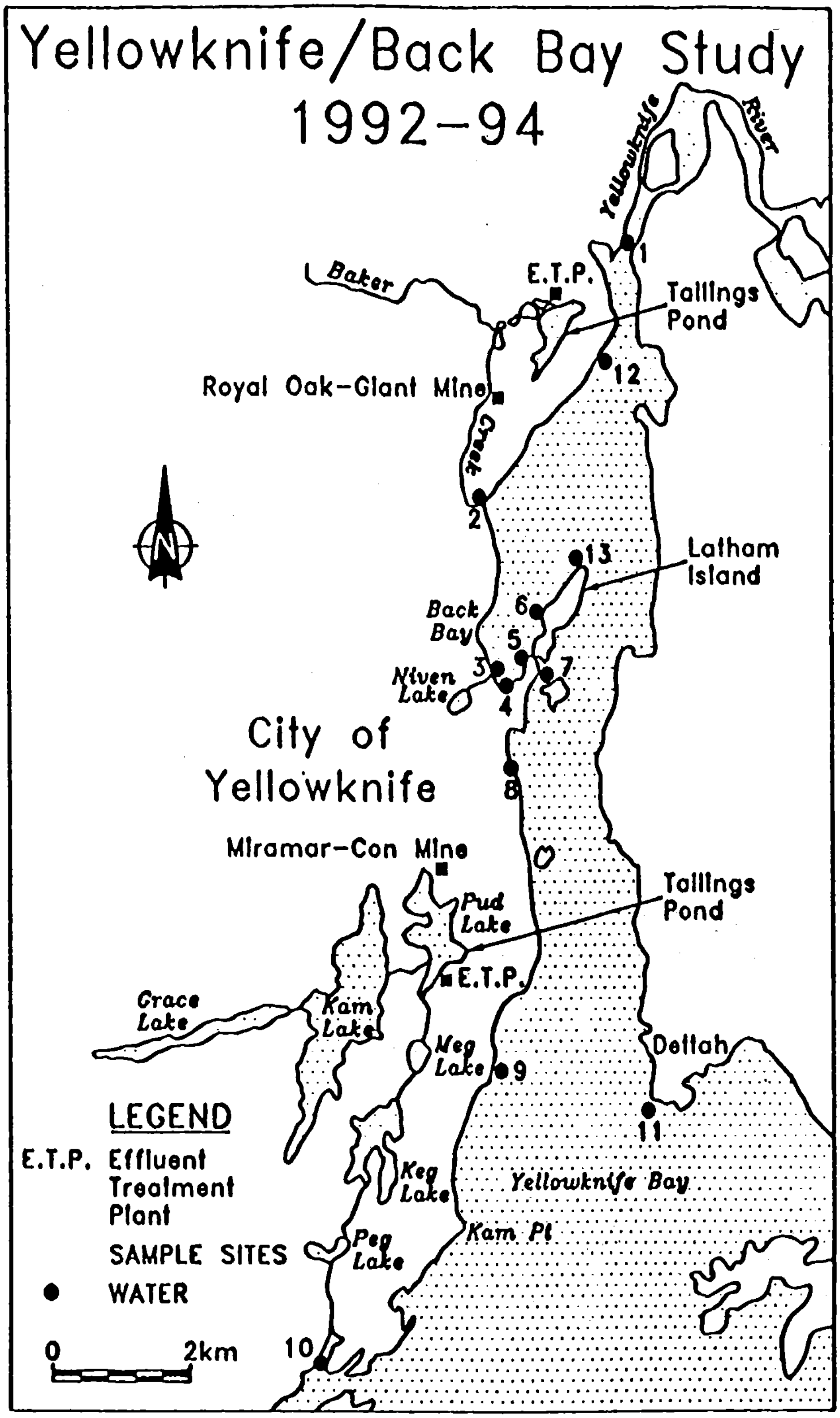
There were 13 water sampling sites (Table 4; Figure 7) established in the study area in an attempt to obtain an overall representation of the concentrations of the various parameters investigated.

Table 4. Site number, location and rationale for choosing the sites.

Site Number	Station Location	Reason for Choosing Site
#1.	Yellowknife River ≈150m upstream from the mouth.	Control
#2.	Baker Creek at Great Slave Lake (GSL).	Royal Oak (waste water).
#3.	Niven Lake @ GSL	Abandoned sewage outlet.
#4.	Peace River Flats @ GSL.	Furthest point inside Back Bay.
#5.	Causeway between Latham Is. and mainland.	Heavy traffic area -aircraft, vehicles, snowmobiles, boats
#6.	Ndilo dock west side of Latham Island.	Additional sample site in the Back Bay area.
#7.	Between DFO dock and Jolliffe Is.	Heavy traffic area -aircraft, boats
#8.	City of YK - Water pumping station.	Emergency Water Pumphouse
#9.	Adjacent to Meg Lake @ GSL.	Overflow area in the winter months
#10.	Peg outlet @ GSL ≈500m from mouth.	Miramar-Con mine (waste water).
#11.	Dettah dock.	Swimming area.
#12.	Old Giant Tailings release area.	Abandoned discharged area.
#13.	Tip of Latham Island.	Swimming area.

A more intense sampling program was carried out in the Back Bay area due to year round activities in that area (eg. stack emissions from Royal Oak mine, aircraft on floats and skis, motor boats, snowmobiles, dog kennels, canoeing and wind surfing). It is also a catchment area for the effluents from Baker Creek due to the Yellowknife River currents moving across the mouth of the

Figure 7. Water Sampling Sites in the Yellowknife-Back Bay Study Area.



Back Bay area. Winds from the north also contribute by blowing materials from Baker Creek directly into the Back Bay area. In addition, the Back Bay area was the main receiving waters for the Niven Lake (abandoned sewage lagoon) outflow up until November 1981.

2.1.2 Sampling Schedule

The water sampling program consisted of six water sample collections. The water samples were collected as follows - three open water collections (September 1992, June 1993 and August 1993) and three under ice conditions (February/March 1993, January/February 1994 and March 1994). Each water collection was completed in two days between Monday and Wednesday due to the bacteriological samples needing immediate lab analysis.

2.1.3 Sampling Procedures/Protocols

The main objective of the sampling procedures/protocols was to collect enough samples to provide a good representation of the physio-chemical characteristics of the waters in the two bay areas without introducing too many variables (ie. errors) to the samples collected.

To minimize contamination of water samples, field equipment was cleaned before each field trip in the following way: 1) wash with soap and regular tap water, 2) rinse with a weak acid solution, 3) rinse with type 1 water (type 1 water=de-ionized water). Samples were handled in such a way as not to contaminate them by working in clean conditions and following good field practices (eg. no smoking when samples are being collected).

In addition to the field water samples, a field and/or travel blank was collected (both preferred). These blanks were used to check for contamination during the sample trip. Once the site was chosen, the regular water sample from that site was collected, then a field blank sample. The field blank consisted of type 1 water handled using the same sampling protocol used when collecting regular field samples (i.e. fill a set of bottles as with the regular field collection using the type 1 water and add the appropriate preservatives). Travel blanks were bottles filled in the lab with type 1 water and appropriate preservatives prior to the field trip. The travel blanks were placed in the storage coolers where the field samples were stored.

The water samples were collected using a surface grab technique or horizontal Van Dorn sampler at a depth of one metre. All the samples collected in the winter were surface grab samples through motorized auger drilled holes. In the summer, water samples were always collected first, followed by the sediment samples, to avoid picking up any extra suspended sediments in the water.

Summer sampling took place with the assistance of the two community representatives. Two crews were used, one for sediment sampling and one for water quality sampling. Two 16 foot aluminum Lund boats and two 20 HP Mercury outboard motors were used. During the winter sampling program, ski-doos and sleighs supplied by the community assistants were used to get to the sampling sites. The winter sampling equipment included the following: ice auger, gas, extra auger flighting extensions, water sample bottles, preservatives for water samples, de-slusher, ice chisel, shovel and two coolers to store the sample bottles.

2.1.4 Analytical Methods

All the water samples were analysed at the DIAND Water Resources--Northern Analytical Laboratory (NAL) in Yellowknife, which is a member of the Canadian Association of Environmental Analytical Laboratories (CAEAL), a national organization established to ensure consistent laboratory quality assurance.

The Northern Analytical Laboratory methods are in two categories: 1) routine, nutrient and major ion type parameters and 2) metal type parameters based upon atomic spectroscopic and Inductively Coupled Plasma-Mass Spectrometer (ICP-MS) measurements. NAL's analytical methodologies are based upon the "**NAQUADAT Dictionary of Parameter Codes 1988**", "**Analytical Methods Manual 1979**", Environment Canada and "**Standard Methods for Examination of Water and Waste Water 1985**" (APHA, 1985)

For Quality Assurance/Quality Control (QA/QC) DIAND's Water Laboratory uses standard methods from the Water Quality Branch of Environment Canada's "**Quality Control/Quality Assurance in the Water Quality National Laboratory**" (Environmment Canada,1985). This manual assists the analyst in the organization of data and quality control (B. Coedy, personal communication).

2.2 RESULTS

2.2.1 Water Chemistry

Raw data for all water parameters can be found in Appendices 1-6 of the water section. Only the parameters that relate to the concerns of the communities (metals and bacteria) and those related to the industries of area (nutrients and major ions) are summarized in the following pages. In all cases the number of samples collected equalled six.

The water quality results were compared to the Raw Water for Drinking Water Supply (DWSG) and Freshwater Aquatic Life guidelines (FWALG) in the Canadian Council of Ministers of the Environment's (CCME) **Canadian Water Quality Guidelines** (CWQG) produced by Environment Canada and Health and Welfare Canada (formerly called CCREM, 1987) that has been revised to August 1994. These guidelines were produced in close consultation with the provinces and territories. On the following graphs these guidelines are shown by dotted lines.

For statistical and calculation purposes, data shown as being less than detection limit are treated as at the detection limit.

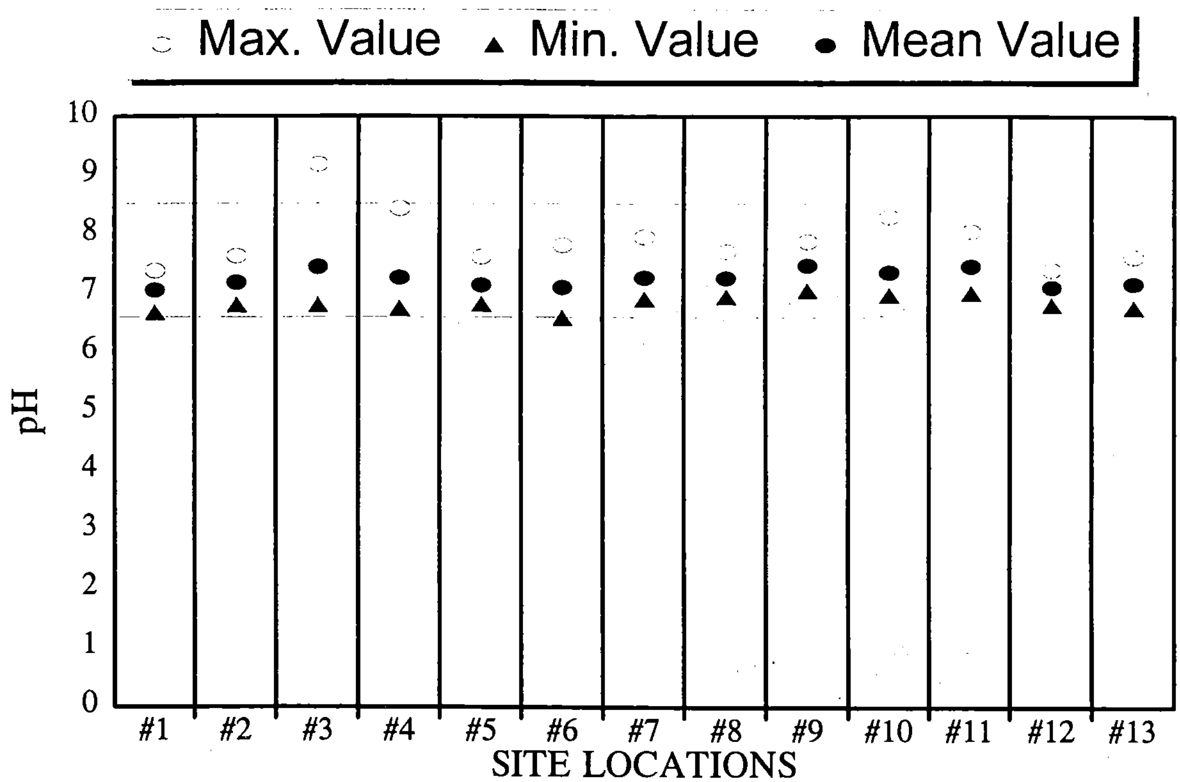
2.2.1.1

pH is an indicator of the balance between acids and bases in water. It is measured on a scale of 0-14, where 7 indicates a neutral condition; anything less than 7 is considered an acidic condition and any value greater than 7 is in an alkaline condition.

The average pH results throughout the study period were well within the CWQGs for freshwater aquatic life at the time the samples were collected. There was one sample at 9.19 that exceeded both the freshwater aquatic life and raw water for drinking water guidelines. This occurred at site #3 (Niven Lake outlet at Great Slave Lake).

Drinking Water Supply Guideline (DWSG)= 6.5-8.5 (plotted)
Freshwater Aquatic Life Guideline (FWALG) = 6.5-9.0

FIGURE 8: YK-BACK BAY (WATER)
pH Values 1992-94



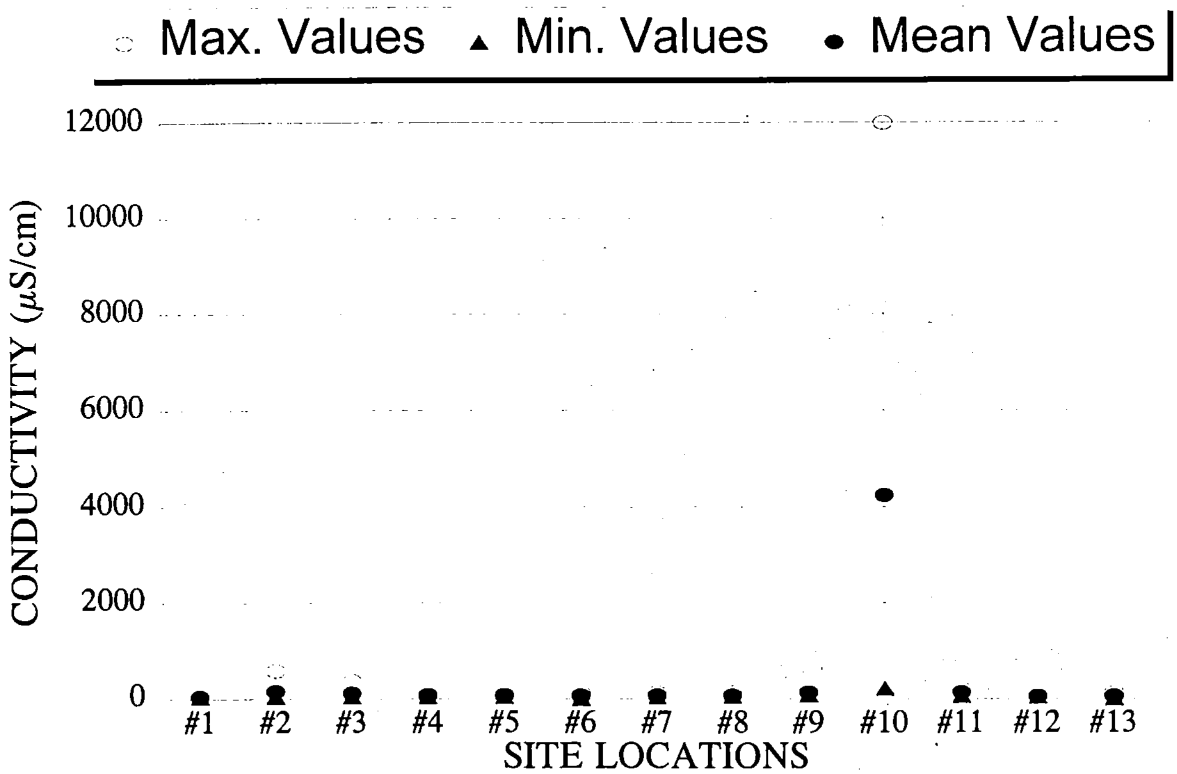
2.2.1.2

Conductivity is a measure of water's ability to conduct an electrical current and is an indicator of areas where significant concentrations of contaminants are present. Specific conductance of natural surface waters can range from 50 to 1500 μS/cm. Industrial waters can elevate the conductance of receiving waters to 10,000 μS/cm.

All conductivity results exhibit values that are similar to those of natural surface waters with the exception of site location #10, Peg outlet at Great Slave Lake. Because the average value is higher than the norm for natural surface waters, one would expect to see this kind of value from industrial wastewater, which in this case is the effluent from Miramar-Con mine.

DWSG = NONE
FWALG = NONE

FIGURE 9:YK-BACK BAY (WATER)
CONDUCTIVITY VALUES 1992-94



2.2.1.3

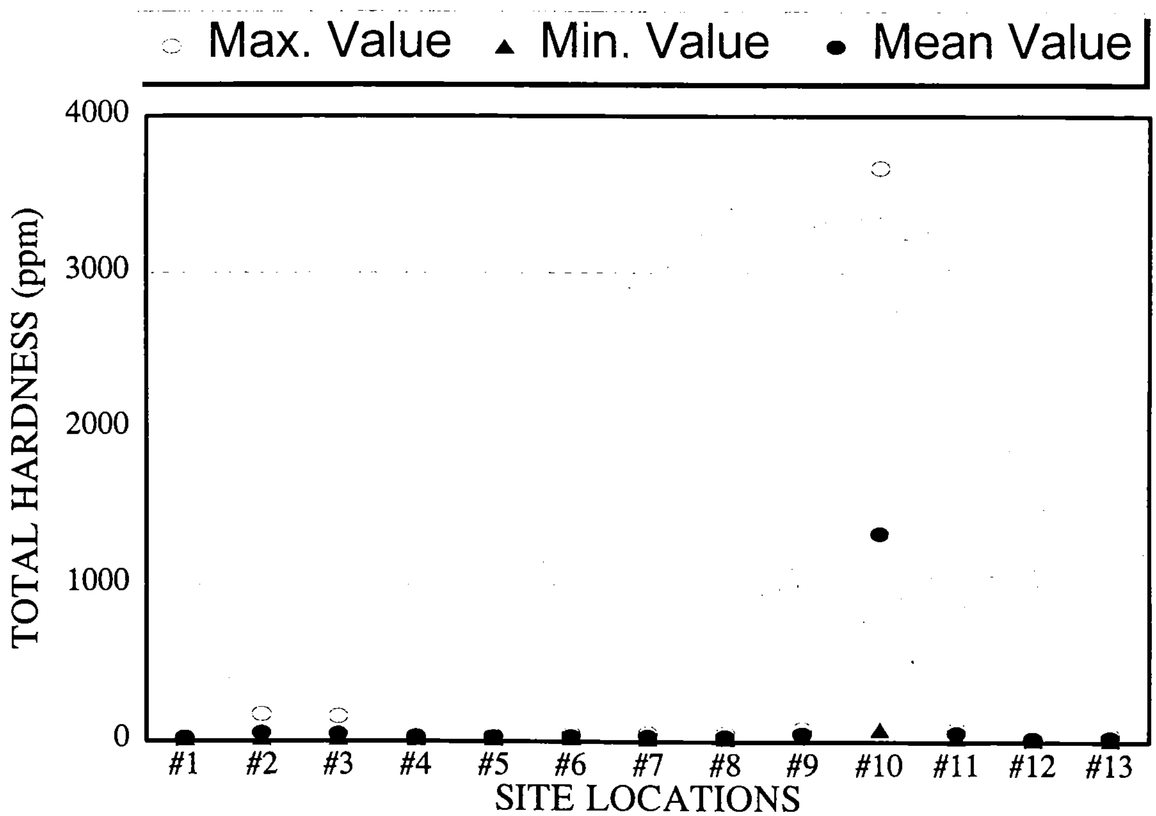
Total Hardness of water was originally defined as the water's ability to produce lather from soap. The harder the water the more difficult it is to lather soap. For example, water with calcium carbonate ($CaCO_3$) concentrations that are below 30 mg/L is considered very soft and above 180 mg/L it is considered very hard.

In general, water with a $CaCO_3$ concentration less than 120 mg/L is desirable for most uses, anything exceeding 500 mg/L is considered undesirable for both domestic and industrial uses.

All sites generally contain soft water, only the Peg outlet at Great Slave Lake (site location #10) has very hard water. The water hardness is high probably due to the water from old tailings (Negus mine), surface run-off and Miramar-Con mine tailings effluent which contains ions such as magnesium and calcium.

DWSG = NONE
FWALG = NONE

FIGURE 10:YK-BACK BAY (WATER)
HARDNESS VALUES 1992-94



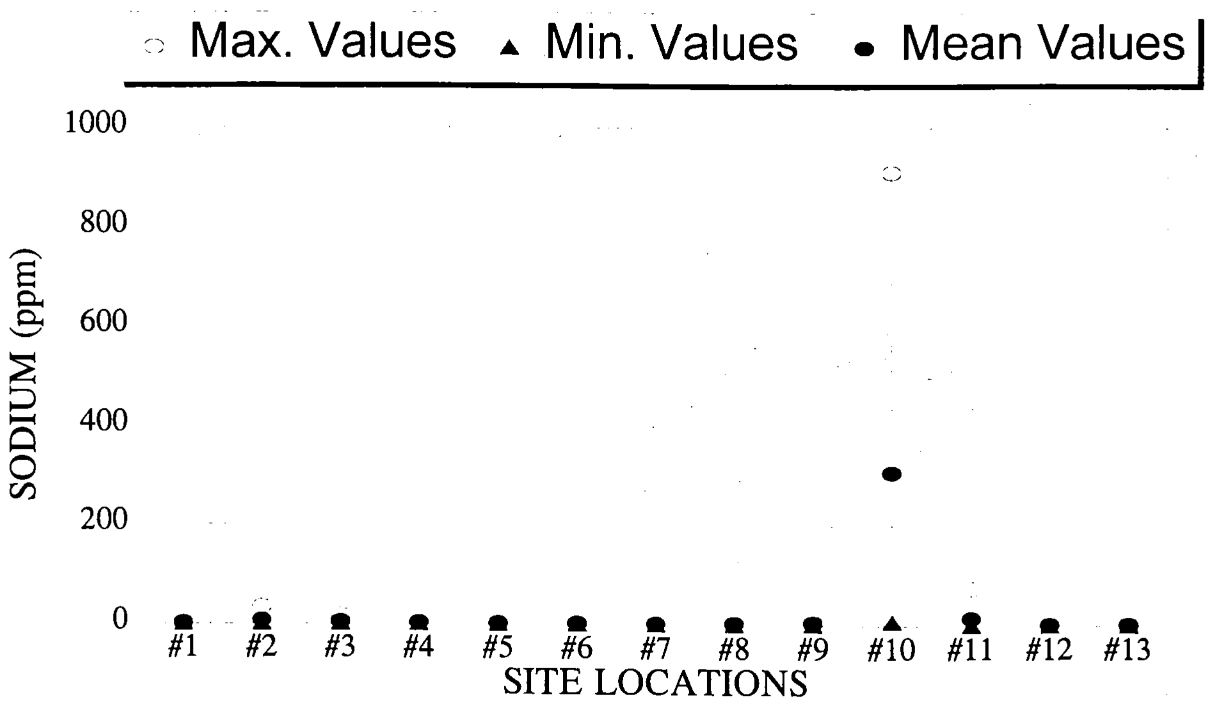
2.2.1.4

Sodium is an alkali metal found in all surface waters in an ionic (dissolved) form. All natural waters contain sodium. Sodium concentrations can range from 1 mg/L to 100,000 mg/L. Sodium salts can be found in industrial waste waters, municipal sewage and road salt.

All sites were below the Drinking Water Supply Guidelines except Site #10, Peg outlet at Great Slave Lake, where three values were above, which is characteristic of water coming from an industrial discharge.

DWSG = ≤200 mg/L
FWALG = NONE

FIGURE 11:YK-BACK BAY (WATER)
SODIUM VALUES 1992-94



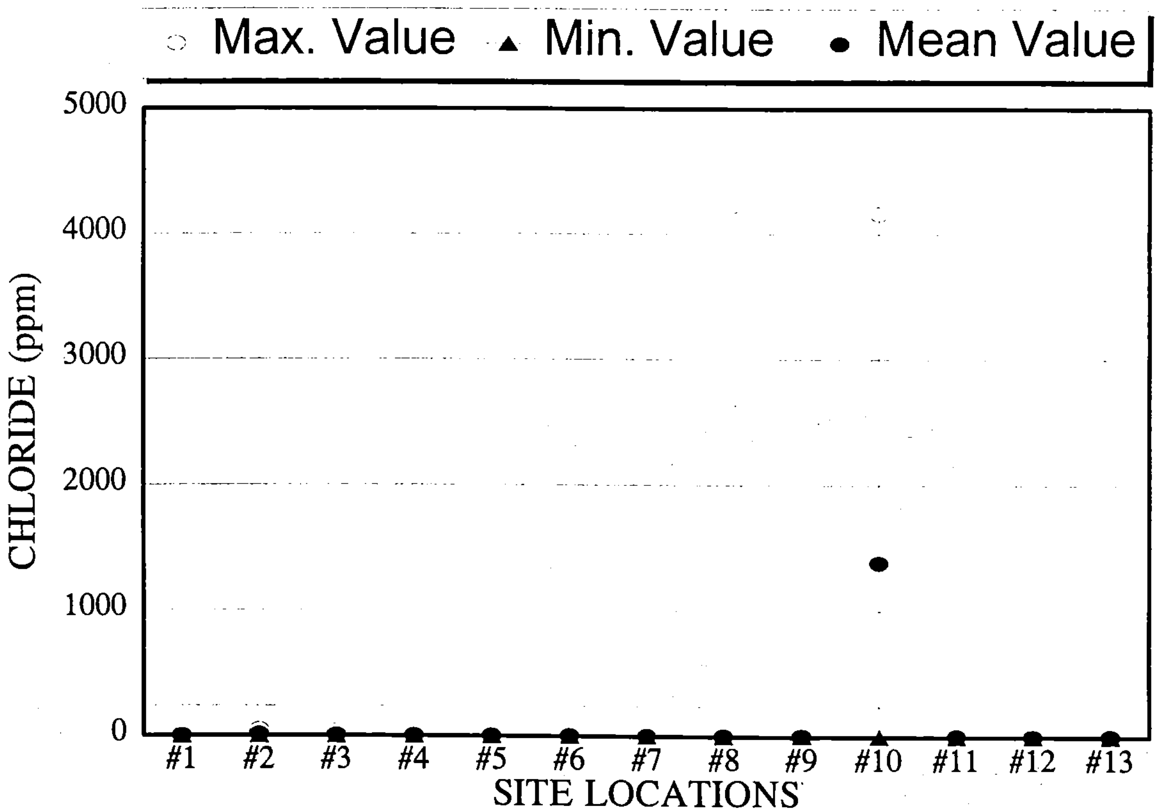
2.2.1.5

Chloride The main reason to consider chloride in water is to prevent any undesirable taste in water or beverages.

Site #10 (Peg Outlet), had three values out of six that exceeded the DWSG which is characteristic of industrial waste water.

DWSG = ≤250 mg/L
FWALG = NONE

FIGURE 12: YK-BACK BAY (WATER)
CHLORIDE VALUES 1992-94



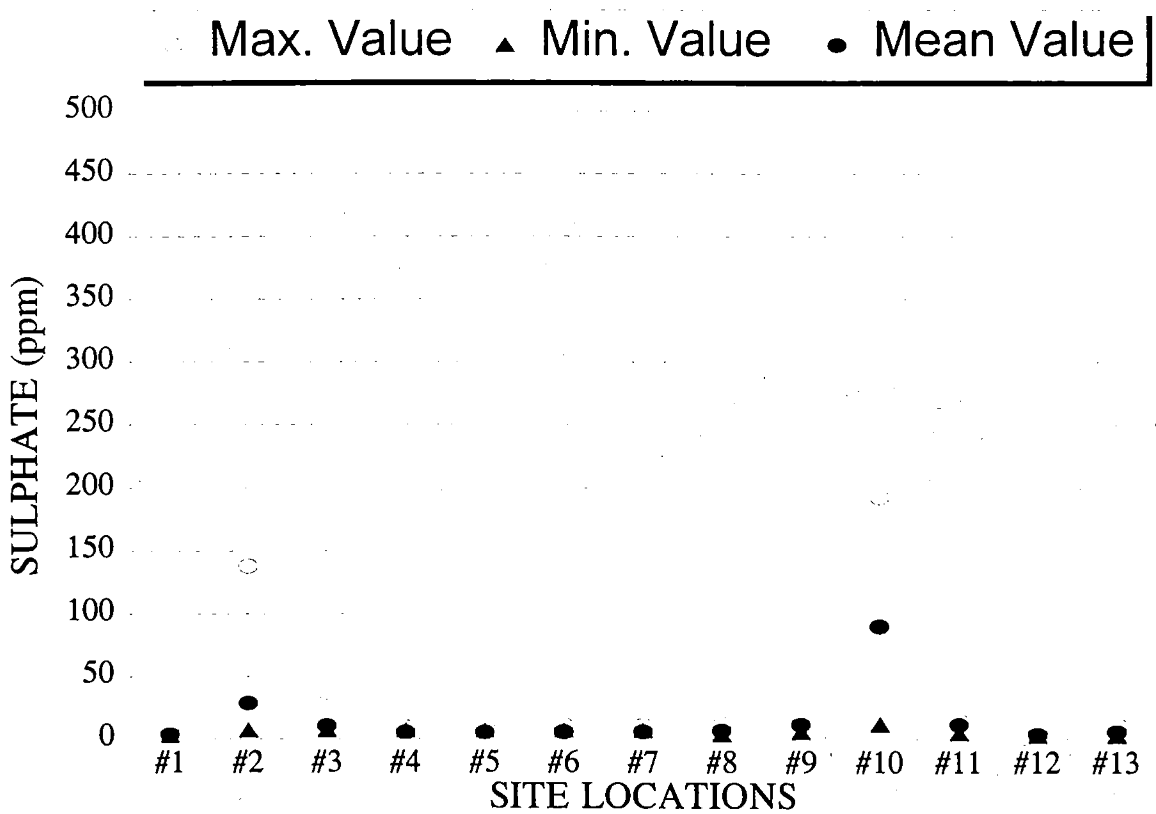
2.2.1.6

Sulphate The major concerns related to sulphate in drinking water are gastrointestinal irritation and unpleasant taste. Changes in sulphate concentrations can vary in drinking water, particularly where ground water sources are used as opposed to surface waters from rivers or lakes.

All sulphate concentrations throughout the sample sites are well within the CWQGs for raw waters that may be used for drinking purposes.

DWSG = 500 mg/L
FWALG = NONE

FIGURE 13:YK-BACK BAY (WATER)
SULPHATE VALUES 1992-94



2.2.1.7

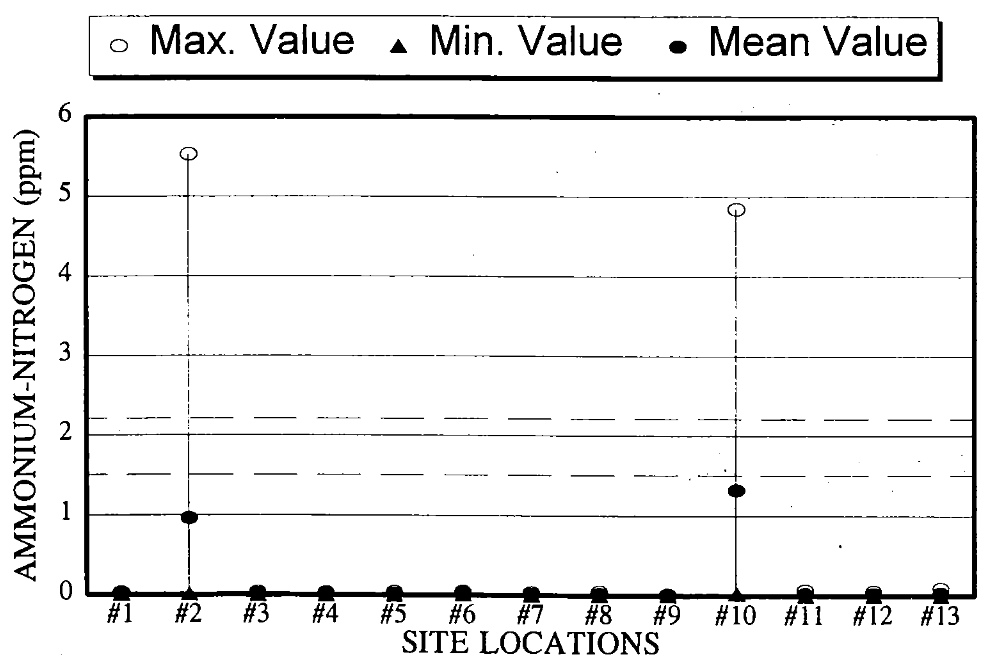
Ammonia is a highly soluble compound resulting from either the decomposition of nitrogenous organic matter (vegetable or animal waste) or microbial reduction of nitrates or nitrites under anaerobic conditions. Although ammonia is only a small component of the total nitrogen cycle, it is a common constituent of treated sewage. In addition, it is used in explosives at mines which are a mixture of ammonium-nitrate and fuel oil (ANFO). Ammonia contributes to the productivity of algae, because nitrogen is an essential plant nutrient.

Note: Ammonia toxicity is dependent on water temperature and pH.

Most of the samples collected throughout the study area showed that the total ammonia concentrations were below the total ammonia guidelines. The maximum values at sites #2 (Baker Creek at GSL) and #10 (Peg Outlet at GSL) did exceed the freshwater aquatic guidelines. Both were in industrial discharge areas. However, the mean values did not exceed the freshwater aquatic life guideline.

DWSG = NONE
FWALG = 1.37-2.20 mg/L

FIGURE 14:YK-BACK BAY (WATER)
AMMONIUM-N VALUES 1992-94



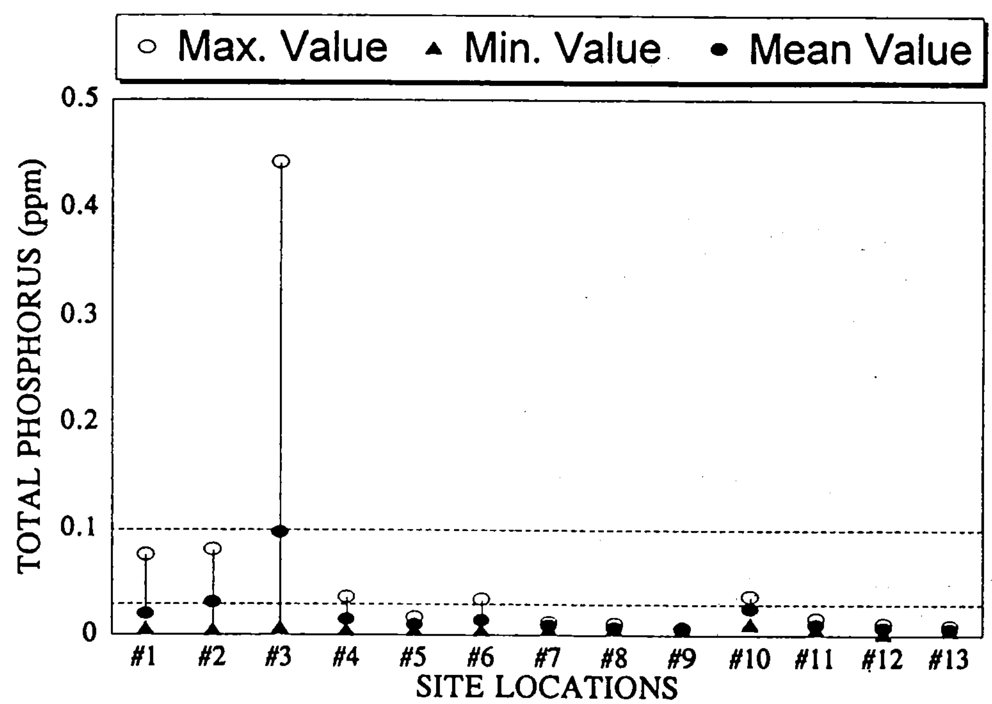
2.2.1.8

Phosphorus is a non-metallic element and can be present in water as dissolved or particulate species. It is an essential plant nutrient, therefore may be a limiting factor for plant growth. It is rarely found in significant concentrations in naturally occurring surface waters, because it is usually taken up by plants. A general index of maximum desirable concentrations is as follows: 0.10 mg/L in flowing water and 0.025 mg/L in lakes and reservoirs (USEPA, 1976).

The average phosphorus concentrations in the study area ranged from 0.002 mg/L to 0.442 mg/L. At site #1 (flowing water site) all values were below 0.10 mg/L. At the lake sites there were five maximum values and two mean values above 0.025. The highest value was at site #3 (Niven Lake Outflow).

DWSG = NONE
FWALG = NONE
Dashed lines indicate EPA guidelines

FIGURE 15:YK-BACK BAY (WATER)
PHOSPHORUS VALUES 1992-94



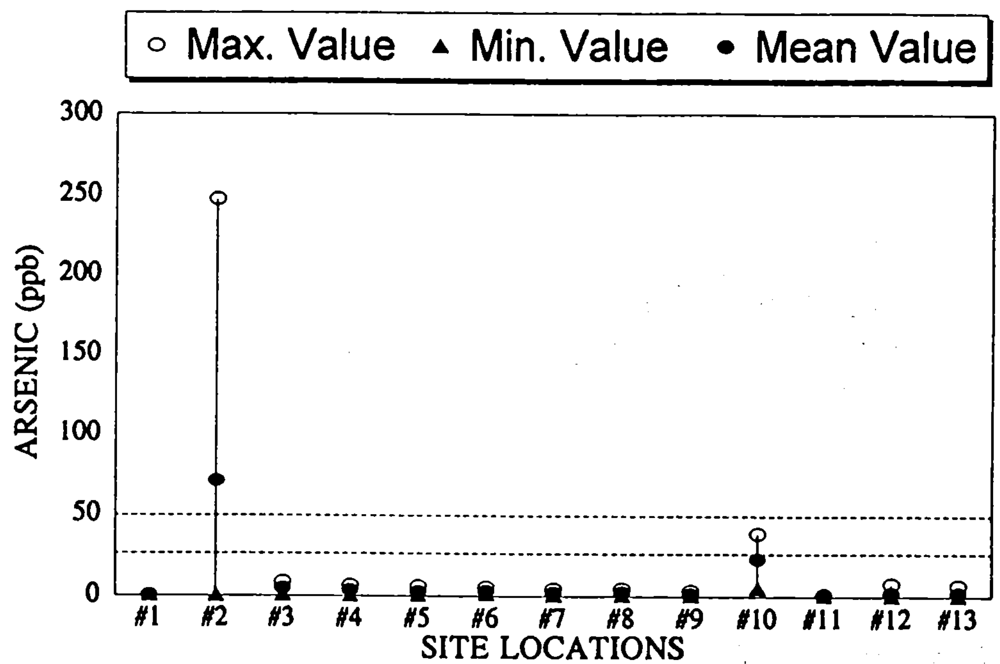
2.2.1.9

Arsenic does occur naturally in certain waters in small quantities. In nature it occurs primarily as metal arsenides and sulphides such as niccolite (NiAs), arsenopyrite (FeAsS), and elemental arsenic. Soils and weathering of igneous and sedimentary rocks may release arsenic to the water in the form of oxides (eg. As_2O_3). It is often found in mine effluents.

In most cases, the average arsenic concentrations were low. However, Site #2, Baker Creek at Great Slave Lake, did have an average concentration of 70.7 ppb which is over both the drinking water and freshwater aquatic life guidelines. There were two other exceedances, maximum values from Baker Creek (247 ppb) and Peg outlet at Great Slave Lake (38.6 ppb).

DWSG = 25.0 ppb
FWALG = 50.0 ppb

FIGURE 16:YK-BACK BAY (WATER)
ARSENIC VALUES 1992-94



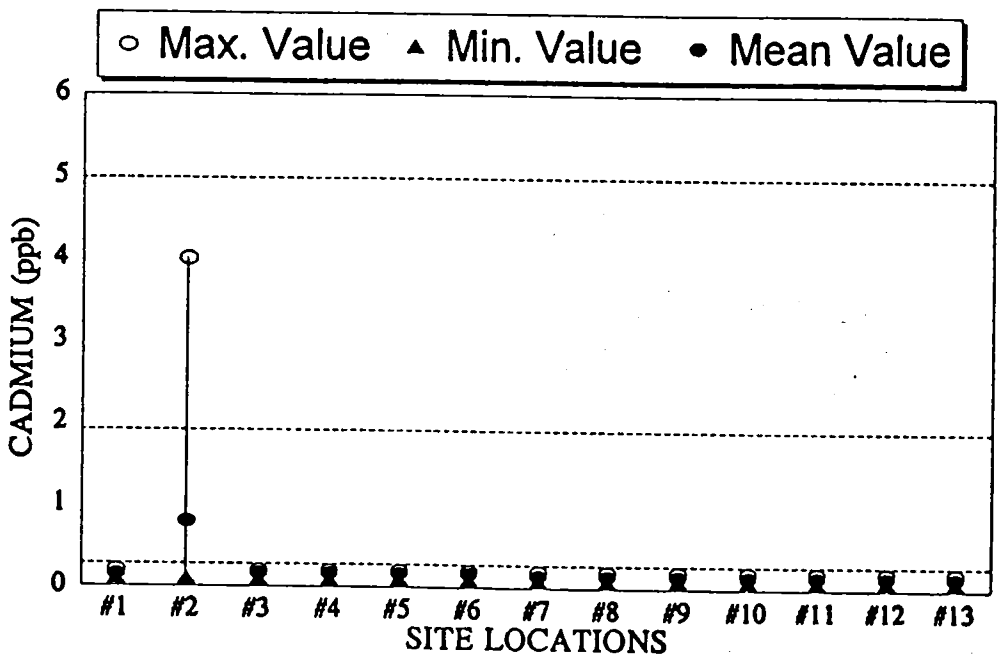
2.2.1.10

Cadmium tends to occur in natural waters in very small amounts. Cadmium salts (chlorides, nitrates or sulphates) may be present as organic or inorganic complexes or adsorbed on suspended particles or sediments. Natural waters contain trace levels that may range from 0.1 ppb to 10 ppb, while higher concentrations can be attributed to anthropogenic sources. Note: Cadmium accumulation and toxicity are dependent on the hardness of the water.

All sample sites in the study area are below the recommended CWQGs for cadmium concentrations set for drinking water, with the exception of the maximum value for Baker Creek at Great Slave Lake (site #2) which exceeds the recommended guideline for freshwater aquatic life but not for drinking water supplies.

DWSG = 5.0 ppb
FWALG = 0.2-1.8 ppb

FIGURE 17:YK-BACK BAY (WATER)
CADMIUM VALUES 1992-94



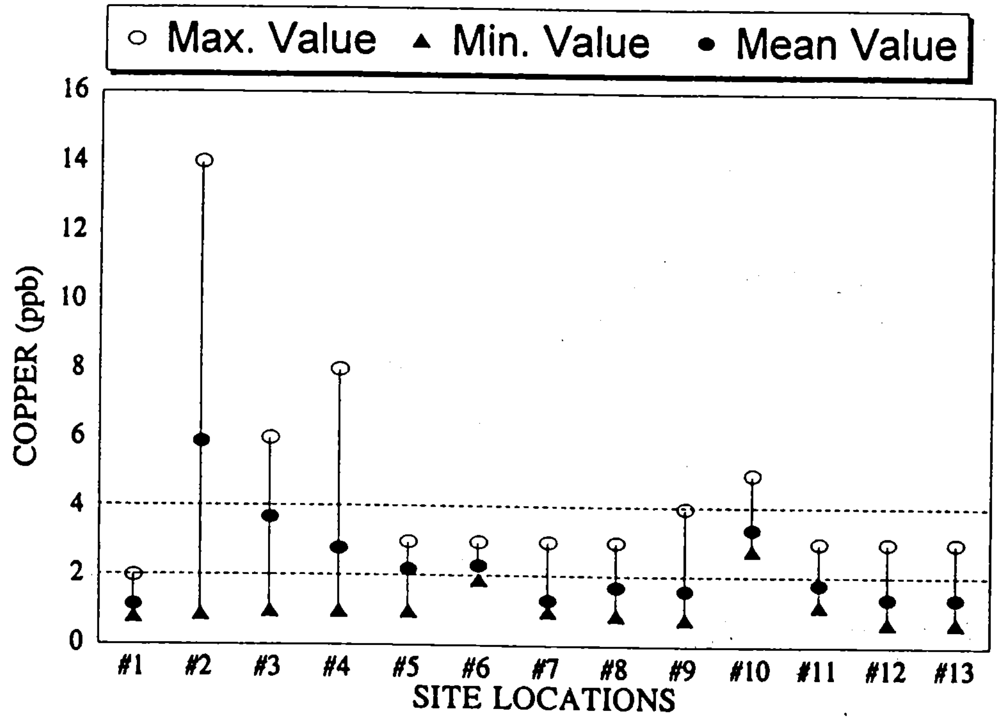
2.2.1.11

Copper is essential for all plant and animal nutrition. It is generally found in trace amounts in natural surface waters up to a concentration of 50 μg/L (ppb). Natural sources of copper include the weathering of sulphide and carbonate ores which occurs under oxidizing conditions. Toxicity of copper varies with the form of copper available and is also dependent on the physical characteristics of the water (ie. hardness, temperature and turbidity).

All the concentrations are below the drinking water guidelines. The average value of 5.9 ppb at Baker Creek at Great Slave Lake (site #2) is above the recommended guideline for freshwater aquatic life, as are three other maximums. In all, there were five mean values and eight maximums and one minimum in the range (2-4 ppb). The highest values were at sites #2 (Baker Creek at GSL), #3 (Niven Lake Outlet), #4 (Peace River Flats) and #10 (Peg Oulet at GSL).

DWSG = ≤1000 ppb
FWALG = 2 - 4 ppb

FIGURE 18:YK-BACK BAY (WATER)
COPPER VALUES 1992-94



2.2.1.12

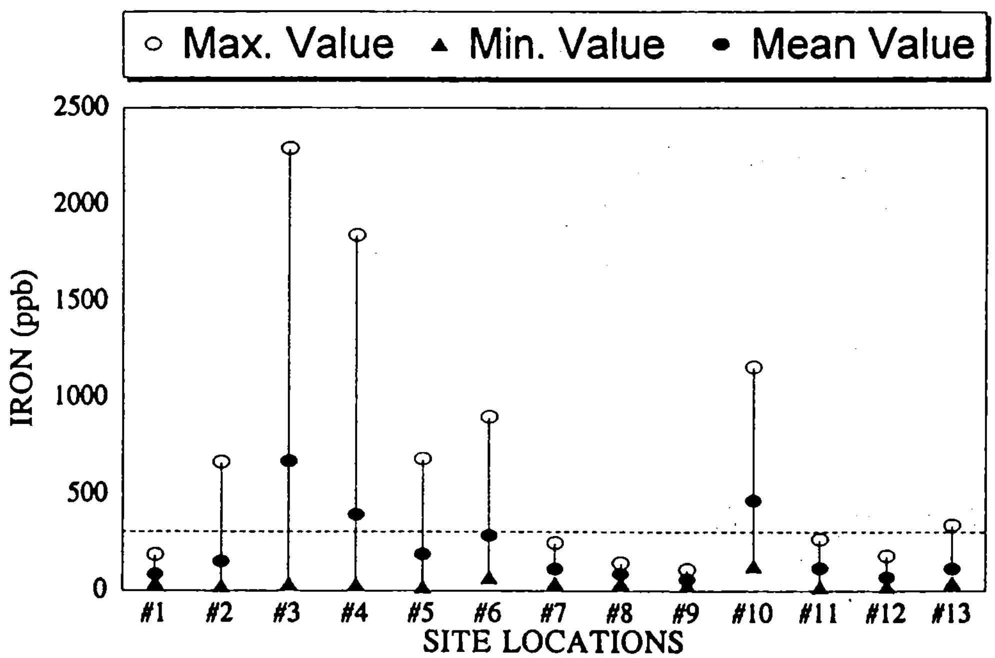
Iron is the fourth most abundant element in the earth's crust. It is produced by the weathering of igneous, sedimentary and metamorphic rocks. Atmospheric transportation can provide as much as 50 ppb of iron in rainfall (Dwyer et al., 1979). Anthropogenic iron sources may contribute to the environment via industrial waste, acid mine drainage and mineral processing.

High concentrations affect drinking water by making the water taste bitter. In addition, high iron concentrations can cause staining of laundry, enamel, porcelain and plumbing.

Three average iron concentrations were above the recommended guidelines for drinking water and freshwater aquatic life, site #3 (Niven Lake Outlet), #4 (Peace River Flats), #10 (Peg Outlet at GSL) and there were seven maximum values also over the guidelines. The highest values were at sites 3, 4 and 10.

DWSG = 300 ppb
FWALG = 300 ppb

FIGURE 19:YK-BACK BAY (WATER)
IRON VALUES 1992-94



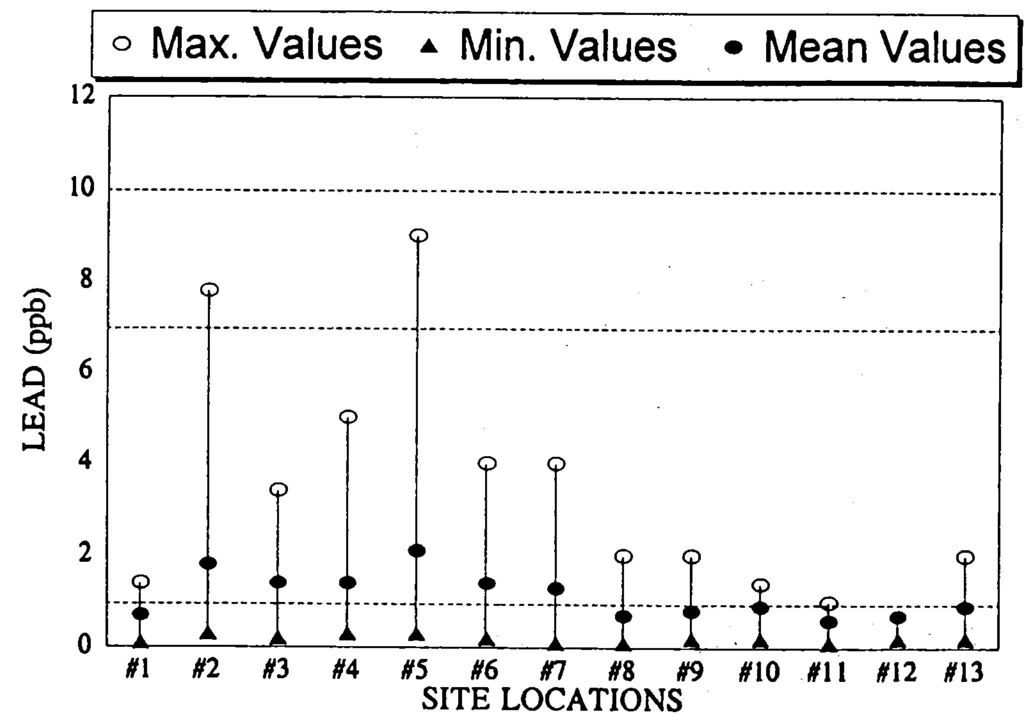
2.2.1.13

Lead is rarely found in high concentrations in natural waters. The weathering of sulphide ores (galena-PbS) and calcareous bedrock are natural sources of lead. Anthropogenic sources include the burning of leaded fuels (ie. automobile fuel, snowmobiles, outboard motors etc.), ore smelting and refining, production of storage batteries, lead pipes and motor oils. The limit set for the protection of the freshwater aquatic life is dependent on water hardness, alkalinity and dissolved oxygen.

All the average values for lead concentrations throughout the sample sites are well below the recommended DWSG, there were two maximum values above the range of the FWAL guideline (Baker Creek, Site #2 and Causeway, Site #5).

DWSG = 10 ppb
FWALG = 1-7 ppb

FIGURE 20:YK-BACK BAY (WATER)
LEAD VALUES 1992-94



2.2.1.14

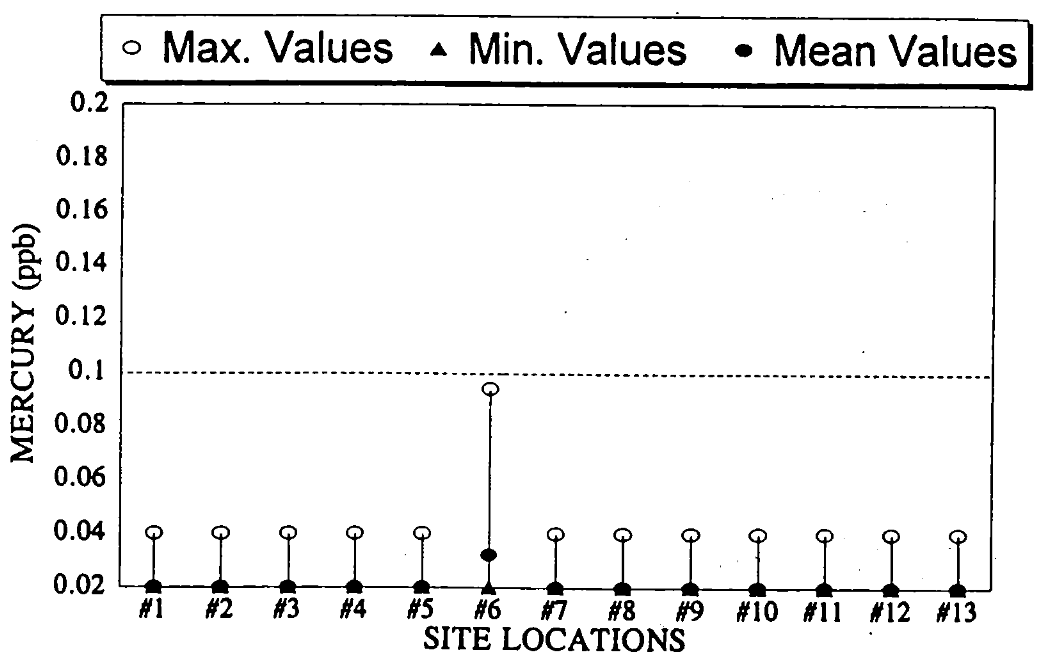
Mercury can occur in small amounts in natural waters because it is a trace metal in the earth's crust. In the natural environment, the amounts of mono and dimethyl mercury are influenced by the presence of microbial flora, organic carbon concentrations, inorganic mercury concentrations, pH and temperature. Mercury compounds are highly toxic to animals and man. Mercury tends to bind to particulate matter and settle out into the sediments. Once in the sediments, mercury then becomes bioavailable to the benthic organisms by ingestion and aquatic plants by passive diffusion.

All the average and maximum values for mercury concentrations were well below the recommended guidelines for raw water for drinking water supplies and freshwater aquatic life.

The highest value, which is still below the FWALG, was found at site #6, off the Ndilo dock on the west side of Latham Island. There is no obvious explanation as to why there is a high value at this site. At all other sites the values were below the detection limit.

DWSG = 1.0 ppb
FWALG = 0.1 ppb

FIGURE 21:YK-BACK BAY (WATER)
MERCURY VALUES 1992-94



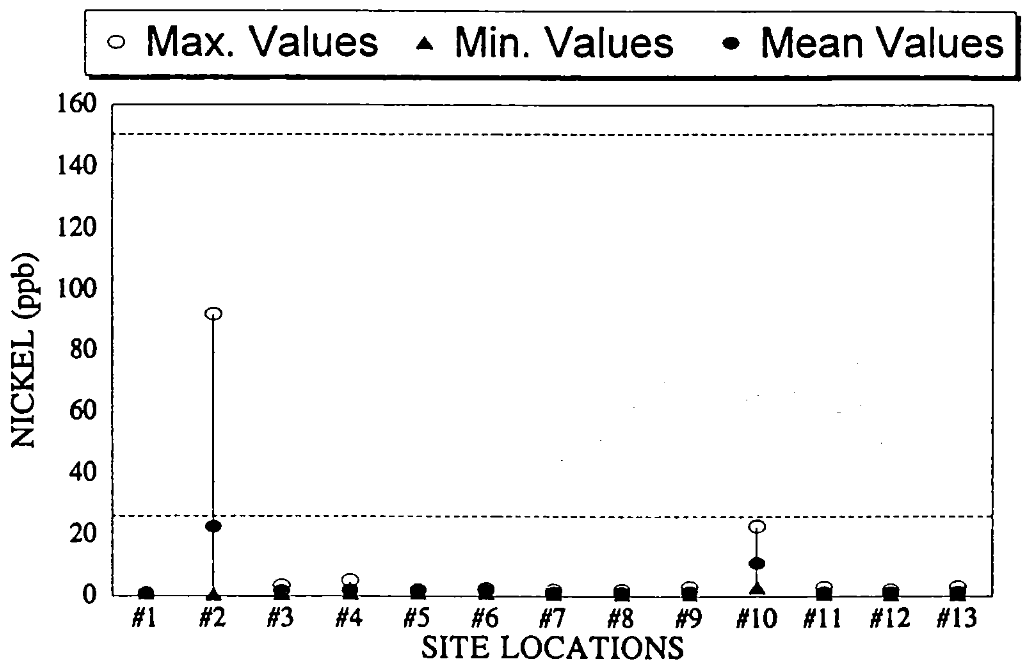
2.2.1.15

Nickel is seldom found in its elemental state but may be found in its natural state either in mineral or ore bodies. Natural sources for example may be igneous rocks. Anthropogenic sources include the processing of nickel ores, burning of fossil fuels and waste incinerates. For the protection of freshwater aquatic life the guidelines are dependent on water hardness.

There were no exceedances for nickel in the study area. The highest value was at site 2 (Baker Creek at GSL)

DWSG = NONE
FWALG = 25-150 ppb

FIGURE 22:YK-BACK BAY (WATER)
NICKEL VALUES 1992-94



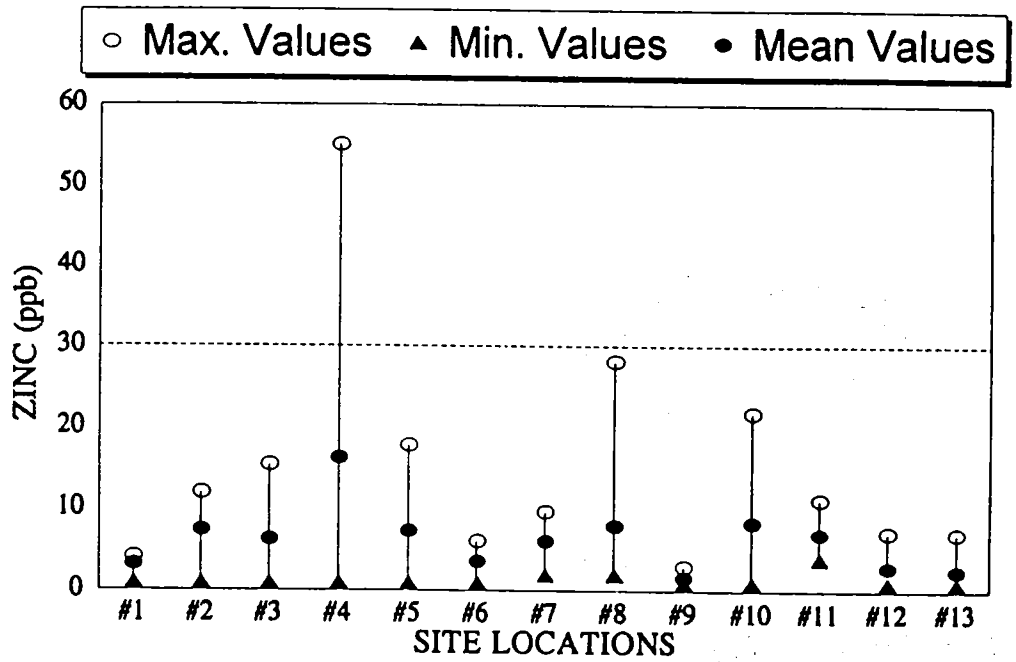
2.2.1.16

Zinc is abundant in nature and readily adsorbed to sediments. Usually zinc is present in small amounts in both surface and ground waters. Zinc is an essential element for plants and animals because it is a co-factor in many enzymes. Relatively non-toxic to man, zinc is however acutely and chronically toxic to aquatic organisms such as fish. Zinc toxicity increases with decreasing water hardness, increasing temperature and decreasing dissolved oxygen.

All of the average values were well within the specified limits. There was one maximum value that exceeded the FWAL guideline. This was site #4 (Peace River Flats), and there is no obvious explanation as to why.

DWSG = 5000 ppb
FWALG = 30 ppb

FIGURE 23:YK-BACK BAY (WATER)
ZINC VALUES 1992-94



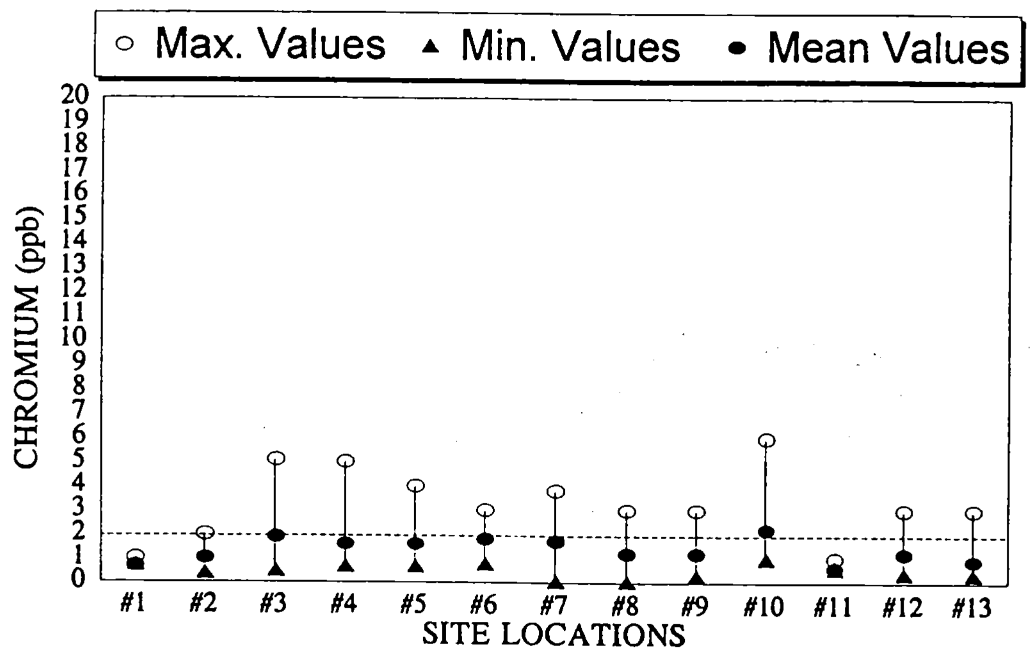
2.2.1.17

Chromium can occur in small amounts in natural water and like mercury, it is a trace metal found in the earth's crust. Small amounts of chromium are present in rocks, usually found in igneous rock and soils. Chromium is commonly used in industrial and domestic applications, ie. manufacturing of stainless steel, paints, dyes, explosives, ceramics, paper, hot water heaters, refrigerators and fire sprinkler systems. Water hardness has a significant effect on toxicity; chromium (III) is more toxic in soft water.

All maximum values fall within the guidelines.

DWSG = 50 ppb
FWALG = 2-20 ppb

FIGURE 24:YK-BACK BAY (WATER)
CHROMIUM VALUES 1992-94



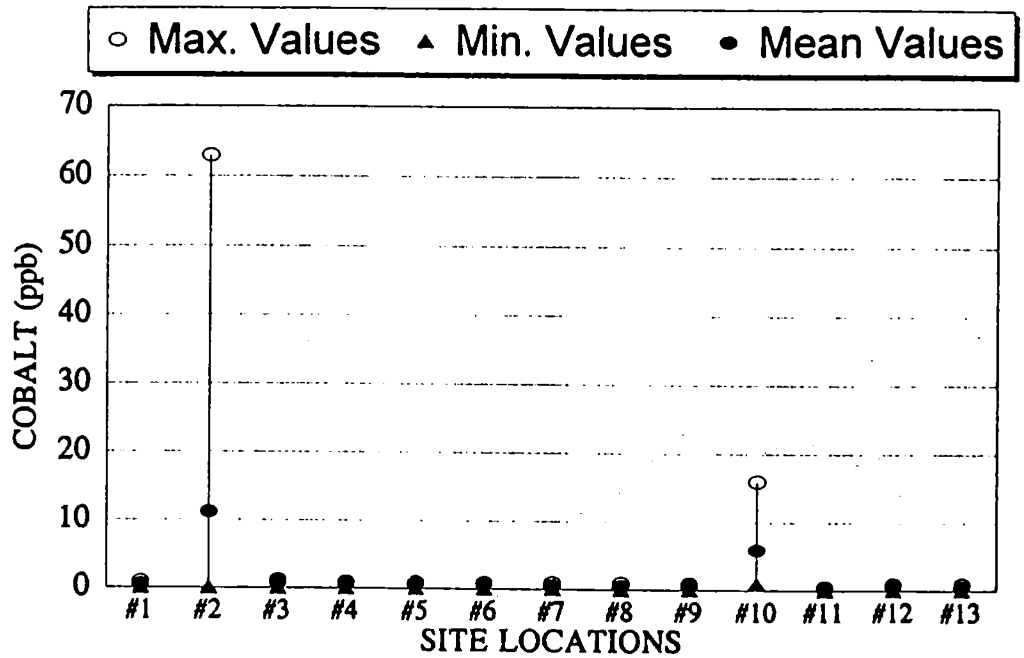
2.2.1.18

Cobalt is a heavy metal similar to nickel, the main difference is cobalt is more soluble in water. Cobalt has low toxic effects to man and effects on freshwater aquatic life have not been thoroughly investigated. At this time no limits have been established by the Canadian Water Quality Guidelines committee.

The highest values are found at sites #2 (Baker Creek at GSL) and #10 (Peg Outlet at GSL).

DWSG = NONE
FWALG = NONE

FIGURE 25:YK-BACK BAY (WATER)
COBALT VALUES 1992-94



2.2.2 Microbiological Parameters

Because there were specific concerns directly related to the domestic/recreational use of the water in the Yellowknife-Back Bay area, it was necessary to look at fecal coliforms, total coliforms and fecal streptococci as part of the study. Fecal coliforms (eg. E. coli) indicate pollution from sewage because they exist in the intestinal tract of warm-blooded animals. The use of "fecal" coliform bacteria to indicate sewage pollution has been proven to be more significant than the use of "total" coliform bacteria to indicate municipal pollution because the fecal bacteria are restricted to the intestinal tract of warm blooded animals.

In addition to analysing the coliforms as separate entities, a fecal coliform/fecal streptococci ratio was calculated. This identifies and differentiates to some degree between human feces and other forms of warm-blooded mammal feces and therefore provides information as to the source of contamination. For example, determining whether or not the source is from animals like dogs or a sewage lagoon can be very useful.

Although tests for parasites were not done, anyone who drinks untreated lake or river water increases their risk of ingesting cysts that cause "beaver-fever". These cysts are from the parasite called Giardia which lives in the gut of warm blooded mammals such as dogs, muskrats and beavers. Treatment in the form of boiling the water for a minimum of ten minutes is suggested.

2.2.2.1

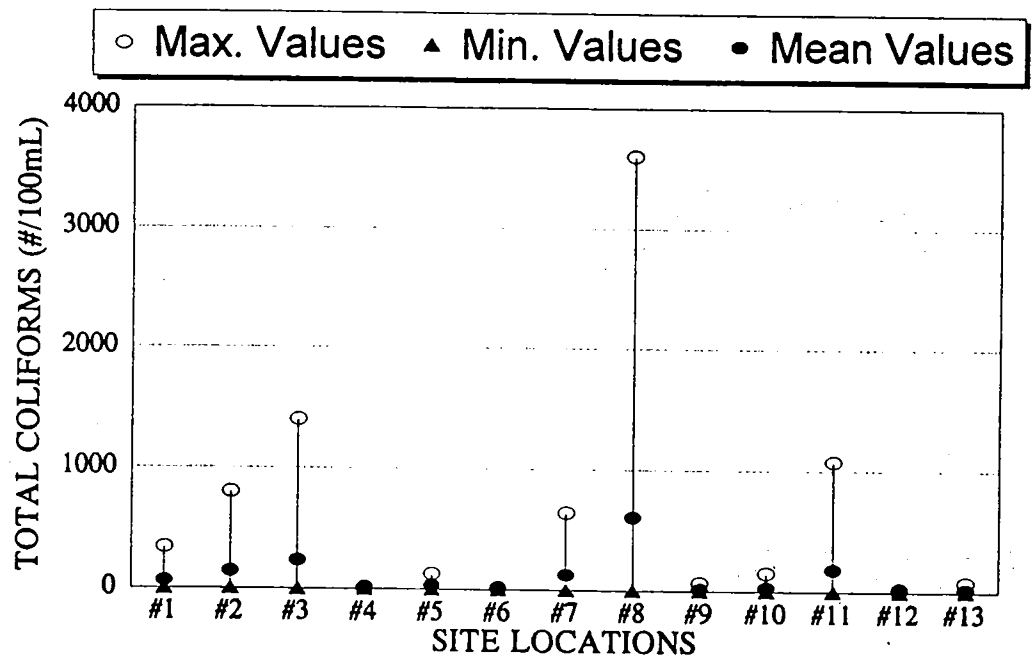
Total Coliform - at this time there are no set maximum acceptable limits for recreational uses (ie. swimming). Occasional monitoring for total coliforms may be useful for historical purposes and in establishing long-term trends.

However, there are limits that have been set by the CWQG's committee for raw water for drinking water supplies. If there is a value that exceeds that limit it is recommended that the water be treated prior to consumption.

As noted in the results, all sites had at least one sample above the limit. Ten average values and all the maximum values exceeded it. The exceedances were mainly in the summer months when the water is warm and the organisms can grow easily. September 1992 values were generally higher than the June and August 1993 values. The highest values were at sites #8 (Emergency Water Pumphouse), #3 (Niven Lake Outlet) and #11 (Dettah dock).

Recreational (swimming) Guideline = NONE
DWSG = 10 organisms/100 mL

FIGURE 26:YK-BACK BAY (WATER)
TOTAL COLIFORM VALUES 1992-94

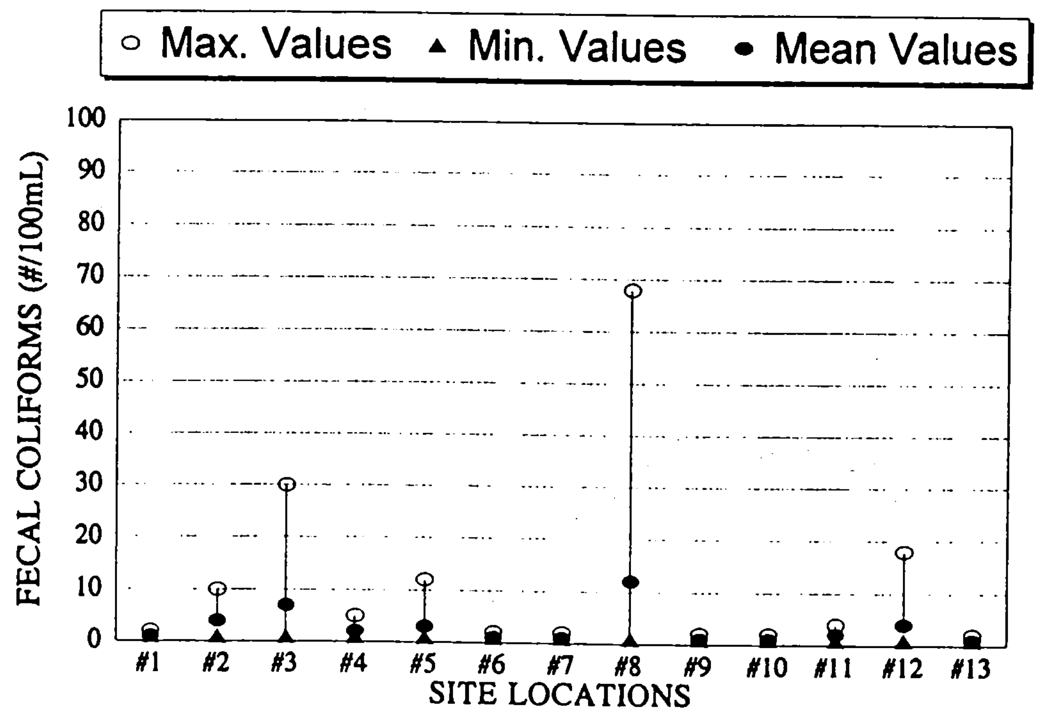


2.2.2.2

Fecal Coliforms - All the average values were well below the recreational guidelines (ie. swimming). As for raw water for drinking water supplies, all the average values exceeded the set limit, therefore it is recommended that the water be treated prior to consumption to kill pathogenic organisms. Treatment of water can be either by boiling, chlorination or filtration. The highest values were at sites #8 (Emergency Water Pumphouse), #3 (Niven Lake Outlet) and #12 (Old Giant tailings release area).

DWSG = 0 organisms/100 mL
Recreational Guideline = 200 organisms/100 mL

FIGURE 27: YK-BACK BAY (WATER)
FECAL COLIFORM VALUES 1992-94



2.2.2.3

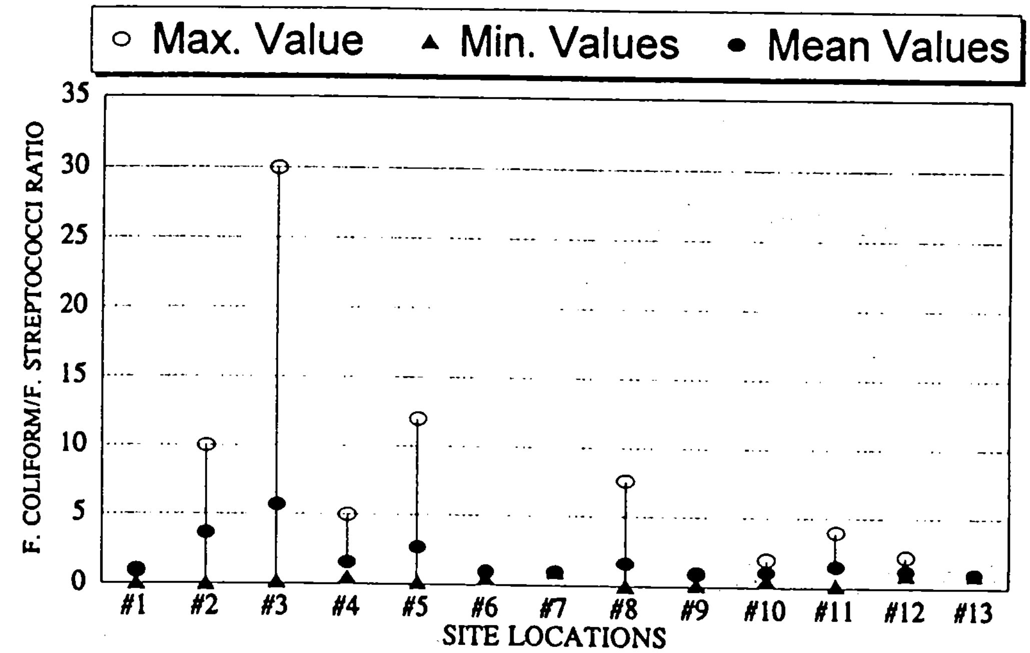
Fecal Coliform/Fecal Strep. Ratio - this is a general way of evaluating whether or not the coliforms that are present are human or animal (eg. dog) origin. Listed below is a general index used for guidance in determining a source:

Greater than 4	TYPE I	Human origin only
2-4	TYPE II	Human origin with mixed pollution
0.7-1.0	TYPE III	Anima! origin with mixed pollution
Less than 0.7	TYPE IV	Animal origin only

Maximum Values

There were five sites (#2,3,4,5 and 8) classified as TYPE I origin, three sites (10,11 and 12) classified as TYPE II and five sites (1,6,7,9 and 13) classified as TYPE III.

FIGURE 28:YK-BACK BAY (WATER)
FC/FS RATIO VALUES 1992-94



2.3 DISCUSSION AND RECOMMENDATIONS

The main purpose of this study was to attempt to provide answers to the following questions: 1. Is the water safe to drink?, 2. Is the water safe to swim in? and 3. Are the fish safe to eat?

To answer the first two questions all the data from the thirteen sites sampled were compiled and sent to Mackenzie Regional Health Services (MRHS) for a health risk assessment. They determined that the physical and chemical parameters were within the guidelines for drinking water quality and for recreational use such as swimming (see MRHS letter regarding health risk assessment in Appendix 8). According to the Total Coliforms and Fecal Coliforms values recorded during the study period September 1992 to March 1994 and the health assessment there was no risk to human health for swimming.

In addition, the data were also evaluated using the Canadian Water Quality Guidelines for freshwater aquatic life and raw drinking water supplies. Overall, there were more exceedances in the freshwater aquatic life (18) than there were for the raw water for drinking water supplies (11). Table 5 summarizes the locations that exceeded the Freshwater Aquatic Life (FWAL) and Raw Water for Drinking Water Supplies Guidelines (DWSG) throughout the study area.

There were no exceedances in the winter months, the time of the year when mine waste water is not being released because extreme weather conditions make effluent treatment difficult. During this period the untreated effluent is stored in approved tailings containment areas (tailings ponds) until decant season (open water months). When the treated effluents are released they must meet limits that are specified in their water licences which are issued by the N.W.T Water Board. (Table 1)

There are a number of other reasons why there are lower concentrations of contaminants in the winter months (versus decant season) in the Yellowknife-Back Bay area. They are as follows: during the winter months there is no surface run off; storm drains are not operating; and the waters in the two bay areas are not being disturbed by winds, meaning there is very little disturbance of the bottom sediments. For these reasons, summer levels would have more of a tendency to be higher.

Overall, the water in the Yellowknife-Back Bay is regarded as safe to drink after treatment and swim in according to the health risk assessment conducted by Mackenzie Regional Health Services (Appendix 8). A reminder to the public, if the water in Yellowknife - Back Bay area is going to be used for consumption, the water must be treated prior to use to kill or remove pathogenic organisms.

In conclusion, it is recommended that waters be monitored on a periodic basis because of the municipal/industrial effluents (eg. mine waste water and storm drains) that are discharged into Great Slave Lake.

Table 5. Sample sites that exceed the Freshwater Aquatic Life and Drinking Water Supplies Guidelines. ("+" indicates that the guideline was exceeded).

Location	Substance	FWALG	DWSG	Values that exceeded guidelines
#2 Baker Ck.	Ammonia	+		Maximum
#2 "	Arsenic	+	+	Mean & Max.
#2 "	Cadmium	+		Maximum
#2 "	Copper	+		Mean & Max.
#2 "	Iron	+	+	Maximum
#2 "	Lead	+		Maximum
#3 Niven Lk.	Copper	+		Maximum
#3 "	Iron	+	+	Mean & Max.
#4 Peace R. Flats	Copper	+		Maximum
#4 "	Iron	+	+	Mean & Max.
#4 "	Zinc	+		Maximum
#5 Causeway	Iron	+	+	Maximum
#5 "	Lead	+		Maximum
#6 Ndilo dock	Iron	+	+	Maximum
#10 Peg Outlet	Sodium		+	Max. & Mean
#10 "	Chloride		+	Mean & Max.
#10 "	Ammonia	+		Maximum
#10 "	Arsenic	+	+	Maximum
#10 "	Copper	+		Maximum
#10 "	Iron	+	+	Mean & Max.
#13 "	Iron	+	+	Maximum
TOTALS		19	11	

SECTION THREE: Sediment Sampling Program

3.1 INTRODUCTION

3.1.1 Background

The Yellowknife-Back Bay areas include the outlet of Baker Creek at Great Slave Lake (Royal Oak-Giant mine) and Peg Lake outlet at Great Slave Lake (Miramar-Con mine) where metals, trace elements and cyanide (process chemical) in various concentrations are released. The metals are a by-product of the extracting process when obtaining the gold from the ore. Baker Creek and Meg-Keg-Peg systems are the water systems carrying mine waste water containing metals (ie. arsenic, copper, lead, nickel, zinc) that have not settled in the tailings ponds. These water systems continue to act like small collection basins accumulating trace metals that have bypassed the tailings pond systems.

While Con mine began its operation in 1938, it shared the area with the Negus mine from 1939 to 1952. Now called Miramar-Con mine, it continues to operate and discharge treated liquid effluent into the Meg-Keg-Peg lake system (Figure 29). Giant mine began operating in 1948, with the tailings from this operation deposited onto the land east of the mill site. In 1951, the tailings were deposited into a small lake to the north of the mine and the liquid effluent was directed to Baker Creek and site #12 (old Giant tailings release area) where the latter were stopped in 1968 (Sutherland, 1989).

The metal concentrations in these systems have decreased since 1981 as water licences have become mandatory with limits set on the amount of metals allowed to be discharged into the environment (Sutherland, 1989). However, the old effluents from the Negus mining operations have left high amounts of contaminants in the Pud Lake area that have eventually ended up in the Meg-Keg-Peg system. These contaminants are now being picked up by the modern flow, so that the treated effluent leaving Miramar-Con mine may be cleaner than the water that reaches Great Slave Lake.

3.1.2 Objective

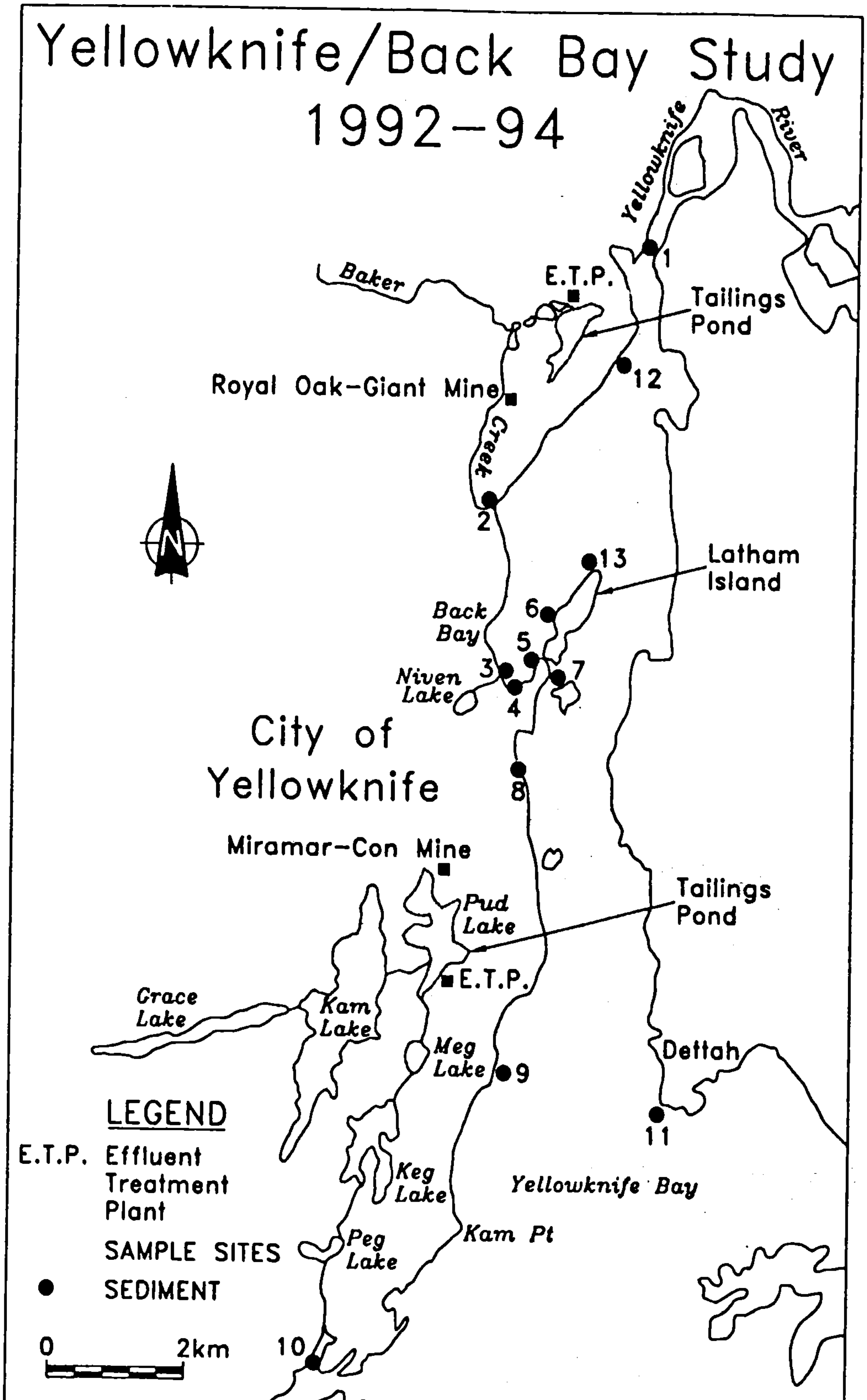
The main objective of the sediment sampling program was to obtain a general inventory of the kinds of metals present and what concentrations would be found at the time the samples were collected.

3.2 METHODOLOGY

3.2.1 Sampling Schedule

There were three sets of sediments collected in the open water months (September 1992, June 1993 and August 1993) at the thirteen sites shown in Figure 29. The sediment and water samples were collected from the same sites. There were no sediment samples collected in the winter.

Figure 29. Sediment sampling sites in the Yellowknife-Back Bay area.



3.2.2 Sampling Procedure/Protocol

Because sediment contamination was expected to be highest at the two mine outlets, more samples were collected at sites #2 and #10. This meant that triplicate or duplicate samples were collected to obtain a better representation of what was in those areas.

Sediment sample contamination was reduced by cleaning all the field equipment prior to use in the field. This was done by washing the equipment with soap and water, rinsing with a weak acid followed by a type 1 (de-ionized) water rinse. Sediment sampling equipment consisted of a petite ponar, stainless steel spatula, Whirlpaks, a small basin and a cooler to store samples.

To check temporal variations, a corer was to be used for the first collection but this method was not followed due to the bottom being too hard to get proper core samples. Therefore a petite ponar was used to collect all the sediment samples during the summer months.

Sediment samples were collected after the water samples were taken to avoid collecting any extra suspended sediment in the water samples. The samples were analysed for a wide range of heavy metals (Appendices 9,10 and 11)

3.2.3 Analytical Methods

All the sediment samples were sent to CANTEST Laboratory Ltd. in Vancouver, B.C. that is a member of the Canadian Association of Environmental Analytical Laboratories (CAEAL), a national organization established to ensure consistent laboratory quality assurance.

Method of Testing:

Metals in soil - Undried representative samples were digested with a mixture of three parts nitric and one part hydrochloric acids ("Reverse Aqua Regia"). Analysis was performed using Inductively Coupled Argon Plasma Spectroscopy (ICAP) or by specific techniques as described below. Moisture was determined gravimetrically at 105°C on a separate sample portion.

Arsenic - Analysis by Zeeman background-corrected Graphite Furnace Atomic Absorption Spectrophotometry.

Cadmium - Analysis by background-corrected Flame Atomic Absorption Spectrophotometry.

Lead - Analysis by background-corrected Flame Atomic Absorption Spectrophotometry.

Mercury - Analysis by Cold Vapour Atomic Absorption Spectrophotometry.

Selenium - Analysis by Zeeman background-corrected Graphite Furnace Atomic Absorption Spectrophotometry.

Total Organic Carbon - Acid digestion, analysis of residue by Leco Induction Furnace. Results reported on a "dry weight" basis

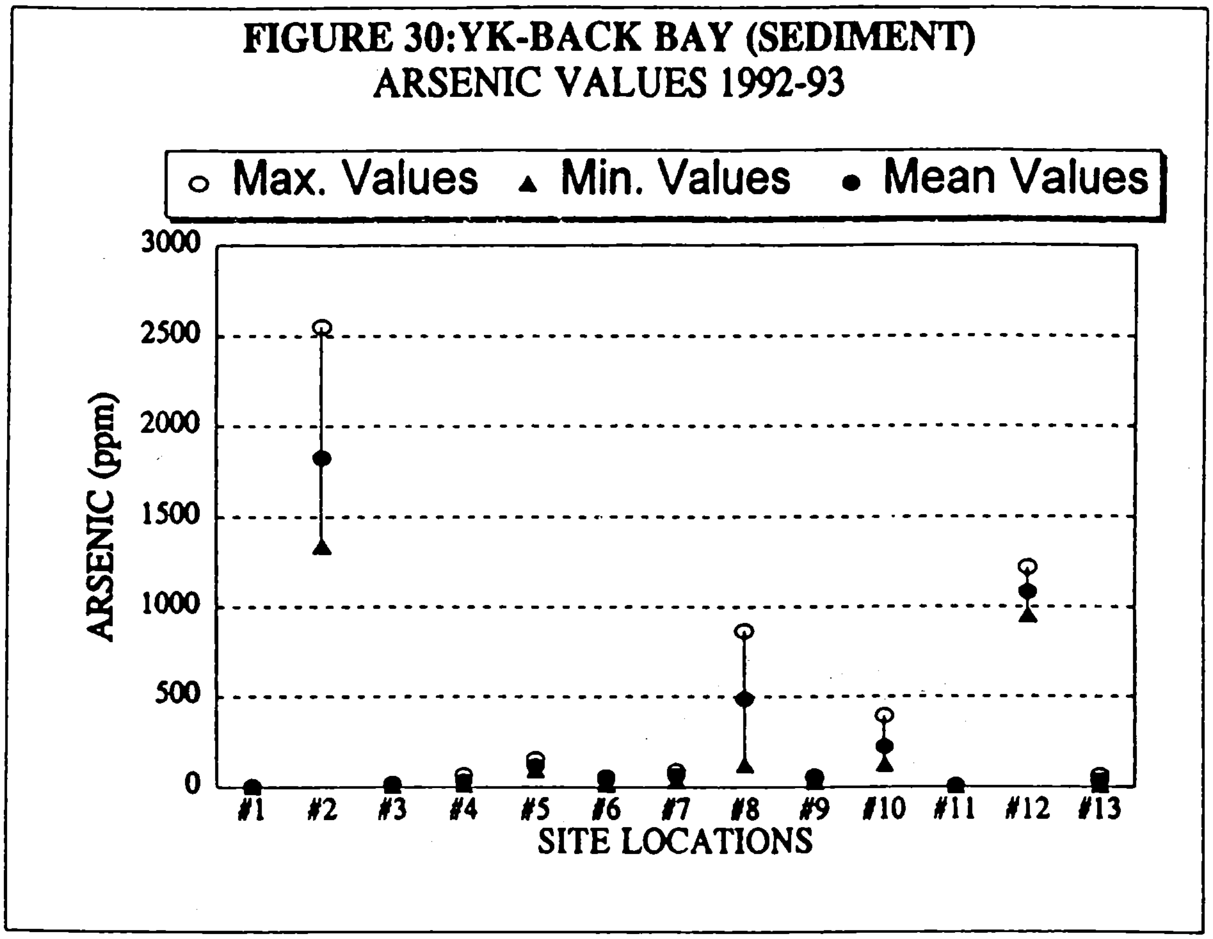
3.3 RESULTS

3.3.1 Sediment Chemistry

For this report only certain metal concentrations were summarized in the following figures. The complete lists of all the metals analyzed are in Appendices 9-11. At this time there are no sediment guidelines, however there are draft guidelines for mercury and cadmium that are being reviewed by CCME and should be out in 1995. The following are other metals that will have interim guidelines coming out in 1997: arsenic, chromium, copper, lead, nickel, silver and zinc.

3.3.1.1

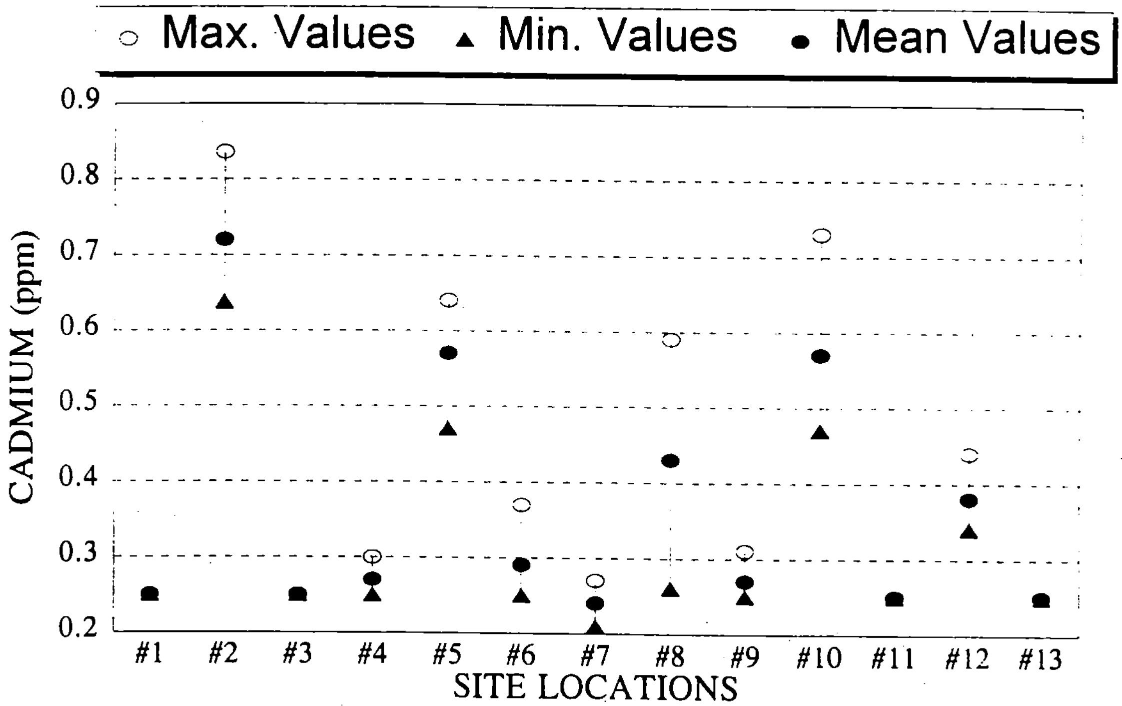
ARSENIC - the highest levels of arsenic were found at site #2, (Baker Creek @ GSL), with lower levels at site #12, (Old Giant Tailings Release Area), site #8, (Emergency Water Pumphouse) and site #10 (Peg Outlet). There are no obvious explanations for site #8's high concentrations.



3.3.1.2

CADMIUM - the highest cadmium concentrations were detected at the following sites, #2 (Baker Creek), #10 (Peg outlet at Great Slave Lake), #5 (Causeway), #8 (Emergency Water Pumphouse) and #12 (Old Giant Tailings Release Area).

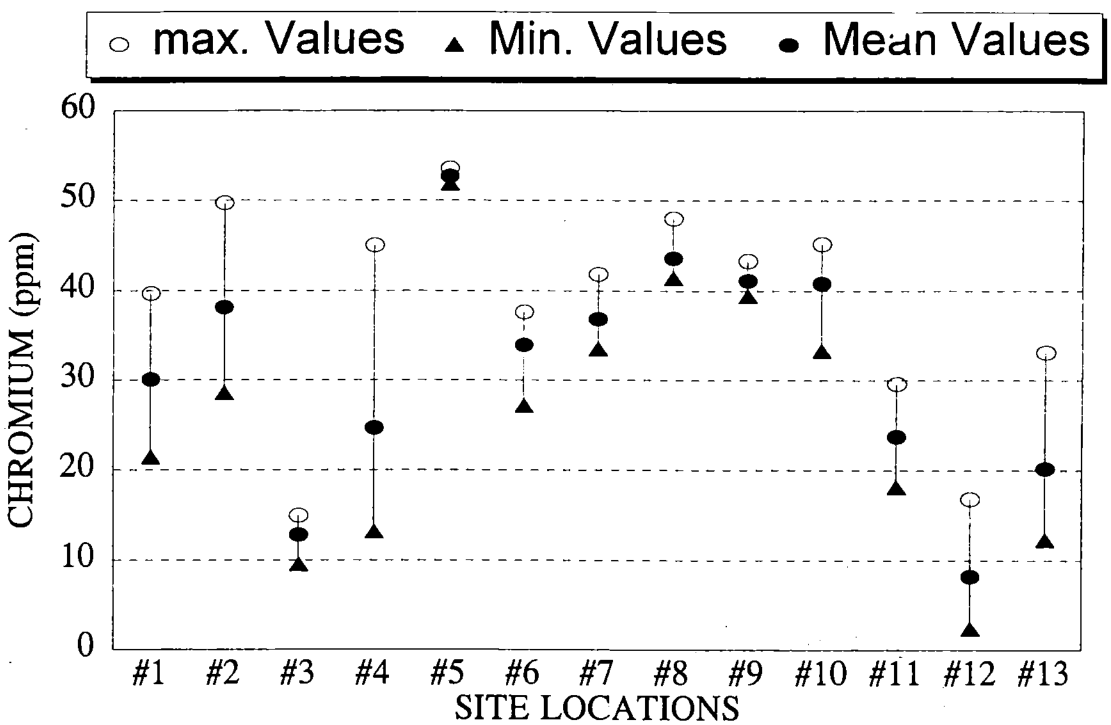
FIGURE 31:YK-BACK BAY (SEDIMENT)
CADMIUM VALUES 1992-93



3.3.1.3

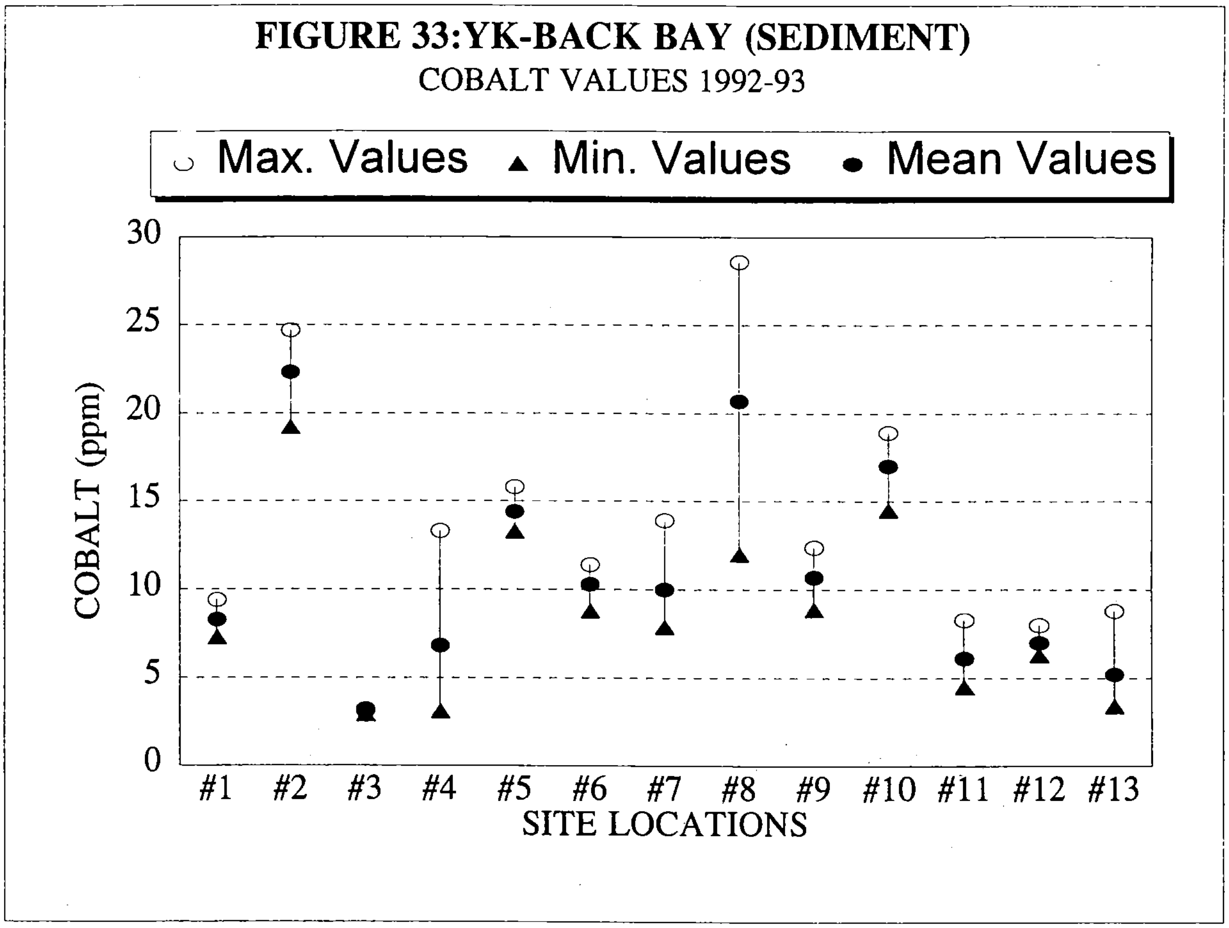
CHROMIUM levels were highest at site #5 (Causeway). There is no obvious explanation about why this site has the higher value.

FIGURE 32:YK-BACK BAY (SEDIMENT)
CHROMIUM VALUES 1992-93



3.3.1.4

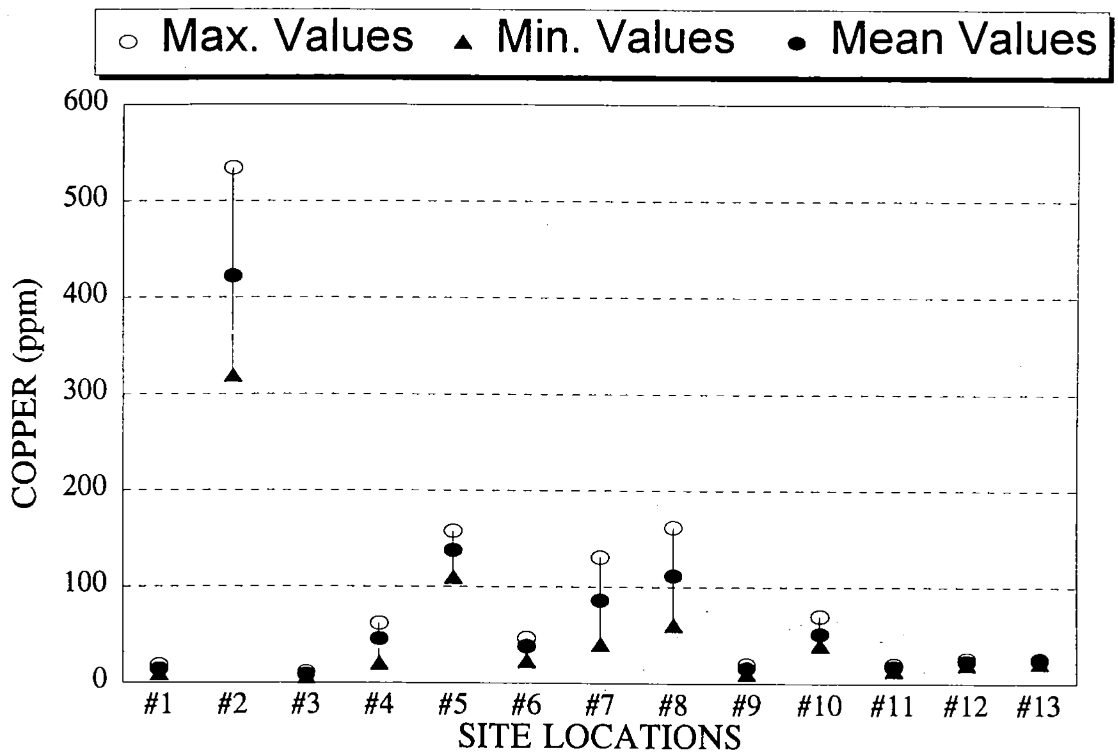
COBALT levels were highest at sites #2 (Baker Creek) and #8 (Emergency Water Pumphouse).



3.3.1.5

COPPER levels were noticeably highest at site #2 (Baker Creek at the mouth)

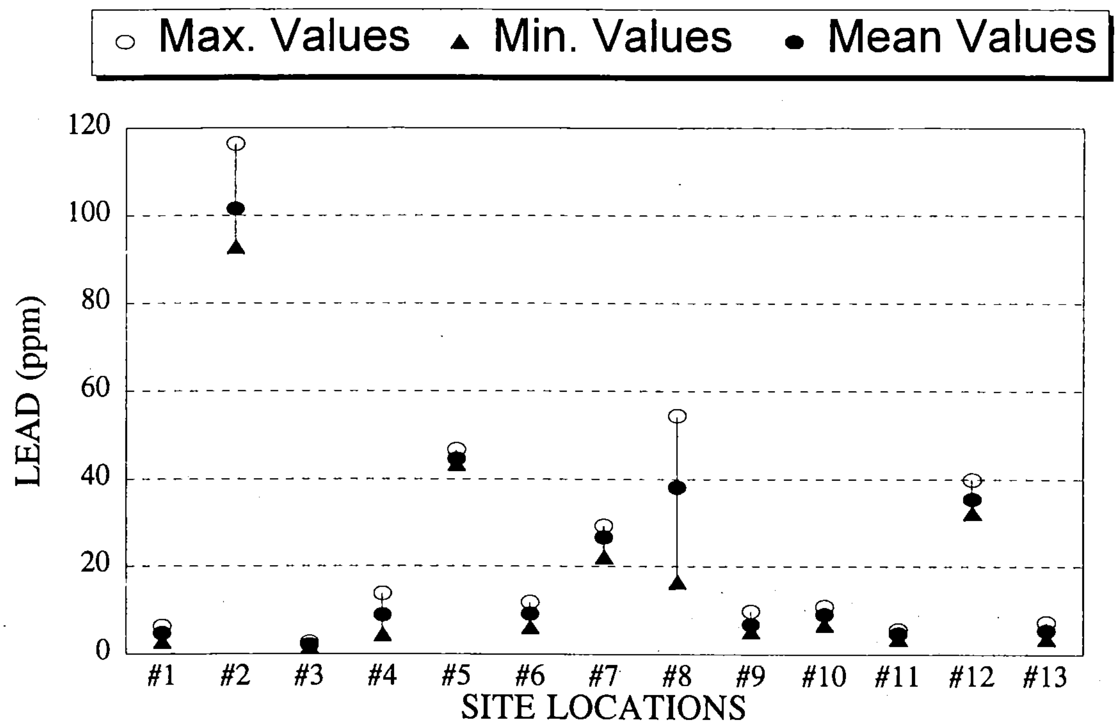
FIGURE 34:YK-BACK BAY (SEDIMENTS)
COPPER VALUES 1992-93



3.3.1.6

LEAD concentrations were highest at the site #2 (Baker Creek at the mouth), #5 (Causeway), #8 (Emergency Water Pumphouse) and site #12 (Old Giant Tailings Release Area). Besides the Royal Oak-Giant mine outlet, other sources may be fuel from the float plane base, snowmobiling and general motor vehicle activity.

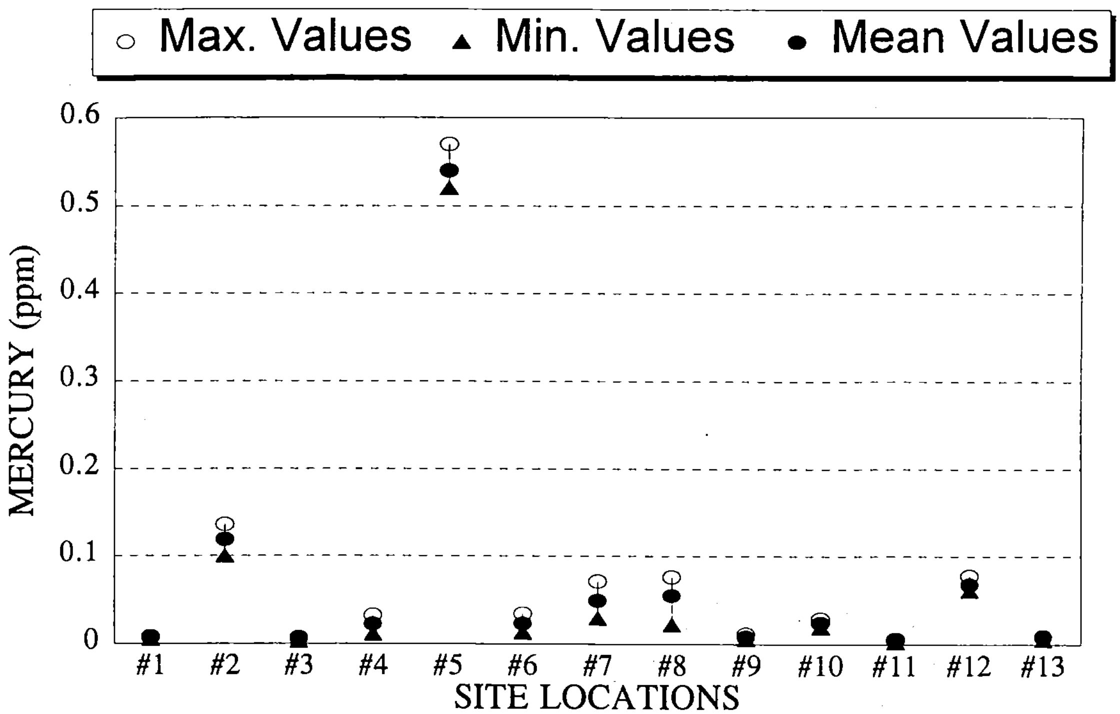
FIGURE 35:YK-BACK BAY (SEDIMENT)
LEAD VALUES 1992-93



3.3.1.7

MERCURY levels in the sediment were highest at site #5 (Causeway), no obvious reason as to why.

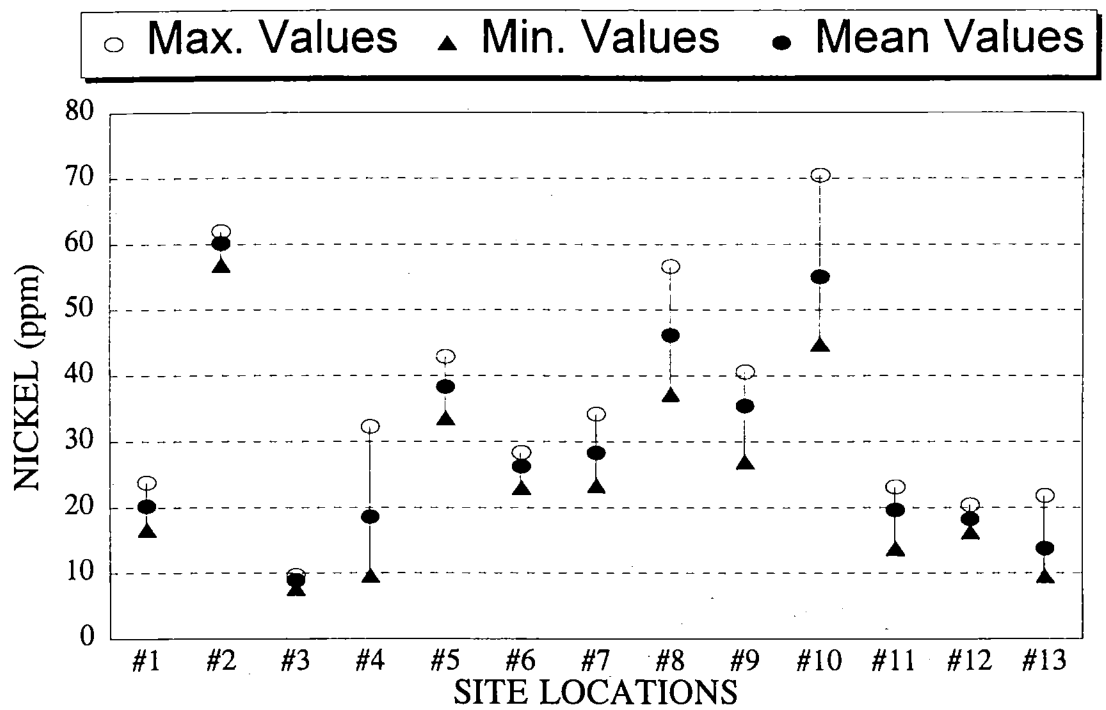
FIGURE 36:YK-BACK BAY (SEDIMENT)
MERCURY VALUES 1992-93



3.3.1.8

NICKEL levels were somewhat higher at sites #2 (Baker Creek at the mouth) and #10 (Peg Outlet at GSL) when compared to the other sites.

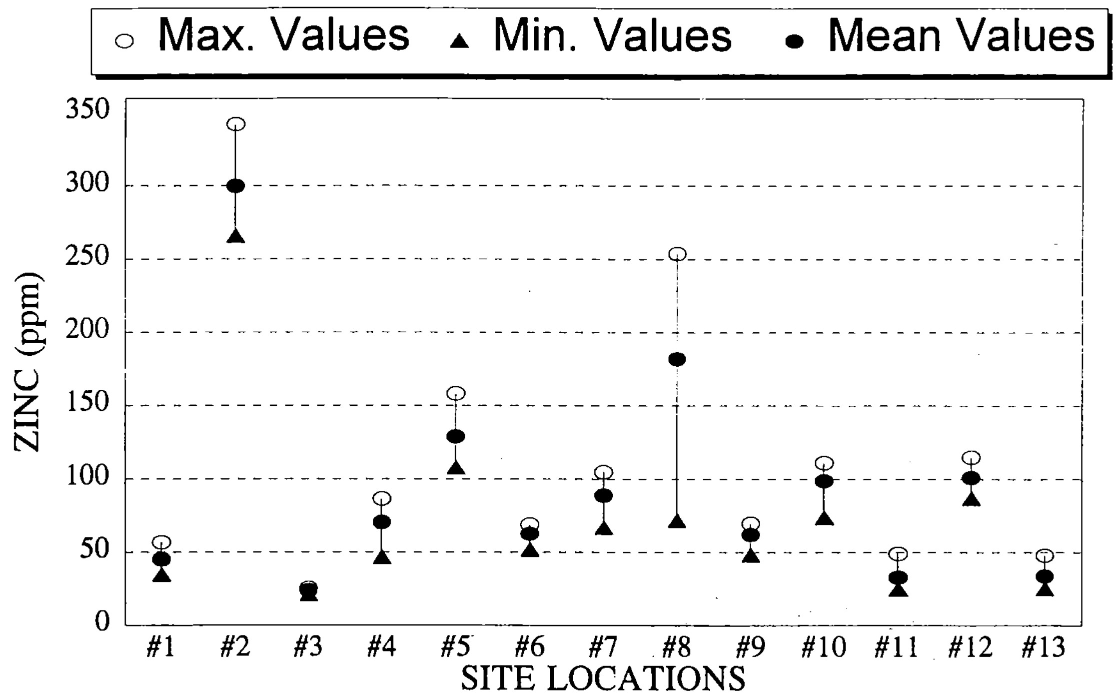
FIGURE 37:YK-BACK BAY (SEDIMENT)
NICKEL VALUES 1992-93



3.3.1.9

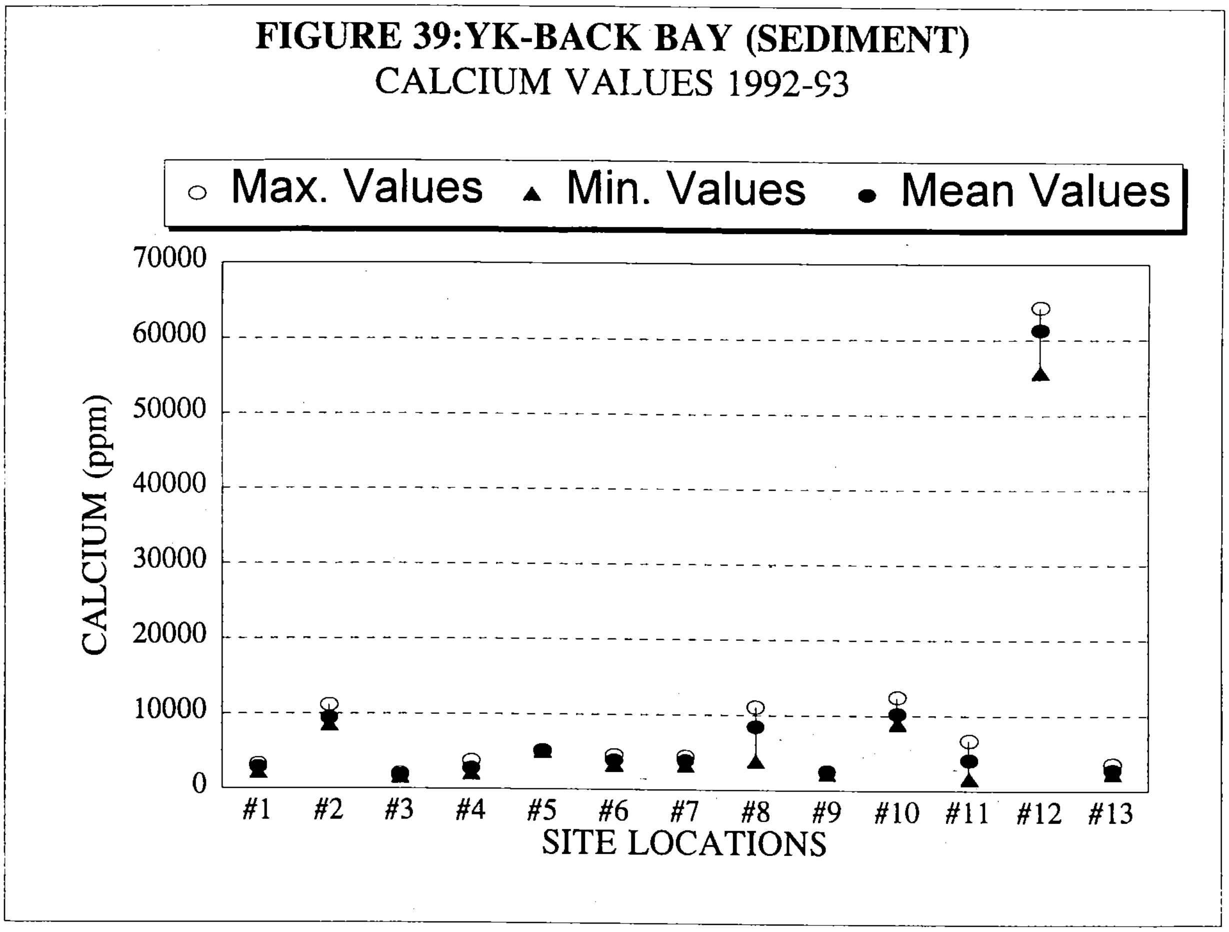
ZINC levels were highest at site #2 and #8, (Baker Creek at the mouth and the Emergency Water Pumphouse area).

FIGURE 38:YK-BACK BAY (SEDIMENT)
ZINC VALUES 1992-93



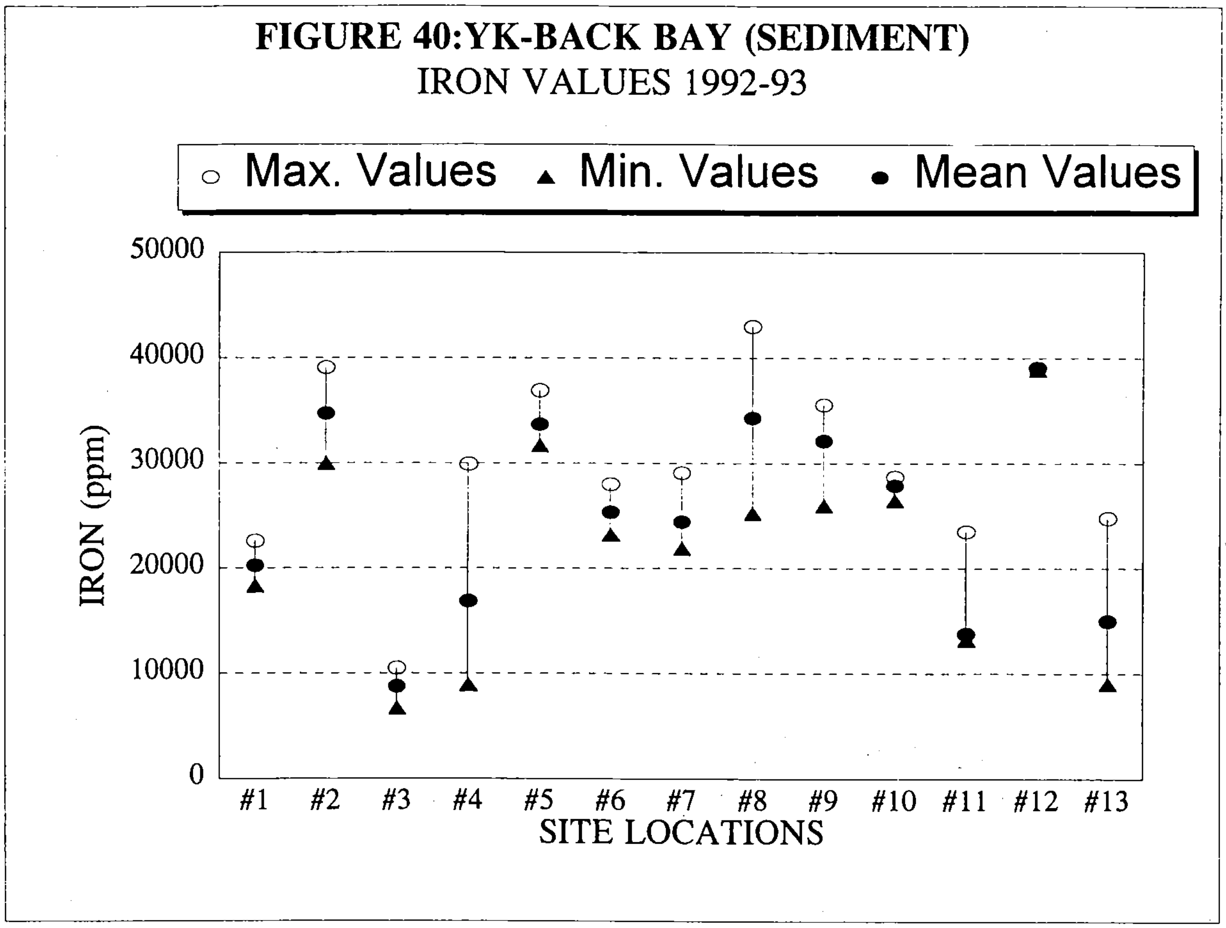
3.3.1.10

CALCIUM levels were similar throughout the study area with one exception, site #12, the Old Giant Mine Tailings Release area.



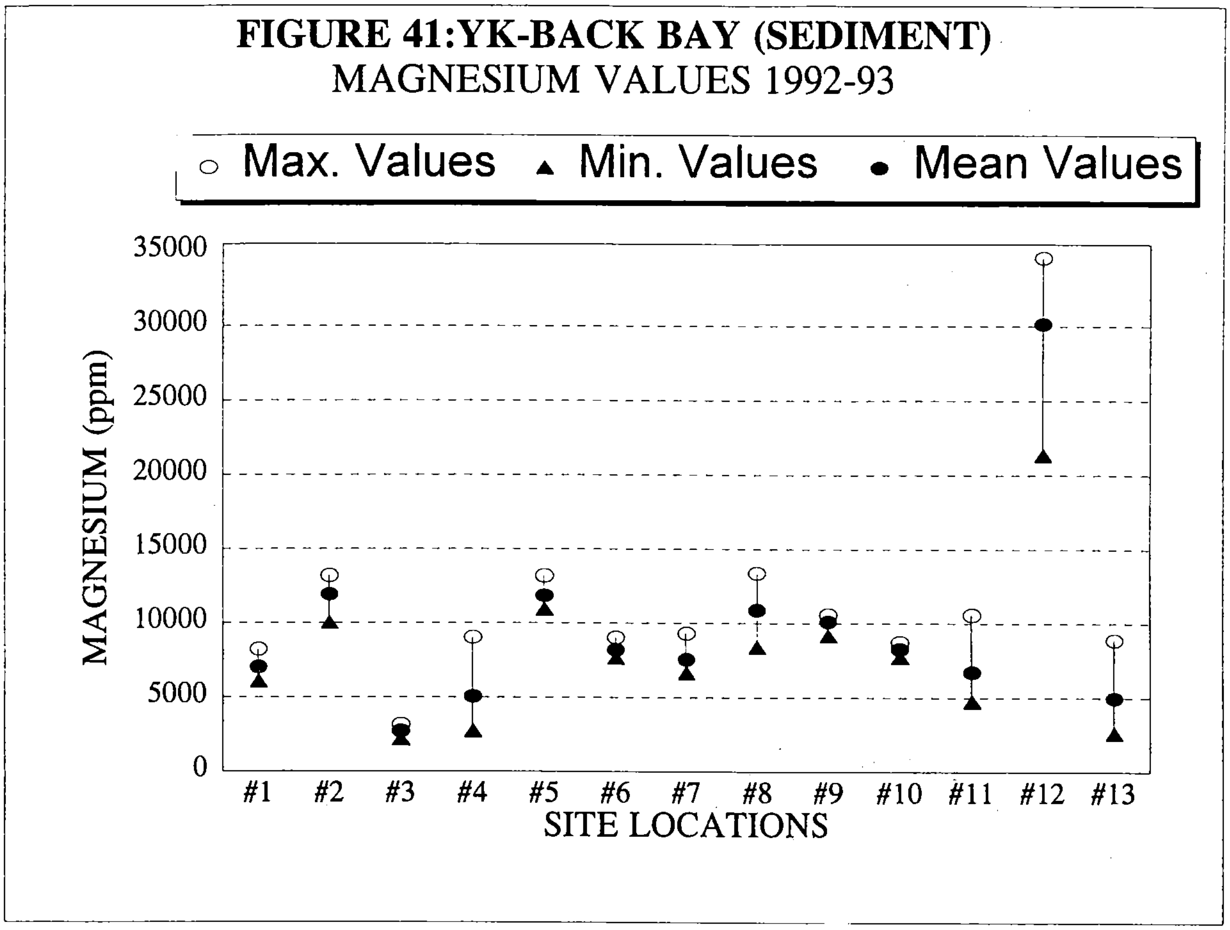
3.3.1.11

IRON levels were similar throughout the study area.



3.3.1.12

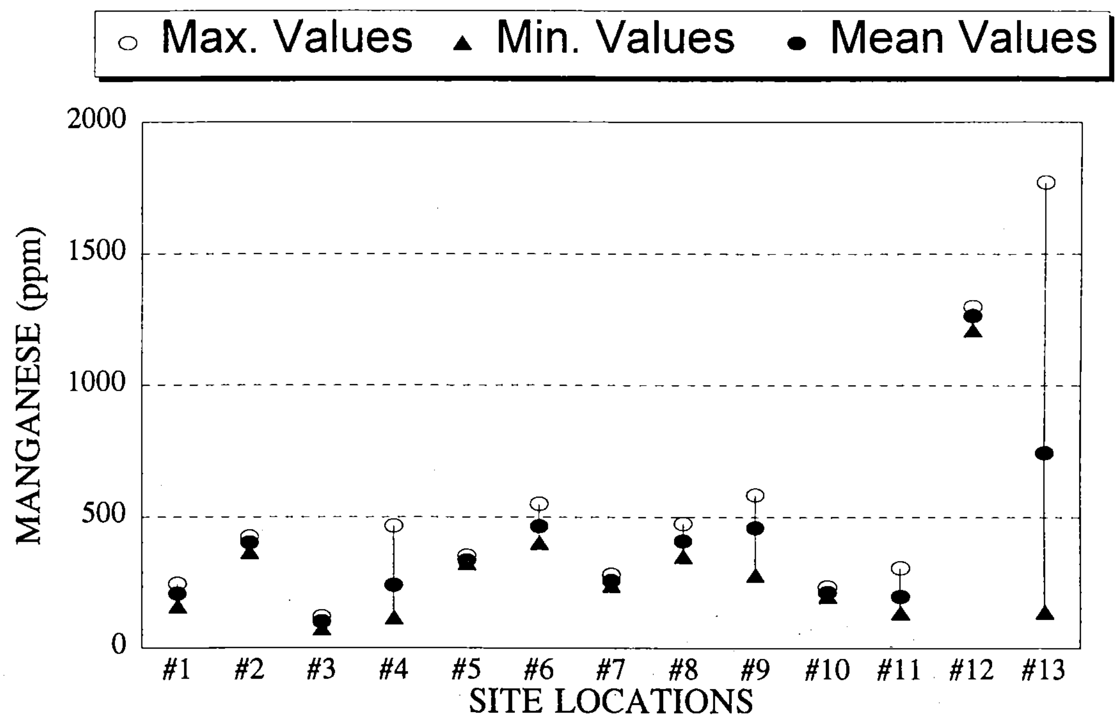
MAGNESIUM levels throughout the study area were similar to what was detected at site #1 (Yellowknife River) which was approximately 7000 ppm. There was one exception, site #12, (old Giant Tailings Release area) having an average value just over 30,000 ppm.



3.3.1.13

MANGANESE levels like magnesium levels were similar throughout the study area with two exceptions site #12 (Old Giant Tailings Release area) and site #13 (Tip of Latham Island).

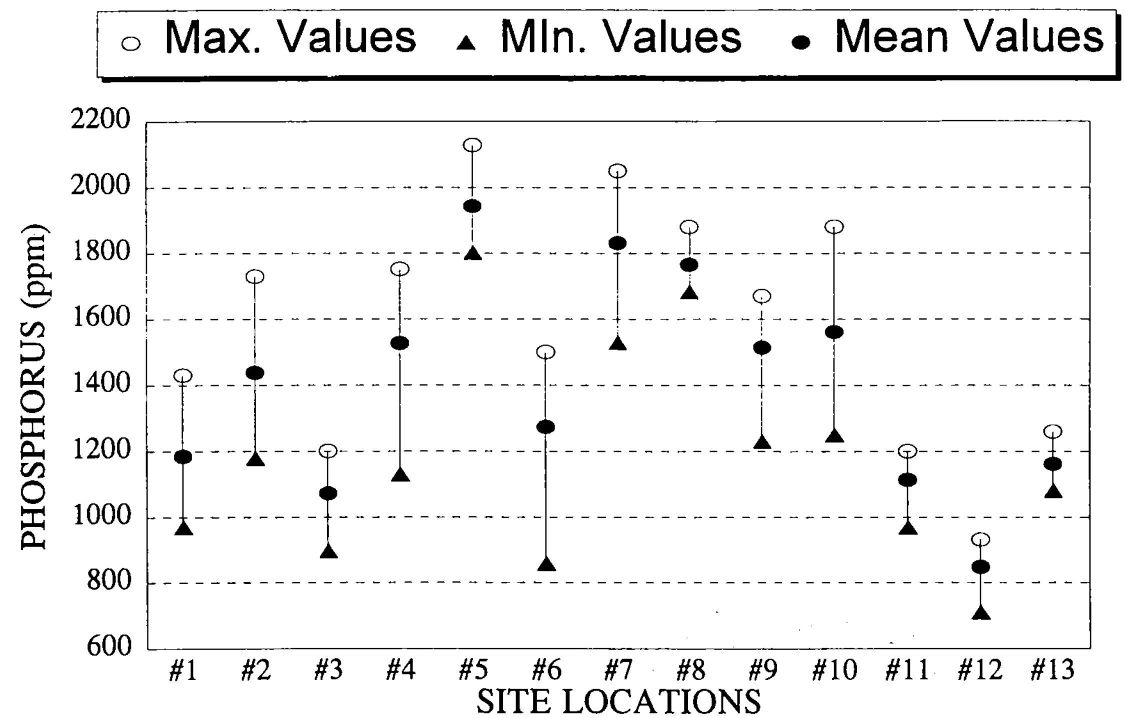
FIGURE 42:YK-BACK BAY (SEDIMENT)
MANGANESE VALUES 1992-93



3.3.1.14

PHOSPHORUS levels had a wide range of concentrations throughout the study area. The concentrations ranged from 900 ppm at site #12 (old Giant Tailings Release area) to 1900 ppm at site #5 (Causeway).

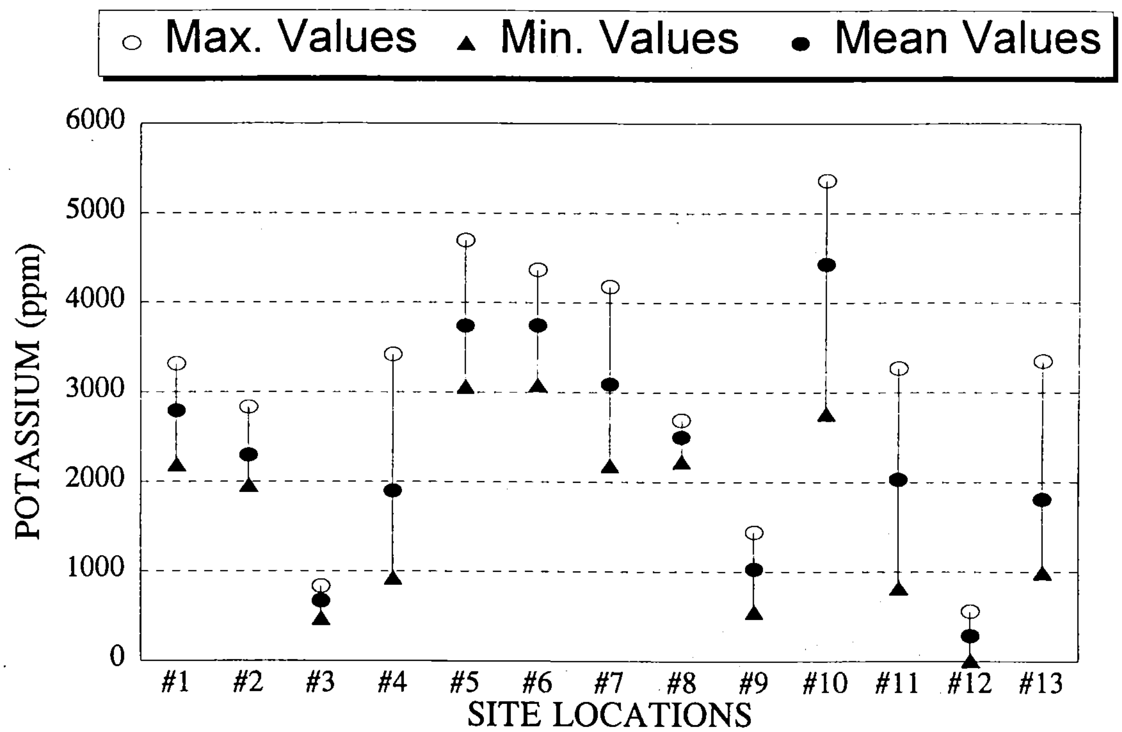
FIGURE 43:YK-BACK BAY (SEDIMENT)
PHOSPHORUS VALUES 1992-93



3.3.1.15

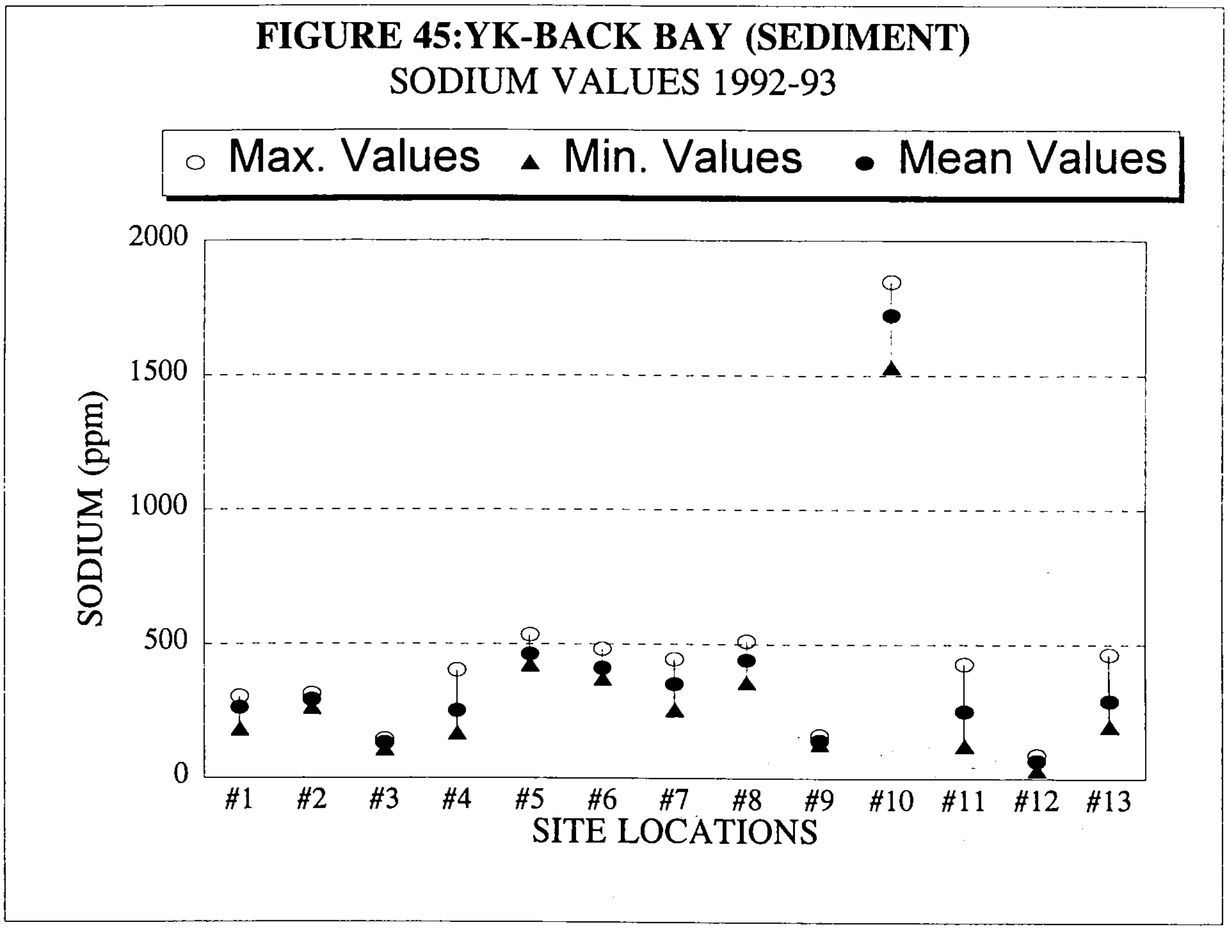
POTASSIUM average levels ranged from less than 500 ppm at site #12 (Old Giant Tailings Release area) to 4400 ppm at site #10 (Peg Lake outlet at Great Slave Lake (GSL).

FIGURE 44:YK-BACK BAY (SEDIMENT)
POTASSIUM VALUES 1992-93



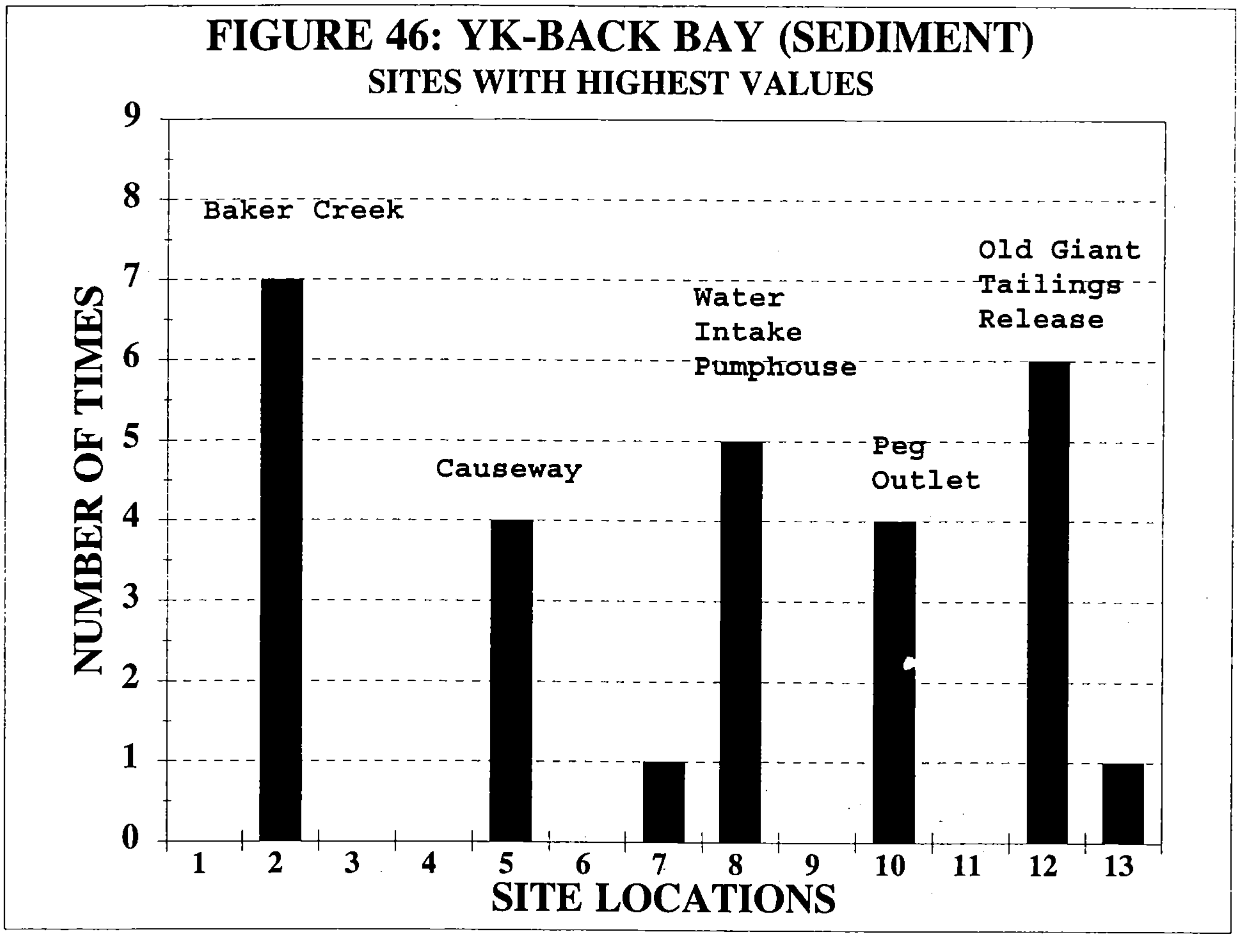
3.3.1.16

SODIUM levels were noticeably highest at site #10 (Peg outlet at GSL). This may be due to the industrial waste water.



3.3.1.17

SITES WITH THE HIGHEST CONCENTRATIONS when comparing the same elements to other sample sites in the study area.



3.4 DISCUSSION AND RECOMMENDATIONS

Because there are no sediment quality guidelines at this time, sediment samples were collected to obtain an inventory of the concentrations of contaminants in the study area.

Overall, Site #2 (Baker Creek at GSL) had seven noticeably higher values out of the 16 elements analyzed. Site #12 (Old Giant Mine Tailings Release Area) had six noticeably higher values out of the 16 elements, followed by site #8 with five, site #5 and #10 with four and sites # 7 and # 13 with one each. It makes sense that the Baker Creek system, Meg-Keg-Peg system and the old Giant Tailings Release area have the highest concentrations of metals in the sediment when compared to the other sites. Baker Creek and Peg outlet still carry the treated liquid effluent and the old Giant Tailings Release area carried liquid effluent until 1968.

In future Yellowknife - Back Bay studies that include sediment sampling, it is recommended that sampling sites be in the same areas as in the study conducted by D. Sutherland, March 1989 using similar sampling techniques. Ideally, core samples should be collected in the late winter months, (eg. April). At this time of the year contaminants will have had a chance to settle down into the sediment. In addition, when analyzing the core slices, similar techniques should be followed to compare historical data. This may help in identifying temporal and/or spatial trends like those in the study conducted by D. Sutherland 1989.

The freshwater aquatic life communities are targets for metal contamination because of the gold mining activity in the two bay areas. To determine the degree of affect requires additional work based on metal bioavailabilty from the bottom sediments near the mine sites.

Even with the reduction of metal loading in the Yellowknife-Back Bay area due to stringent licence limits and improved treatment facilities, based on sediment rates, it has been estimated that it will take about 14 years in Back Bay and 21 years in Yellowknife Bay to reduce of the amount of contamination in the top five centimetres of the bottom sediments to background levels (D.Sutherland 1989). Because the mine outlets exhibit the highest metal concentrations in the sediment samples combined with slow sedimentation rates in the two bay areas and high metal concentrations in fish tissues, there needs to be research focussed strictly on metal bioavailabiltiy.

The main factor that affects the benthic community that the fish eats is the depth of new, less contaminated sediments, which has accummulated over the old sediments. These less contaminated sediments will provide the suitable environment for the benthic community to recover. Therefore, gathering and assessing further data in the Yellowknife-Back Bay area, to monitor the rate of recovery in the benthic community, will be useful to determine the effect that the mines had on that environment.

<u>SECTION FOUR:</u> Fish Sampling Program

4.1 MATERIALS AND METHODS

4.1.1 Fish sampling sites

The sampling sites were chosen taking into consideration the mining activities and the areas fished domestically and recreationally by residents of Yellowknife, Ndilo and Dettah. Five sites (GSL 1 to 5) were selected and are identified in Figure 47. GSL 1, 2 and 4 are traditional fishing sites. GSL 3 and 5, located in proximity to Peg Lake and Baker Creek outlets, were retained to assess the potential impact of water entering Great Slave Lake contaminated with tailing effluents from Miramar-Con and Royal Oak Mines, respectively.

In October 1992, the Department of Fisheries and Oceans conducted a study on the movement of lake whitefish and provided an additional sample for the present study. These twenty-six northern pike and one burbot collected with commercial sized gillnets (131 mm mesh) on the opposite shore to Negus Point (GSL-1a) and in the Old barge area (GSL-1) are considered to be from GSL-6.

4.1.2 Fish collection

The fish were collected over the period August 25, 1992 to December 3, 1993 based on their availability. Gillnets of 89 mm and 114 mm stretched mesh, 46 metres long captured most species. An experimental net (mesh sizes between 25 and 140 mm, 138 metres long) was used to collect lake cisco. Northern pike were angled to complete the required samples.

Burbot were not collected efficiently with gillnets therefore set lines were prepared using a lead sinker and a large hook baited with a piece of lake whitefish. Winter sets selected burbot; a few northern pike were also captured. All nets and set lines were set overnight and fished for an average of 12 to 24 hours before they were checked and reset.

Fishing effort was estimated as follows: 29 nets of 89 mm and 114 mm stretched mesh were fished for a total of approximately 483 hours; 10 to 24 set lines were fished for a total of 216 hours; and about 9 hours of angling was done.

The details of the catches for each location are presented in Table 6. Table 7 summarizes the collection in relation to the time of the year.

Table 6: Fish catches per sampling site.

Species	NRPK	BRBT	WALL	LKWH	LNSC	LKCS	LKTR	Total
GSL1	16	10	22	38	1	13	2	102
GSL2	1	1	7	30	25	0	0	64
GSL3	32	30	1	37	3	0	0	103
GSL4	30	31	0	30	1	0	0	92
GSL5	4	0	0	60	0	0	0	64
GSL6	26	1	0	0	0	0	0	27
Total	109	73	30	195	30	13	2	452

NRPK=Northern pike; BRBT=Burbot; WALL=Walleye; LKWH=Lake Whitefish; LNSC=Longnose sucker; LKCS=Lake cisco; LKTR=Lake trout

GSL-1, 2 & 4=Traditional fishing sites.
GSL-3 & 5 =Located in proximity of Peg Lake and Baker Creek outlets.
GSL-1 (old barge area) & GSL-1a (opposite shore of Negus point) = GSL-6

Figure 47. Fish sampling sites.

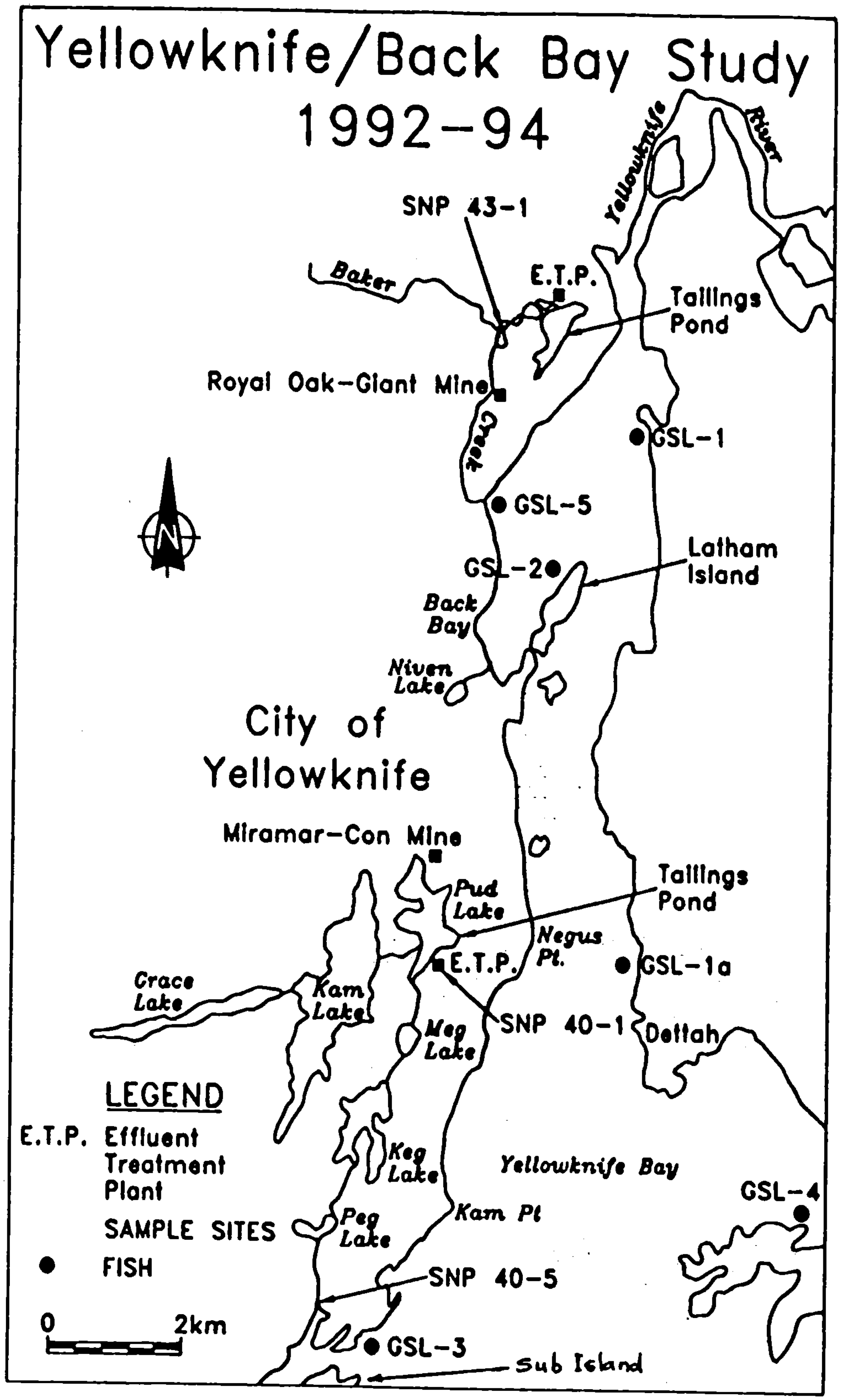


Table 7: Fish catches per month.

Species	NRPK	BRBT	WAL	LKWH	LNSC	LKCS	LKTR	Total
January								0
February								0
March	34	70	-	49	1	-	2	156
April								0
May								0
June	15	1	-	9	16	-	-	41
July	3	-	-	-	-	-	-	3
August	26	1	27	77	13			144
September	1	-	3	-	-	-	-	4
October*	26	1	-	-	-	-	-	29
November								0
December	4	-	-	60	-	13	-	77
Total	109	73	30	195	30	13	2	452

* : from GSL-6

NRPK- northern pike; BRBT- burbot; WALL-walleye; LKWH-lake whitefish; LNSC-longnose sucker; LKCS-lake cisco; LKTR- lake trout.

Note: No fishing was done in January, February, April, May or November.

4.1.3 Fish Processing

The fish captured were processed in D.F.O. Habitat Laboratory in Yellowknife within 5 hours of removal from the water. For every fish, fork length (± 1 mm), round weight (± 1 g) and liver weight (± 0.1 g) were recorded. The sex and the stage of maturity were assessed by a visual examination of the gonads. The criteria for evaluation are summarized in Appendix 12. Ageing structures were sampled and aged as described in Appendix 13 during winter 1993 by Mario Paris.

The fish tissues were collected using DFO standard sampling protocols described in Appendix 14. Dorsal muscle, liver and kidney were sampled on each fish and, in addition, eggs and stomachs were collected on a few lake whitefish. Tissues were individually packed in contaminant free bags, labelled and sent frozen for metal analysis.

4.1.4 Ageing techniques

As previously mentioned, each species of fish had various ageing structures sampled. Over the course of this study the methodology of ageing changed. The technician aged lake whitefish otoliths instead of the previously used scales. The main amendment conceived in the process was to thin-slice otoliths (Appendix 13).

Ageing structures are archived in D.F.O.'s Habitat Lab in Yellowknife, N.W.T. All thin-sliced slides are available for reviewing.

The thin-slice method was used from 1993. Previous to that, lake whitefish were aged with scales only and while sampling for this study, otoliths were not always collected from the lake whitefish as secondary structures. It is important to validate the use of scales to obtain data on fish age. In the Yellowknife Bay, the lake whitefish population is exploited and it is suggested that this situation renders the population younger on average hence decreasing the discrepancy that is normally found between the age derived from scales and otoliths in unexploited northern lakes. Where the two methods were used and compared, otoliths were considered more reliable to age lake whitefish. Burbot otoliths were aged following the two main methods (grinding and thin slicing) and are believed to be most reliable. Northern pike, walleye and suckers' ageing methods (Appendix 13) have not been modified over the course of this study and should be considered consistent. The ageing and the modifications have been done by the same technician (Mario Paris, DFO contractor).

4.1.5 Analysis of tissue samples for metals.

Heavy metal analyses were conducted by Robert Hunt, Environmental Chemistry Laboratory, Freshwater Institute, Winnipeg. Tissue samples were digested and analysed for metals using the methodology described in Appendix 15. All results are reported as milligrams of element per "wet" kilogram (ppm) of tissue. Detection limits for the various elements are presented in Table 8. Biological parameters as well as results of the metal analysis performed on individual fish tissues are presented in Appendices 16 to 22.

Table 8: Detection limits (ppm, wet weight basis)

Metal	Symbol	Liver/Kidney	Muscle
Arsenic	As	0.05	0.05
Cadmium	Cd	0.001	0.0001
Copper	Cu	0.25	0.10
Mercury	Hg	0.005	0.005
Nickel	Ni	0.04	0.02
Selenium	Se	0.05	0.05
Lead	Pb	0.05	0.03
Zinc	Zn	0.13	0.05

4.1.6 Data analysis

Descriptive statistics as well as weight-length relationships ($\log_{10}$ weight = a + b $\log_{10}$ length) were generated from Statistix 4.0 software. Fulton's condition factor was chosen as a measure of plumpness of a fish and was calculated as $K = (\text{Weight} * 10^5) / \text{Length}^3$.

As reported later in section 4.3, metal concentrations in fish tissues were initially analysed on data not adjusted for fish age or sex. A one-way analysis of variance was conducted employing the following model:

$Y_{ij} = \mu + \tau_i + \varepsilon_{ij}$

where:

Y_{ij} = metal concentration (μg/g)
μ = population mean
τ_i = treatment effect of sampling site
ε_{ij} = random error

Statistical analysis was conducted independently for each species and each tissue (i.e. muscle, liver and kidney). Dunnett's one tailed t-test ($\alpha=0.05$) was used to test whether means at selected sampling sites were significantly higher than those from the designated reference site.

Metal concentrations in fish tissues were then normalized for fish age and statistical analysis conducted employing a randomized complete block design analysis of variance, blocked on sex:

$Y_{ijk} = \mu + \beta_i + \tau_j + \varepsilon_{ijk}$

where:

Y_{ijk} = metal concentration (μg/g) / age (yr)
μ = population mean
β_i = fish sex (block)
τ_j = treatment effect of sampling site
ε_{ijk} = random error

Once again, Dunnett's one-tailed t-test ($\alpha=0.05$) was used to test whether means at selected sampling sites were significantly higher than those from the designated reference site.

Those metal concentrations reported at less than the analytical detection limit were estimated as one half of the detection limit. All statistical analysis was performed in the General Linear Models procedure of SAS.

4.2 RESULTS OF BIOLOGICAL EVALUATION

4.2.1 Lake whitefish (*Coregonus clupeaformis*)

Distinct lake whitefish stocks from Yellowknife-Back Bay cannot be identified, however it is believed that resident populations and migratory stocks inhabit the bay (George Low, pers. comm.). Lake whitefish was by far the most abundant species and was present throughout the study area; the present sample of 195 represents only a portion of the total catch. The 195 specimens (Table 9) taken in 89 and 114 mm stretch mesh gillnets ranged in fork lengths from 294 to 882mm (mean=401 mm) and weighed between 319 and 1565 g (mean=885 g). Otolith readings estimated the age between five and twenty-three years old. 89% of the catch was between 7 and 14 years old. Compared to fish captured in unexploited lakes of the Northwest Territories and aged by similar methods (Table 10), lake whitefish from Yellowknife-Back Bay areas are relatively young. Commercial and domestic exploitation of Great Slave Lake and Yellowknife Bay are factors that certainly contribute to explaining this difference in age.

Lake whitefish were present in every net set. 99 females and 94 males composed the samples retained, a ratio that approaches 1:1. The sex of two fish could not be identified. When the maturity of this fall spawning species was examined in relation to the time of the year, most lake whitefish captured at the mouth of Baker Creek (GSL-5) on December 1st and 2nd had completed spawning (index 5 or 10; Appendix 16); others were in spawning condition (index 4 and 9). Peak spawning for this species must therefore occur in November. Scott and Crossman (1973) mention that Rawson reported spawning occuring late in September to October in Great Slave Lake.

The maturity of the fish was inspected to identify any differential spawning periods between sites and there were no significant findings; lake whitefish were at similar stage of maturity. It was however observed that between March 5 and June 17 mature females (index 3) were caught but males of the corresponding index (i.e. 8) were absent from the catch for a same site. This suggests that females mature earlier than males but a larger sample size would be required to support this generalization.

The condition factors for the majority of the whitefish captured in this study varied between 1.0 and 1.8. Quite unusually, however, three specimens with extreme condition factors (0.11, 0.33 and 3.33) were captured in Akaitcho Bay (GSL-4).

Sample #	Length(mm)	Weight(g)	Maturity	Age (yrs)	K factor
242	882	741	2	13	0.11
244	545	535	1	10	0.33
273	326	1152	7	11	3.33

Table 9 Biological descriptors by age group for lake whitefish caught in Yellowknife-Back Bay (GSL 1-5) in 1992 and 1993.

MALES										
		Length			Weight			Kfactor		%
Age	N	Mean	SD	Range	Mean	SD	Range	Mean	Range	Mature
5	0	-	-	-	-	-	-	-	-	-
6	2	355	81	298-412	671	416	377-965	1.40	1.38-1.42	50
7	9	361	43	294-413	641	228	319-969	1.30	1.22-1.41	56
8	9	379	49	325-490	693	173	440-951	1.28	.70-1.51	66
9	16	394	33	299-422	861	210	480-1120	1.39	1.13-1.80	81
10	13	378	48	301-452	741	335	350-1413	1.29	.79-1.53	62
11	17	398	40	296-443	926	216	352-1295	1.48	1.21-3.33	94
12	7	423	26	384-452	1093	223	851-1478	1.43	1.26-1.61	86
13	12	421	34	374-488	1048	243	753-1565	1.39	1.17-1.56	84
14	3	399	5	395-405	818	47	773-866	1.29	1.23-1.38	100
15	4	397	26	370-432	920	165	750-1077	1.47	1.30-1.70	100
16	0	-	-	-	-	-	-	-	-	-
17	1	421	-	421	1027	-	1027	1.38	1.38	100
18	1	416	-	416	997	-	997	1.38	1.38	100
19	0	-	-	-	-	-	-	-	-	-
21	0	-	-	-	-	-	-	-	-	-
23	0	-	-	-	-	-	-	-	-	-
TOTAL	94									
MEAN		394	42		860	264		1.38		
MEAN AGE	10.5									

FEMALES										
		Length			Weight			Kfactor		%
Age	N	Mean	SD	Range	Mean	SD	Range	Mean	Range	Mature
5	1	325	-	325	431	-	431	1.26	1.25	100
6	1	425	-	425	1255	-	1255	1.63	1.63	100
7	2	346	37	320-372	547	84	487-606	1.33	1.18-1.49	50
8	11	377	42	320-440	765	318	383-1317	1.34	1.17-1.61	73
9	10	393	41	319-436	819	247	394-1191	1.31	1.21-1.44	90
10	9 *	41	49	376-545	860	157	535-1130	1.26	.33-1.44	70
11	13	414	24	368-440	965	194	585-1244	1.35	1.13-1.52	100
12	6	387	34	348-437	858	256	570-1263	1.44	1.35-1.53	83
13	17	423	120	365-882	875	144	696-1247	1.36	.11-1.56	88
14	17	416	33	374-478	1025	256	726-1459	1.39	1.19-1.55	94
15	4	415	18	399-440	1019	39	989-1073	1.43	1.26-1.56	100
16	3	417	43	372-458	977	340	588-1217	1.31	1.14-1.51	67
17	0	-	-	-	-	-	-	-	-	-
18	1	423	-	423	1098	-	1098	1.45	1.45	100
19	1	427	-	427	885	-	885	1.14	1.14	100
21	1	437	-	437	1282	-	1282	1.54	1.54	100
23	1	440	-	440	1206	-	1206	1.42	1.42	100
TOTAL	98 *									
MEAN		407	61		904	243		1.36		
MEAN AGE	11.7									

*Weight missing, for length N=99

Table 9. continued

COMBINED												
		Length			Weight			Kfactor		%
Age	N	Mean	SD	Range	Mean	SD	Range	Mean	Range	Mature
5	1	325	-	325	431	-	431	1.26	1.26	100
6	3	378	70	298-425	866	447	377-1255	1.48	1.38-1.63	67
7	11	358	40	294-413	624	209	319-969	1.31	1.17-1.49	55
8	20	378	44	320-490	733	259	383-1317	1.32	.70-1.61	70
9	26	393	35	299-436	845	221	394-1191	1.36	1.13-1.80	85
10	24	394	50	301-545	797	274	350-1413	1.29	.33-1.53	63
11	30	405	34	296-443	943	204	352-1295	1.42	1.13-3.33	97
12	13	406	34	348-452	984	259	570-1478	1.44	1.27-1.61	85
13	30	423	92	365-882	958	212	696-1565	1.37	.11-1.56	83
14	20	414	31	374-478	994	248	726-1459	1.38	1.19-1.55	95
15	8	406	23	370-440	969	123	750-1077	1.45	1.26-1.70	100
16	3	417	43	372-458	977	340	588-1217	1.31	1.14-1.51	67
17	1	421	-	421	1027	-	1027	1.38	1.38	100
18	2	420	5	416-423	1048	71	997-1098	1.42	1.38-1.45	100
19	1	427	-	427	885	-	885	1.14	1.14	100
21	1	437	-	437	1282	-	1282	1.54	1.54	100
23	1	440	-	440	1206	-	1206	1.42	1.42	100
TOTAL	195 *									
MEAN		401	52		885	254		1.37		
MEAN AGE	11.1									

*Two sexes missing

Maturity codes																		
Age	Female									Male								
5			2															
6			2									6			8			
7		1-2	3		3							6		7-8	8	9		
8	1	1-2	2		3							6	7		8	9		
9	1		2		3			5	5-2			6	7		8	9		
10	1	1-2	2		3		4	5				6	7	7-8	8			
11			2		3	3-4		5				6	7		8	9	9-10	9-10
12	1		2		3							6	7		8	9		
13	1		2	-3	3	3-4		5		6	6-7		7		8		9-10	9-10
14	1		2		3			5					7		8			
15			2		3			5					7		8			
16	1		2		3													
17																		
18								5								9		
19								5										
21			2															
23								5										

Bolded= most prevalent value

Weight-Length Relationships

Female: log 10 (W) = -0.75 + 1.42 log 10 (L) R-squared = 0.34 p<0.001, n=98

Male: log 10 (W) = -4.43 + 2.83 log 10 (L) R-squared = 0.81 p<0.001,n=94

Combined: log 10 (W) = -2.41 + 2.05 log 10 (L) R-squared = 0.55 p<0.001,n=194

Table 10 Biological descriptors (means) for fish from various locations in the Northwest Territories.

Species	Location	Year	N	Age (YEARS)	Length (mm)	Weight (g)	K Factor
Walleye	Kam Lake	1988-91	18	12	497	1613	1.24
	Trout Lake	1990	20	9	474	1230	1.1
Lake cisco	Kam Lake	1988-91	23	8	310	333-540	1.16-1.69
	Prelude Lake***	1979	77	-	182	55	0.95
	Prosperus Lake**	1979	20	-	171	52	1.06
Lake Trout	Giauque Lake	1992	30	21 (a)	532	1909	1.08
	Thistlethwaite Lake	1992	30	20 (a)	533	1688	1.11
	Trout Lake*	1990-91	12	15 (b)	535	1810	1.2
Northern pike	Giauque Lake	1992	12	8	586	1473	0.71
	Thistlethwaite Lake	1992	6	9	640	1725	0.66
	Kam Lake	1988-91	35	9	613	2149	0.71-0.82
	Prelude Lake***	1979	7	-	515	950	0.67
	Prosperus Lake**	1979	42	-	644	1990	0.75
	Trout Lake	1990/91	2	6	629	2075	0.83
Lake whitefish	Giauque Lake	1992	30	24 (a)	506	1888	1.35
	Thistlethwaite Lake	1992	30	25 (a)	451	1270	1.37
	Kam Lake	1988-91	40	7 (b)	405	1135	1.52
	Prelude Lake	1979	358	-	358	695	1.28
	Prosperus Lake	1979	667	-	349	604	1.28
	Trout Lake	1990/91	7	8 (b)	340	574	1.31
Longnose sucker	Giauque Lake	1992	19	16	474	1313	1.39
	Thistlethwaite Lake	1992	6	16	484	1492	1.37
	Prosperus Lake	1979	11	-	372	886	1.51
	Trout Lake	1990-91	16	16	472	1529	1.45
Burbot	Trout Lake	1990-91	13	11	671	2356	0.8

(a): Otolith Readin (b) Scale Reading (may have underestimated the age)

* Domestially exploited lake; Swyripa et al, 1994
**Commercial exploited lake; Robergeet al., 1986
***Roberge et al., 1990

The mean condition factor of lake whitefish from Great Slave Lake (1.37) is within the range of means (1.28-1.52) for lake whitefish caught with gillnets of similar mesh sizes in various NWT lakes (Table 10). This suggests that lake whitefish are in good condition. The relationships between fork length and round weight for this species are described by the equation at the bottom of Table 9 on page 76. The variation in length explains only 34% of the variation in weight for females while the percentage reaches 81% for males. Females weights are more variable than those of males of similar length. Maturity may be a factor.

4.2.2 Northern pike (*Esox lucius*)

Northern pike was easily captured with either set lines, gillnets or fishing rod especially at a depth of 20 m or less. It was present at all locations except GSL-5 which was sampled during the winter in deeper water. Rawson (1951) noted that the greatest concentration of pike was in the Islands area east of Outpost and along the shores of Yellowknife Bay, and that the majority of the pike he harvested were within 400 metres from shore and 10m from the surface. Falk et al. (1973) pointed out that northern pike appeared to exist in similar numbers throughout Yellowknife Bay. These observations are consistent with this study.

A total of one hundred and nine northern pike was harvested during this two year study. Tables 11 and 12 summarize by age group, the biological descriptors of northern pike caught with 89 and 114 mm stretched mesh gillnets, fishing rod and setlines (GSL 1 to 5) and with commercial sized gillnets (131 mm stretched mesh) (GSL 6), respectively.

The 109 northern pike ranged in fork length from 472 to 940 mm and weighed between 491 and 7210 g; larger fish were trapped in the larger mesh size (Table 12). The age of fish captured with the smaller mesh sizes ranged between 3 and 19 years; 48% of the specimens being between 6 and 8 years old. Northern pike from GSL-6 vary between 6 and 14 years; 73% being between 7 and 9 years old. The wider range of age (Table 11) may reflect the variety of fishing devices used for the capture of northern pike.

Females were present in a ratio of 1.37:1 (63 to 46). Spawners were not captured during this 2 year study. Maturity codes in relation to time of year suggest that spawning occurs between March and June; mature and spent females were captured between March 5 and 10 and between June 12 and 17 respectively. No ripe or spent males were harvested during the course of this study. Maturity indices give further information on the age at which maturity is reached. From the data collected we observe a female of three years had reached maturity; the male of the same age was not mature but four years old specimens were.

In central NWT lakes pike condition, expressed as mean K factor, ranges between 0.66-0.83 (Table 10) for fish caught with 89mm and 114mm stretch mesh gillnets. Hence, northern pike caught during the course of this study can be considered in very good condition (mean = 0.77). The weight-length relationships for northern pike are available from Table 11 and 12. These indicate strong relationships between weight and length in all cases.

Table 11 Biological descriptors by age group for northern pike caught in Yellowknife-Back Bay (GSL 1-5) in 1992 and 1993.

MALES

		Length			Weight			Kfactor		%
Age	N	Mean	SD	Range	Mean	SD	Range	Mean	Range	Mature
3	1	479	-	479	988	-	988	0.90	-	0
4	5	501	22	472-528	892	238	491-1065	0.70	.47-.84	100
5	5	517	50	473-603	1109	335	892-1695	0.79	.73-.86	80
6	3	544	16	531-562	1167	250	908-1407	0.72	.61-.79	100
7	5	576	37	529-615	1445	265	1175-1735	0.76	.50-.90	100
8	7	591	46	529-645	1565	285	1185-1967	0.76	.65-.81	100
9	6	630	43	583-710	1976	582	1301-3035	0.77	.66-.85	100
10	2	654	51	618-690	2108	319	1882-2333	0.75	.71-.80	100
11	3	679	58	635-745	2361	613	1903-3058	0.74	.74-.75	100
12	1	595		595	1592	-	1592	0.76	0.76	100
13	2	607	88	545-669	1658	634	1210-2106	0.73	.70-.75	100
14	1	618	-	618	1459	-	1459	0.62	0.61	100
15	0	-	-	-	-	-	-	-	-	-
19	1	784	-	784	4107	-	4107	0.85	0.85	100
TOTAL	42									
MEAN		585	74		1579	675		0.75		
MEAN AGE	8.0									

FEMALES

		Length			Weight			Kfactor		%
Age	N	Mean	SD	Range	Mean	SD	Range	Mean	Range	Mature
3	1	529	-	529	1079	-	1079	0.73	0.72	100
4	5	548	14	536-568	1293	134	1150-1471	0.78	.71-.86	100
5	3	568	67	520-645	1501	566	1155-2154	0.80	.76-.82	100
6	7	591	94	515-781	1367	369	909-2039	0.69	.33-.87	100
7	11	604	42	540-667	1624	451	993-2510	0.72	.61-.86	100
8	6	660	71	578-757	2240	901	1074-3339	0.74	.53-.85	100
9	1	636	-	636	2054	-	2054	0.80	0.80	100
10	1	656	-	656	2108	-	2108	0.75	0.75	100
11	2	729	80	672-785	2844	390	2568-3119	0.75	.64-.85	100
12	3	667	61	620-736	2463	884	1945-3484	0.81	.73-.87	100
13	0	-	-	-	-	-	-	-	-	-
14	0	-	-	-	-	-	-	-	-	-
15	1	875	-	875	4090	-	4090	0.61	0.61	100
19	0	-	-	-	-	-	-	-	-	-
TOTAL	41									
MEAN		618	83		1811	760		0.74		
MEAN AGE	7.2									

Table 11. Continued

COMBINED

Age	N	Length Mean	Length SD	Length Range	Weight Mean	Weight SD	Weight Range	Kfactor Mean	Kfactor Range	% Mature
3	2	504	35	479-529	1034	64	988-1079	0.81	.73-.90	50
4	10	525	31	472-568	1092	279	491-1471	0.74	.47-.86	100
5	8	536	58	473-645	1256	444	892-2154	0.79	.73-.86	75
6	10	577	80	515-781	1307	338	908-2039	0.70	.33-.87	100
7	16	595	41	529-667	1568	402	993-2510	0.74	.50-.90	100
8	13	623	67	529-757	1877	708	1074-3339	0.75	.53-.85	100
9	7	631	39	583-710	1986	532	1301-3035	0.78	.66-.85	100
10	3	655	36	618-690	2108	226	1882-2333	0.75	.71-.80	100
11	5	699	63	635-785	2554	544	1903-3119	0.74	.64-.85	100
12	4	649	61	595-736	2245	843	1592-3484	0.79	.73-.87	100
13	2	607	88	545-669	1658	634	1210-2106	0.73	.70-.75	100
14	1	618	-	618	1459	-	1459	0.62	0.62	100
15	1	875	-	875	4090	-	4090	0.61	0.61	100
19	1	784	-	784	4107	-	4107	0.85	0.85	100
TOTAL	83									
MEAN		601	80		1693	724		0.75		
MEAN AGE	7.6									

Maturity codes

Age	Female				Male					
3		3					6			
4	2	3	3-4					7	7-8	
5	2-3	3			6	6-7		7	7-8	
6	2	3		5-2				7		
7	2	3	3-4	5-1				7		
8	2	3		5-1				7	7-8	
9		3						7	7-8	8
10	2							7	7-8	
11	2-3	3						7		8
12	2	3						7		
13								7		
14								7		
15				5						
19										8

Bolded =most prevalent value

Weight-Length Relationships

Males: log 10 (W) =-5.19 +3.02 log 10 (L) R-squared =0.88 $p<0.001$, n=42

Females: log 10 (W) =-4.21 +2.67 log 10 (L) R-squared =0.79 $p<0.001$, n=41

Combined: log 10 (W) =-4.66 +2.83 log 10 (L) R-squared =0.84 $p<0.001$, n=83

Table 12 Biological descriptors by age group for northern pike caught in Yellowknife Bay (GSL-6) in 1992.

MALES

Age	N	Length Mean	Length SD	Length Range	Weight Mean	Weight SD	Weight Range	Kfactor Mean	Kfactor Range	% Mature
6	1	597	-	597	2028	-	2028	0.95	0.95	100
7	1	649	-	649	2498	-	2498	0.91	0.91	100
8	1	690	-	690	2841	-	2841	0.86	0.86	100
9	0	-	-	-	-	-	-	-	-	-
10	0	-	-	-	-	-	-	-	-	-
11	0	-	-	-	-	-	-	-	-	-
12	1	626	-	626	1996	-	1996	0.81	0.81	100
14	0	-	-	-	-	-	-	-	-	-
TOTAL	4									
MEAN		640	39		2341	405		0.88		
MEAN AGE	8.3									

FEMALES

Age	N	Length Mean	Length SD	Length Range	Weight Mean	Weight SD	Weight Range	Kfactor Mean	Kfactor Range	% Mature
6	0	-	-	-	-	-	-	-	-	-
7	5	673	23	650-700	2492	248	2242-2905	0.82	.71-.90	100
8	5	642	32	592-667	2277	313	1746-2554	0.86	.79-.98	100
9	2	666	11	658-673	2534	211	2385-2683	0.86	.84-.88	100
10	5	676	44	635-751	2707	533	2200-3568	0.87	.79-.98	80
11	2	696	48	662-730	2790	302	2577-3004	0.83	.77-.88	100
12	2	742	64	696-787	3611	598	3188-4034	0.89	.83-.95	100
14	1	940	-	940	7210	-	7210	0.87	0.87	100
TOTAL	22									
MEAN		686	70		2839	1092		0.85		
MEAN AGE	9.2									

Table 12. Continued

		COMBINED								
		Length			Weight			Kfactor		%
Age	N	Mean	SD	Range	Mean	SD	Range	Mean	Range	Mature
6	1	597	-	597	2028	-	2028	0.95	0.95	100
7	6	669	23	649-700	2493	222	2242-2905	0.83	.71-.91	100
8	6	650	34	592-690	2371	362	1746-2841	0.86	.79-.98	100
9	2	666	11	658-673	2534	211	2385-2683	0.86	.84-.88	100
10	5	676	44	635-751	2707	533	2200-3568	0.87	.79-.98	80
11	2	696	48	662-730	2791	302	2577-3004	0.83	.77-.88	100
12	3	703	81	626-787	3072	1024	1996-4034	0.86	.81-.95	100
14	1	940	-	940	7210	-	7210	0.87	0.87	100
TOTAL	26									
MEAN		679	68		2762	1027		0.86		
MEAN AGE	9.1									

	Maturity codes			
Age	Female			Male
6				7
7		2	5-2	7
8		2	5-2	7
9		2	5-2	
10	1-2	2	5-2	
11		2		
12		2		7
14			5-2	

(5-2) Female spent and starting to mature

Weight-Length Relationship

Male: log 10 (W)=-3.90 +2.59 log 10(L) R-squared =0.79 p=0.0728, n=4

Female: log 10 (W) =-4.70 +2.87 log 10 (L) R-squared =0.91 p<0.001,n=22

Combined: log 10 (W) =-4.56 +2.82 log 10 (L) R-squared =0.91 P<0.001, n=26

4.2.3 Walleye (*Stizostedion vitreum*)

Walleye in Yellowknife Bay appear to be migratory rather than resident because the harvest data indicate that they spend most of the year in the main body of the lake and in spring they migrate into Yellowknife Bay to spawn (George Low, pers. comm.). One of the spawning grounds for walleye in the Yellowknife area may be the Yellowknife River. Walleye were caught at the end of August in both 1992 and 1993; no representative of this species was captured at any other time of year (Table 7). These observations suggest a migration of walleye in Yellowknife-Back Bay area during late summer-early fall, but the maturity information collected from the fish sampled (Table 13) does not permit any more inference on the existence of a relationship between this migration and spawning.

Other than one mature male caught at GSL-3 on August 31, 1993, the males were maturing while the females were either immature or maturing (Table 13). It is thus suggested that sampling periods to study Yellowknife Bay walleye should be spread between the beginning of August and the end of September.

The thirty walleye samples included 18 males, 11 females and 1 specimen for which sex could not be assessed. Walleye captured measured between 346 mm and 476 mm and weights ranged between 388 g and 1398 g (Table 13). As for size, the age interval of the walleye captured is narrow. Operculum readings revealed that specimens were between seven and fifteen years old; 50% of the fish being 9 or 10 years in age and 77% being between 8 and 12.

The condition factor for this species ranged between 0.52 and 1.33 with a mean of 1.19. One walleye had a K factor below one (sample #36: 0.52) which is rather unusual. A mean of 1.20 for walleye captured with similar gillnets in northern lakes normally signifies that the fish are robust.

Weight-length relationships for this species presented in Table 13 suggest more variability in weight for a given length in male than in females.

4.2.4 Longnose sucker (*Catostomus catostomus*)

Like lake whitefish, longnose suckers are a bottom feeding species. It may compete with the latter but because it appears to be out-numbered by the lake whitefish it may not be a serious competitor (Rawson, 1951). Lake whitefish could however exert a certain control over the longnose sucker population, but this has not been documented so far. Longnose suckers harvested by the domestic fishery are essentially used as dog food.

Longnose sucker was most often absent in the nets but when present they were relatively numerous which suggests that longnose suckers in Yellowknife-Back Bay move in groups. On June 11, 1993, (Appendix 19) sixteen longnose sucker at various stages of maturity were captured at site GSL-2. Most fish were maturing (index 2 and 7) but mature specimens and a ripe female were also present. This movement may be associated with spawning activity. Harris (1962a) notes that longnose suckers spawn during June in Hay River and mentions that movement is influenced by temperature changes. In Yellowknife Bay it is during the summer months that thermal changes occur; this might explain, at least in part, the abundance of suckers in the summer sets. Measurements were obtained from 30 specimens caught at GSL-1 to -4 but most suckers were caught at GSL-2 (Table 6). Fifteen females, twelve males and three fish of unidentified sex composed the catch (Table 14). Lengths ranged from 348 to 493 mm (mean 401mm) while weights varied between 609 to 1510 g (mean 914 g). The majority (79%) of the suckers captured were between 7 and 12 years of age. Harris (1962a) who documented the growth and reproduction of the longnose sucker of Great Slave Lake, reported that the first spawning run is made at age 9 and fish less than 7 were immature. The mature specimens captured were 10 and 11 years old.

The condition of longnose sucker caught in various lakes of central NWT (Table 10) with gillnets of 89 and 114mm mesh range in mean between 1.37 to 1.51. Mean K factor (1.40) for suckers of Yellowknife Bay lies at the lower end of this interval. The growth of longnose suckers in the Yellowknife-Back Bay study area shows a strong relationship between weight and length as described in Table 14.

4.2.5 Burbot (*Lota lota*)

The life history of burbot in Great Slave Lake has not yet been documented and whether more than one population is present in Yellowknife-Back Bay area is unknown. Rawson (1951) mentioned that the species was especially numerous in Yellowknife Bay and that it was outnumbered by its competitor, the lake trout. Since the commercial fishery started in 1945, the number of lake trout has significantly decreased (George Low, pers.comm.) and competition might not be as important.

Burbot from the southern portion of Great Slave Lake are known to migrate to the Slave River in late November and early December to spawn, while they possibly spend the rest of the year in the main body of the lake. Information on stocks and movement of burbot in Yellowknife Bay is not available.

Most burbot were harvested during the winter with a set line baited with whitefish. A few specimens were gillnetted during the summer (Table 7), suggesting that the species is present in the study area year round. GSL-1 to 4 were fished in March 1993, burbot were most easily captured in the Sub Islands area (GSL-3; N=26) and in Akaitcho Bay (GSL-4; N=31). This suggests that burbot is most abundant at these locations. GSL-2 was the worst area; despite the intensive fishing effort only one specimen was captured. GSL-5 was not fished with set lines and the gillnet sets failed to catch burbot.

The size of the 72 burbot (Table 15) caught at GSL-1 to -4 ranged from 360 to 765 mm in length, (mean= 587 mm) with weights from 308 to 2933 g (mean = 1401 g). The ages, as estimated from otoliths readings, vary between 3 and 27 years and 33% of the catch was 14 years. The burbot gillnetted with 133 mm mesh was 13 years old. Bond (1974) reported ages between 6 and 18 years for burbot caught with 138 mm stretched mesh gillnets in the Wool Bay area. The use of set lines selects a wide range of fish. The size of the bait may be a factor.

The condition factors ranged from 0.38 to 0.86 with a mean of 0.67. Limited data are available for burbot from northern lakes. The condition factor for burbot caught with similar gillnet sizes in Trout Lake (Table 10), a relatively unexploited walleye lake, varied between 0.59 and 1.03 (mean 0.80). Burbot from Yellowknife-Back Bay area are therefore less plump than those found in Trout Lake.

Females in post spawning condition composed the majority of the early March sample. Most males were spawners but a few had completed spawning. From these observations we can infer that the spawning period likely extends from February to the end of March.

Weight-length relationships for burbot harvested at GSL-1 to -4 are reported in Table 15.

4.2.6 Lake cisco (*Coregonus artedii*)

Lake cisco is a plankton eater and an important forage fish in Yellowknife Bay (Rawson, 1951). The migration of lake cisco towards Yellowknife river is observed during fall (Robert Luke, pers. comm.).

As Rawson observed in 1951, the smallest mesh sizes (<89mm) were most efficient to catch lake cisco. No cisco was captured with the 89 and 114mm stretched mesh gillnets. Lengths (Table 16) vary between 147 and 258 mm while weights ranged between 31 and 182 g. They appear in good condition based on comparison with condition factors available for ciscoes from lakes in the Yellowknife area (Table 10). Condition factors for Yellowknife Bay ranged from 0.84 to 1.16. Six females and seven males of four to eight years old composed the sample. Mature specimens were present but most fish caught were immature or maturing.

The weight-length relationships reported for this species on Table 16 are almost perfectly linear (r^2=0.98-0.99).

4.2.7 Lake trout (*Salvelinus namaycush*)

Lake trout populations in Yellowknife-Back Bay have been severely impacted by the commercial fishery. Lake trout are captured with commercial nets before they reach maturity and therefore stocks are not replenished (George Low, pers.comm.). During the course of the present study only two lake trout were collected. Data are presented in Appendix 22.

Table 13 Biological descriptors by age group for walleye caught in Yellowknife-Back Bay (GSL 1-3) in 1992 and 1993.

MALES

		Length			Weight			Kfactor		%
Age	N	Mean	SD	Range	Mean	SD	Range	Mean	Range	Mature
7	0	-	-	-	-	-	-	-	-	-
8	3	398	21	378-420	786	152	656-953	1.23	1.20-1.29	100
9	5	404	46	364-476	715	393	388-1398	1.05	.52-1.30	100
10	5	417	7	410-425	870	67	780-935	1.20	1.08-1.28	100
12	2	412	5	408-415	836	41	806-865	1.20	1.19-1.21	100
13	1	415	-	415	820	-	820	1.15	1.15	100
14	1	411	-	411	862	-	862	1.24	1.24	100
15	1	462	-	462	1159	-	1159	1.18	1.18	100
TOTAL	18									
MEAN		412	28		822	226		1.16		
MEAN AGE	10.3									

FEMALES

		Length			Weight			Kfactor		%
Age	N	Mean	SD	Range	Mean	SD	Range	Mean	Range	Mature
7	2	380	-	380-380	614	30	593-635	1.12	1.08-1.16	0
8	1	382	-	382	634	-	634	1.14	1.14	0
9	4	373	30	348-416	649	215	465-960	1.21	1.10-1.33	25
10	1	422	-	422	988	-	988	1.31	1.31	0
12	2	453	20	439-467	1153	45	1121-1185	1.24	1.16-1.33	100
13	1	459	-	459	1147	-	1147	1.19	1.19	100
14	0	-	-	-	-	-	-	-	-	-
15	0	-	-	-	-	-	-	-	-	-
TOTAL	11									
MEAN		402	41		809	271		1.20		
MEAN AGE	9.5									

Table 13. Continued

COMBINED

		Length			Weight			Kfactor		%
Age	N	Mean	SD	Range	Mean	SD	Range	Mean	Range	Mature
7	3	369	20	346-380	574	72	494-635	1.14	1.08-1.19	0 *
8	4	394	19	378-420	748	145	634-953	1.21	1.14-1.29	75
9	9	390	41	348-476	685	309	388-1398	1.12	.52-1.33	67
10	6	418	7	410-425	889	77	780-988	1.22	1.08-1.31	83
12	4	432	27	408-467	994	187	806-1185	1.22	1.16-1.32	100
13	2	437	31	415-459	983	231	820-1147	1.17	1.15-1.19	100
14	1	411	-	411	862	-	862	1.24	1.24	100
15	1	462	-	462	1159	-	1159	1.18	1.18	100
TOTAL	30									
MEAN		406	34		806	243		1.18		
MEAN AGE	9.9									

* Includes a maturity value of 0

	Maturity codes		Female		Male	
Age						
7	0	1				
8		1		7		8
9		1	2	7		
10		1		7	7-8	
12			2	7		
13			2	7		
14				7		
15				7		

Bold= most prevalent values

Weight-Length Relationships

Male: log 10 (W) =-3.68 + 2.51 log 10 (L) R-squared=0.34 p=0.0065, n=18

Females: log 10(W) =-5.99 +3.41 log 10 (L) R-squared=0.97 p<0.001, n=11

Combined: log 10(W) =-5.14 +3.07 log 10(L) R-squared=0.71 p<0.001,n=30

Table 14 Biological descriptors by age group for longnose sucker caught in Yellowknife-Back Bay (GSL 1-4) in 1992 and 1993.

MALES

		Length			Weight			Kfactor		%
Age	N	Mean	SD	Range	Mean	SD	Range	Mean	Range	Mature
5	0	-	-	-	-	-	-	-	-	-
6	1	358	-	358	660	-	660	1.44	1.44	100
7	1	364	-	364	786	-	786	1.63	1.63	100
8	2	408	24	391-425	984	226	824-1144	1.43	1.38-1.49	100
9	1	405	-	405	1034		1034	1.56	1.56	100
10	2	401	35	376-426	867	264	680-1054	1.32	1.28-1.36	50
11	3	398	26	368-415	884	122	750-987	1.41	1.28-1.50	100
12	2	423	47	390-456	933	88	871-995	1.26	1.05-1.47	50
13	0	-	-	-	-	-	-	-	-	-
15	0	-	-	-	-	-	-	-	-	-
TOTAL	12									
MEAN		399	30		892	155		1.41		
MEAN AGE	9.6									

FEMALES

		Length			Weight			Kfactor		%
Age	N	Mean	SD	Range	Mean	SD	Range	Mean	Range	Mature
5	2	348	-	348	618	4	615-621	1.47	1.46-1.47	0
6	0	-	-	-	-	-	-	-	-	-
7	3	404	22	386-429	1046	174	868-1215	1.57	1.51-1.67	33
8	0	-	-	-	-	-	-	-	-	-
9	2	418	32	395-440	1055	284	854-1255	1.43	1.39-1.47	100
10	1	372	-	372	667		667	1.30	1.30	100
11	2	420	12	411-428	1009	167	891-1126	1.36	1.28-1.44	100
12	2	447	49	412-482	1167	485	824-1510	1.26	1.18-1.35	100
13	1	414	-	414	1044	-	1044	1.47	1.47	0
15	1	493	-	493	1276	-	1276	1.06	1.06	100
TOTAL	14									
MEAN		411	43		987	270		1.40		
MEAN AGE	9.5									

Age not available for 1 female

Table 14. Continued

COMBINED

Age	N	Length Mean	Length SD	Length Range	Weight Mean	Weight SD	Weight Range	Kfactor Mean	Kfactor Range	% Mature
5	2	348	-	348	618	4	615-621	1.47	1.46-1.47	0
6	2	355	4	352-358	635	36	609-660	1.42	1.40-1.44	50
7	4	394	27	364-429	981	192	786-1215	1.59	1.51-1.67	50
8	2	408	24	391-425	984	226	824-1144	1.43	1.38-1.49	100
9	3	413	24	395-440	1048	201	854-1255	1.47	1.39-1.56	100
10	4	381	32	349-426	742	214	566-1054	1.32	1.28-1.36	50
11	6	405	21	368-428	914	133	750-1127	1.37	1.28-1.50	83
12	4	435	42	390-482	1050	315	824-1510	1.26	1.05-1.47	75
13	1	414	-	414	1044	-	1044	1.47	1.47	0
15	1	493	-	493	1276	-	1276	1.06	1.06	100
TOTAL	29									
MEAN		401	38		914	233		1.40		
MEAN AGE	9.5									

Fish without gender identified are included in this table.

Maturity codes

Age	N/A	Female				Male		
5			1					
6	N/A						7	
7			1	2			7	
8							7	
9				2			7	
10	N/A			2		6	7	
11	N/A			2			7	8
12				2	4	6	7	
13		1-2						
15					3			

Bold=most prevalent values

Weight-Length Relationship
Male: log 10 (W) =-2.42 +2.06 log 10 (L) R-squared =0.70 p=0.0004, n=12
Female: log 10 (W) =-3.80 +2.59 log 10 (L) R-squared =0.81 p<0.001, n=15
Combined: log 10 (W) =-3.78 +2.58 log 10 (L) R-squared =0.82 p<0.001 n=30

Table 15 Biological descriptors by age group for burbot caught in Yellowknife-Back Bay (GSL 1-4) in 1992 and 1993.

MALES

Age	N	Length Mean	Length SD	Length Range	Weight Mean	Weight SD	Weight Range	Kfactor Mean	Kfactor Range	% Mature
3	0	-	-	-	-	-	-	-	-	-
7	1	499	-	499	1006	-	1006	0.81	0.81	0
8	1	505	-	505	1045	-	1045	0.81	0.81	0
9	0	-	-	-	-	-	-	-	-	-
10	3	596	35	565-634	1256	317	980-1602	0.61	.38-.79	100
11	1	488	-	488	849	-	849	0.73	0.73	100
12	0	-	-	-	-	-	-	-	-	-
13	3	583.3	27.68	554-609	1384	333.93	1013-1661	0.69	.60-.73	100
14	4	585	39	527-608	1419	317	1008-1677	0.70	.62-.75	100
15	1	681	-	681	1932	-	1932	0.61	0.61	100
16	0	-	-	-	-	-	-	-	-	-
17	1	651	-	651	1492	-	1492	0.5408	0.54	100
18	1	658	-	658	2143	-	2143	0.7522	0.75	100
19	0	-	-	-	-	-	-	-	-	-
20	0	-	-	-	-	-	-	-	-	-
25	0	-	-	-	-	-	-	-	-	-
27	0	-	-	-	-	-	-	-	-	-
TOTAL	16									
MEAN		585	58		1379	384		0.68		
MEAN AGE	12.6									

FEMALES

Age	N	Length Mean	Length SD	Length Range	Weight Mean	Weight SD	Weight Range	Kfactor Mean	Kfactor Range	% Mature
3	0	-	-	-	-	-	-	-	-	-
7	3	463	81	384-545	727	375	418-1144	0.69	.64-.74	67
8	3	511	24	484-531	882	154	704-972	0.66	.62-.70	100
9	0	-	-	-	-	-	-	-	-	-
10	5	545	52	498-635	1237	466	872-2027	0.74	.65-.82	100
11	0	-	-	-	-	-	-	-	-	-
12	2	652	161	538-765	1962	1360	1000-2923	0.65	.64-.65	100
13	2	584	30	563-605	1322	338	1083-1561	0.66	.61-.70	100
14	19	619	41	553-712	1638	438	934-2697	0.68	.51-.84	100
15	4	625	23	604-657	1411	291	977-1597	0.58	.41-.70	100
16	3	574	13	565-589	1224	187	1012-1368	0.65	.56-.70	100
17	1	678	-	678	2217	-	2217	0.71	0.71	100
18	3	640	50	585-684	1950	450	1566-2446	0.74	.67-.78	100
19	1	590	-	590	1149	-	1149	0.56	0.56	100
20	1	655	-	655	1248	-	1248	0.44	0.44	100
25	1	706	-	706	1659	-	1659	0.47	0.47	100
27	1	597	-	597	1477	-	1477	0.69	0.69	100
TOTAL	49									
MEAN		597	69		1462	521		0.67		
MEAN AGE	13.9									

Table 15. Continued

			Combined								
			Length			Weight			Kfactor		%
Age	N	Mean	SD	Range	Mean	SD	Range	Mean	Range	Mature
3	1	360	-	360	308	-	308	0.66	0.66	n/a*
7	5	459	66	384-545	722	335	418-1144	0.70	.63-.81	40*
8	4	509	20	484-531	923	150	704-1045	0.70	.62-.81	75.00
9	1	526	-	526	884	-	884	0.61	0.61	n/a*
10	8	564	51	498-635	1244	391	872-2027	0.69	.38-.82	100.00
11	1	488	-	488	849	-	849	0.73	0.73	100.00
12	2	652	161	538-765	1962	1360	1000-2923	0.65	.64-.65	100.00
13	5	584	25	554-609	1359	292	1013-1661	0.67	.59-.73	100.00
14	23	613	42	527-712	1600	422	934-2697	0.68	.51-.84	100.00
15	5	636	32	604-681	1515	343	977-1932	0.59	.41-.70	100.00
16	3	574	13	565-589	1224	187	1012-1368	0.65	.56-.70	100.00
17	2	665	19	651-678	1855	513	1492-2217	0.63	.54-.71	100.00
18	4	644	42	585-684	1999	380	1566-2446	0.74	.67-.78	100.00
19	1	590	-	590	1149	-	1149	0.56	0.56	100.00
20	1	655	-	655	1248	-	1248	0.44	0.44	100.00
25	1	706	-	706	1659	-	1659	0.47	0.47	100.00
27	1	597	-	597	1477	-	1477	0.69	0.69	100.00
TOTAL	68									
MEAN		587	74		1401	516		0.67		
MEAN AGE	13.3									

* Two maturity codes are 0, one is unavailable.

Maturity codes

Age	Female							Male				
7	1		2			5			6			
8		1-2				5	5-2		6			
9												
10		1-2			4	5					9	10
11												10
12						5						
13						5		6-7		7		10
14			2		3	5				7	9	
15			2			5					9	
16						5						
17						5					9	
18						5						10
19				3-4								
20						5						
25						5						
27						5						

Bold=most prevalent value

Weight-Length Relationships
Male: log 10 (W) =-2.91 + 2.18 log 10 (L) R-squared +0.60 p=0.0003,n=16
Female: log 10 (W) =-4.71 +2.83 log 10 (L) R-squared =0.83 p<0.001, n=49
Combined: log 10 (W) =-4.68 +2.82 log 10 (L) R-squared =0.85 p<0.001, n=68

Table 16 Biological descriptors by age group for lake cisco caught in Yellowknife Bay (GSL-1) in 1992.

MALES

Age	N	Length Mean	Length SD	Length Range	Weight Mean	Weight SD	Weight Range	Kfactor Mean	Kfactor Range	% Mature
4	1	150	-	150	32	-	32	0.95	0.95	0
5	1	176	-	176	46	-	46	0.84	0.84	100
6	1	182	-	182	62	-	62	1.03	1.03	0
7	3	197	45	147-235	93	58	31-146	1.08	.97-1.14	33
8	1	258	-	258	182	-	182	1.06	1.06	0
TOTAL	7									
MEAN		194	42		86	59		1.02		
MEAN AGE	6.3									

FEMALES

Age	N	Length Mean	Length SD	Length Range	Weight Mean	Weight SD	Weight Range	Kfactor Mean	Kfactor Range	% Mature
4	0	-	-	-	-	-	-	-	-	-
5	2	200	52	163-237	98	79	42-154	1.06	.97-1.16	50
6	2	162	3	160-164	41	4	38-43	0.95	.93-.97	100
7	1	161	-	161	37	-	37	0.89	0.89	100
8	1	154	-	154	37	-	37	1.01	1.01	100
TOTAL	6									
MEAN		173	31		59	47		0.99		
MEAN AGE	6.2									

COMBINED

Age	N	Length Mean	Length SD	Length Range	Weight Mean	Weight SD	Weight Range	Kfactor Mean	Kfactor Range	% Mature
4	1	150	-	150	32	-	32	0.95	0.94	0
5	3	192	40	163-237	81	64	42-154	0.99	.84-1.16	67
6	3	169	12	160-182	48	13	38-62	0.98	.93-1.02	67
7	4	188	41	147-235	79	55	31-146	1.03	.89-1.14	50
8	2	206	74	154-258	110	103	37-182	1.04	1.01-1.06	50
TOTAL	13									
MEAN		184	38		73	54		1.00		
MEAN AGE	6.2									

Maturity codes

Age	Female	Male
4		6-7
5	1 5-3	7
6	2 4	6-7
7	3	6 7
8	3-4	6

Bold=most prevalent value

Weight-Length Relationships

Males: log 10(W) =-5.70 +3.31 Log 10(L) R-squared=.98 p<0.001, n=7
Females: log 10(W) =-6.06 + 3.47 Log 10 (L) R-squared=.99 p<0.001, n=6
Combined: log 10 (W) =-5.80 + 3.35 log 10(L) R-squared=.99 p<0.001, n=13

4.2.8 Summary of Biological Evaluation

The various species of fish inhabiting Yellowknife-Back Bay area appear in good condition relative to other fish from various lakes in the Northwest Territories. The information on their biology and ecology is however very limited. Various studies would be required to assess the long term effects of metal contaminated effluents discharged into Yellowknife Bay. The following should be studied:

- Identity of the various fish stocks.
- Migratory patterns of the various stocks.
- Update on the diet of the various species.
- Metal concentrations in the food items of the main fish species.

4.3 STATISTICAL EVALUATION OF CONTAMINANT CONCENTRATIONS IN FISH

4.3.1 Selection of Reference Site

GSL-4 was used as the reference site for comparison of contaminants in fish in the bay as it was the least contaminated site in the study area. This is confirmed by the following table of sediment results that shows arsenic concentrations are 269 times higher and Cu, Hg, and Pb results are 23 to 30 times higher between GSL-4 and other sediment sites near points of effluent discharge.

	CONTAMINANT CONCENTRATIONS IN SEDIMENTS		
Contaminant:	Mouth of Baker Creek (Sed. Site 2) near GSL-5	Peg Lake Outlet (Sed. Site 10) near GSL-3	Dettah Dock (Sed. Site 11) near GSL-4
As (μg/gm dry weight.)	1856 ± 644*	195 ± 114	6.9 ± 2.4
Cu " "	423 ± 142	47 ± 13	16.2 ± 3.0
Hg " "	0.12 ± 0.02	0.022 ± 0.005	0.004 ± 0.002
Ni " "	60.4 ± 6.5	51.0 ± 11.3	18.2 ± 5.1
Pb " "	102 ± 19	8.2 ± 2.0	4.4 ± 1.0
Zn " "	301 ± 46	88 ± 20	31 ± 12

(* = data are expressed as mean ± S.D.)

Site GSL-4, however, could not be used for walleyes and longnose suckers because no walleye and only one longnose sucker was captured at that site (Table 6). For walleyes, comparisons were made (Figures 70 to 78, inclusive) between sites GSL-1 (n = 22) and GSL-2 (n = 7). For longnose suckers, no meaningful comparisons could be made between sites, because most (83%) of the 30 fish were collected from only one site (GSL-2).

4.3.2 Elevated ($p \leq 0.05$) Contaminant Concentrations in Burbot, Lake Whitefish and Northern Pike:

Fish data were analysed to determine whether contamination was associated with proximity to points of effluent discharge. As a first step, statistical significance was set at the conventional $p \leq 0.05$. As noted below, the majority (60%, 18 of 30) of high contaminant concentrations were in fish collected close to the effluent discharge points, GSL-5 (near Baker Creek outlet) and GSL-3 (near Peg Outlet). A further 37% of the fish with elevated concentrations were collected from GSL-1 (opposite shore of Giant mine). This is not surprising because fish collected at that site would have spent time in contaminated parts of the Bay before arriving at GSL-1 and because this site is near an old tailings release area (Sediment Site 12).

Contaminants were elevated ($p \leq 0.05$) over those observed in fish from GSL-4 in the following situations:

1. Arsenic was elevated in:
    a. muscle of lake whitefish from GSL-3 (Fig.48)
    b. liver of lake whitefish from GSL-1, GSL-2, and GSL-5 (Fig.49)
    c. kidney of lake whitefish from GSL-5 (Fig.50)
    d. muscle of northern pike from GSL-3 and GSL-5 (Fig.51)
    e. liver and kidney of northern pike from GSL-1 and GSL-5 (Fig.52 and Fig.53)

2. Cadmium was elevated in:
    a. muscle and kidney of lake whitefish from GSL-5 (Figs. 54 and 55).
    b. liver of northern pike from GSL-1 and GSL-3 (Fig. 56).

3. Copper was elevated in:
    a. liver of lake whitefish from GSL-1, GSL-3 and GSL-5 (Fig. 57)
    b. liver of northern pike from GSL-1 and GSL-3 (Fig. 58)

4. Mercury was elevated in:
    a. Muscle of lake whitefish from GSL-5 (Fig. 59)
    b. muscle of northern pike from GSL-3 (Fig. 60)
    c. liver of northern pike from GSL-1 and GSL-3 (Fig. 61)

5. Nickel was elevated in muscle of lake whitefish from GSL-1 (Fig. 62)

6. Selenium was elevated in:
    a. muscle of lake whitefish from GSL-3 (Fig. 63)
    b. liver of lake whitefish from GSL-5 (Fig. 64)
    c. kidney of lake whitefish from GSL-1 (Fig. 65)
    d. liver of northern pike from GSL-1 and GSL-3 (Fig. 66)

7. Zinc was elevated in:
    a. liver of lake whitefish from GSL-1 (Fig. 67)
    b. kidney of lake whitefish from GSL-5 (Fig. 68)
    c. liver of northern pike from GSL-1 and GSL-3 (Fig. 69)

The lead concentrations in all muscle samples were below the detection limit of 0.03 $\mu g/g$.

Concentrations of contaminants in muscle from burbot were below those found in fish captured at GSL-4. Contaminant concentrations in liver and kidney from burbot were similar to those found in burbot captured at GSL-4. Although these patterns demonstrate some elevated contaminant concentrations in muscle from fish collected near points of effluent discharge, the concentrations appear well below limits established for consumption by humans. This has yet to be confirmed by Health Canada (HC) in Ottawa.

4.3.3 Contaminant concentrations in Walleye:

Significant differences ($p \leq 0.05$) in As, Hg, and Se concentrations in muscle from walleyes captured at sites GSL-1 and GSL-2 were also observed (Figures 70-78). As with the other fish species, contaminant concentrations appeared well below limits for consumption by humans (to be confirmed by HC). Significant differences were observed between sites GSL-1 and GSL-2 in Cd and Cu concentrations in walleye liver and in As, Cd, Hg and Se in kidneys. In all cases, lead concentrations in liver and kidney were below the detection limit of 0.05 μg/g.

4.3.4 Analysis of data normalized for age and sex for Lake Whitefish and Northern Pike:

Some contaminants, e.g. Cd and Hg, can remain in fish tissues for long periods of time, increase in concentration with age and vary with sex. Consequently, additional statistical analyses were conducted on the data for lake whitefish and northern pike to evaluate the influence of fish age and sex on accumulation of contaminants. Fish data used were from sites GSL-1, GSL-3, and GSL-5. All data were age-normalized and separated by sex. This resulted in a loss of statistical confidence but results were still obtained.

With the significance level at $p \leq 0.05$, 58% of 26 occurrences of elevated contaminant concentrations were from fish at GSL-3 and GSL-5. The remaining 42% were from GSL-1. Again, these last fish may have been in contaminated parts of the Bay before arriving at GSL-1. To identify the most serious cases a significance level of $p \leq 0.005$ was used and the analysis was repeated. 54% of 13 occurrences of elevated contaminant concentrations were from fish at GSL-5, 38% from GSL-1 and 8% from GSL-3. Elevated concentrations of arsenic represented 54% of the observations.

The following presents the information on elevated contaminant concentrations after the data were age-normalized and split into sex. All cases mentioned were significant at $p \leq 0.05$ and those marked with a star (★) were also significant at $p \leq 0.005$.

1. Arsenic was elevated in:
    - a. muscle of male lake whitefish from GSL-3
    - ★b. liver of female and male lake whitefish from GSL-5
    - c. kidney of male lake whitefish from GSL-1
    - ★d. muscle of female northern pike from GSL-5
    - ★e. liver of female and male northern pike from GSL-5
    - ★f. liver of female northern pike from GSL-1
    - ★g. kidney of female northern pike from GSL-5

h. kidney of male northern pike from GSL-5
i. kidney of female northern pike from GSL-1

2. Cadmium was elevated in:
   a. muscle of female lake whitefish from GSL-3
   b. liver of female and male northern pike from GSL-1

3. Copper was elevated in:
   ★a. liver of male lake whitefish from GSL-1
   b. liver of male lake whitefish from GSL-3
   c. muscle of female northern pike from GSL-5
   ★d. liver of female northern pike from GSL-1
   e. liver of male northern pike from GSL-1
   ★f. liver of male northern pike from GSL-3
   g. kidney of female northern pike from GSL-1 and GSL-5

4. Mercury was elevated in:
   ★a. muscle of female lake whitefish from GSL-5
   b. liver of female northern pike from GSL-1
   ★c. liver of male northern pike from GSL-1
   d. liver of male northern pike from GSL-3

5. Nickel was elevated in:
   ★a. muscle of female lake whitefish from GSL-1
   b. muscle of male lake whitefish from GSL-1
   c. muscle of female northern pike from GSL-5

6. Selenium was elevated in:
   a. muscle of female lake whitefish from GSL-3
   b. kidney of male lake whitefish from GSL-1

7. Zinc was elevated in:
   a. liver of female northern pike from GSL-1
   b. kidney of female northern pike from GSL-5

4.3.5 Relevance to limits for consumption by humans

While three (23%) of 13 most serious contaminant occurrences ($p \leq 0.005$) were made in fish muscle, concentrations of arsenic and mercury were below limits for human consumption. For example, the mean (± standard error of the mean, S.E.M.) arsenic concentration in muscle of female northern pike collected at site GSL-5 was 0.385 (± 0.185) μg As/g (wet weight). This is well below the limit of 5.0 μg As/g that was set in the Food and Drug Regulations of 1975 (personal communication, John Salminen, Health and Welfare Canada, Ottawa, Ontario). The mean (± S.E.M.) mercury concentration in muscle of female lake whitefish collected at GSL-5 was 0.09 (± 0.01) μg Hg/g (wet weight) which is well below the consumption limit of 0.5 μg Hg/g. The mean (± S.E.M.) nickel concentration in muscle of female lake whitefish collected at site GSL-5 was 0.019 (± 0.004) μg Ni/g (wet weight) is below the consumption limit, when put in perspective, consider the average daily intake of 0.16 to 0.50 mg/day consumed by a 70-kg reference man on a typical western diet (Moore, 1991). NOTE: All comments in this section are tentative. A complete health assessment by HC is in progress.

4.3.6 Relevance to fish health:

Nine (69%) of the above 13 observations ($p \leq 0.005$) were observed on elevated contaminant concentrations in liver and one (8%) was in kidney. Actual concentrations, expressed as mean ± S.E.M., (wet weight) in liver are as follows:

Arsenic:

Site:	Species:	Sex:	$[As]_{Liver}$ (μg/g):
GSL-5	Lake Whitefish	female	0.68 ± 0.06
GSL-5	Lake Whitefish	male	0.54 ± 0.06
GSL-5	Northern Pike	female	0.83 ± 0.25
GSL-5	Northern Pike	male	0.61 ± 0.03
GSL-1	Northern Pike	female	0.39 ± 0.08

Copper:

Site:	Species:	Sex:	$[Cu]_{Liver}$ (μg/g):
GSL-1	Lake Whitefish	male	13.9 ± 2.0
GSL-1	Northern Pike	female	10.1 ± 2.6
GSL-3	Northern Pike	male	4.86 ± 0.88

Mercury:

Site:	Species:	Sex:	$[Hg]_{Liver}$ (μg/g):
GSL-1	Northern Pike	male	0.134 ± 0.014

The significant ($p \leq 0.005$) observation in kidney was as follows:

Arsenic:

Site:	Species:	Sex:	$[As]_{Kidney}$ (μg/g):
GSL-5	Northern Pike	female	0.50 ± 0.30

A review of scientific literature did not provide any reports linking concentrations of arsenic, copper and mercury in liver, and concentrations of arsenic in kidney to adverse effects on the health of lake whitefish and northern pike. Consequently, conclusions on the relevance of these concentrations to fish health cannot be made directly.

health of lake whitefish and northern pike. Consequently, conclusions on the relevance of these concentrations to fish health cannot be made directly.

Accumulation of arsenic in other fish species has been documented (Moore, 1991; Sorensen, 1991). These studies, however, generally measure whole-body arsenic concentrations in small, juvenile fish from laboratory exposures for short periods of time to high arsenic concentrations in water. In the natural environment, such as Yellowknife-Back Bay, accumulation likely occurs through the dietary intake over long periods of time. Bottom-feeding fish in association with arsenic-contaminated sediments have substantially higher concentrations of arsenic than pelagic-feeding fish collected from the same general area (Kennedy, 1976).

Arsenic-exposed fish accumulate the contaminant in their livers and kidneys and exhibit signs of sub-lethal toxicity. Considerable damage at the cellular level with probable adverse effects on liver function has been documented. For example, fish livers exposed to arsenic, have exhibited a number of abnormalities (Gilderhus, 1966; Sorensen et al., 1980 and 1985; Sorensen, 1991, Sorensen and Smith, 1981; Sorensen et al., 1982; Mitchell and Sorensen, 1987).

These bio-indicators could provide very useful and relevant benchmarks for evaluating potential adverse effects of arsenic in lake whitefish and northern pike from Yellowknife Bay. Kidneys from these fish could also be evaluated for the presence of various abnormalities which have been observed in As-exposed organisms (Klaassen, 1985). These histopathological analyses of liver and kidney may demonstrate that these organs are healthy and that the elevated concentrations of arsenic are without adverse effects.

To assess whether the elevated copper and mercury concentrations in the livers of lake whitefish and northern pike collected from GSL-1 and GSL-3 are having any effects on these fish, measurements should be made of the metal-binding protein, metallothionein. It is well documented that concentrations of this protein increase in fish exposed to copper and mercury (Klaverkamp et. al., 1984; Hamilton and Mehrle, 1986; Klaverkamp and Duncan, 1987; Roesijadi, 1992) as an acclimation to metal toxicity response. A lack of metallothionein response would provide evidence that the elevated concentrations of copper and mercury are below thresholds for effects.

Figure 48. Arsenic in lake whitefish muscle, Yellowknife Bay 1992-93.

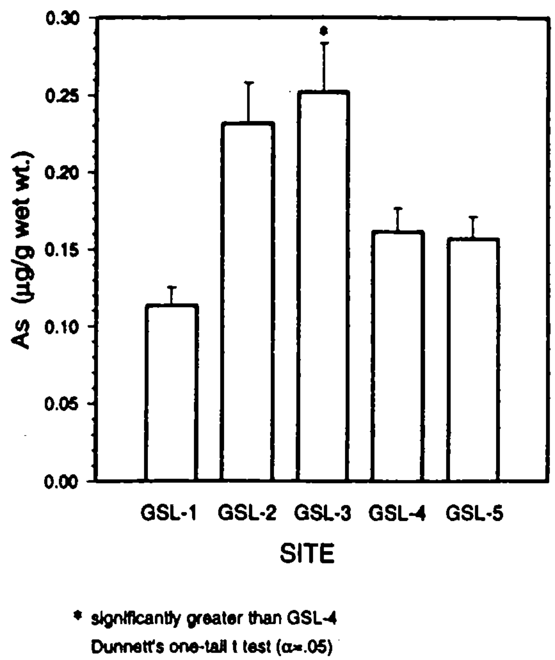


Figure 49. Arsenic in lake whitefish liver, Yellowknife Bay 1992-93.

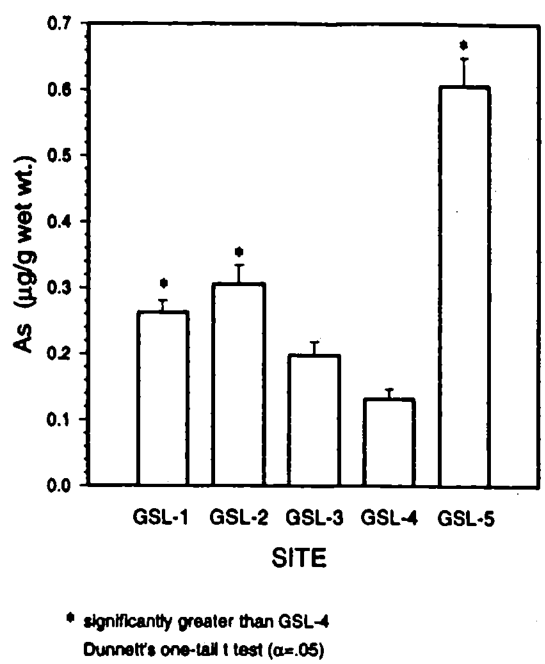


Figure 50. Arsenic in lake whitefish kidney, Yellowknife Bay 1992-93.

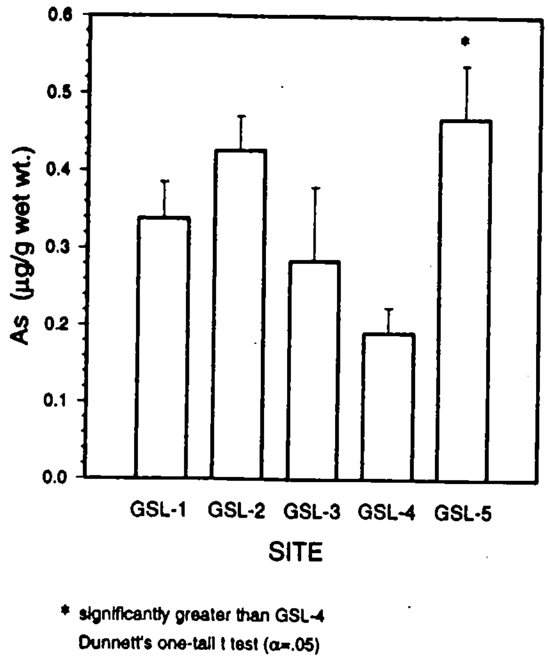


Figure 51. Arsenic in northern pike muscle, Yellowknife Bay 1992-93.

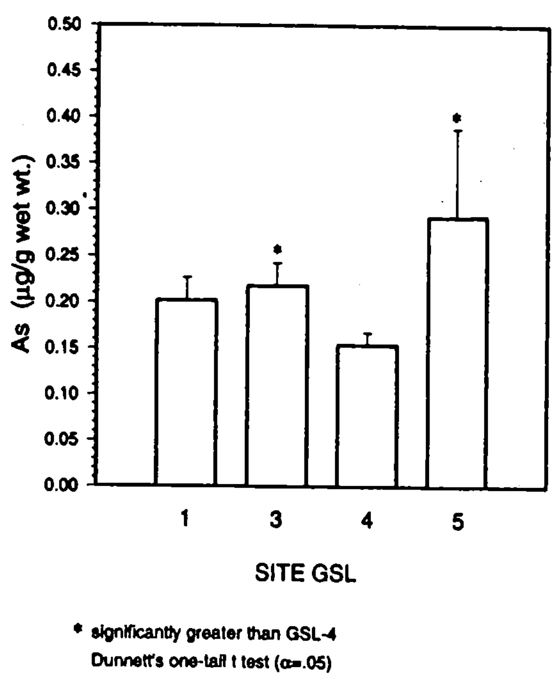


Figure 52. Arsenic in northern pike liver, Yellowknife Bay 1992-93.

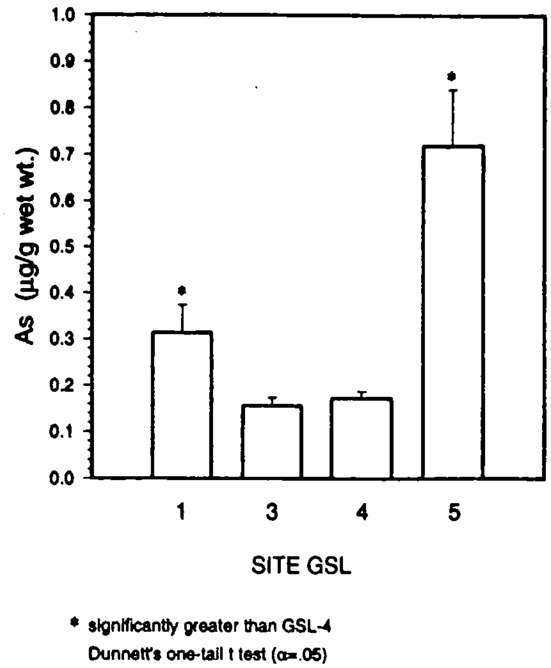


Figure 53. Arsenic in northern pike kidney, Yellowknife Bay 1992-93.

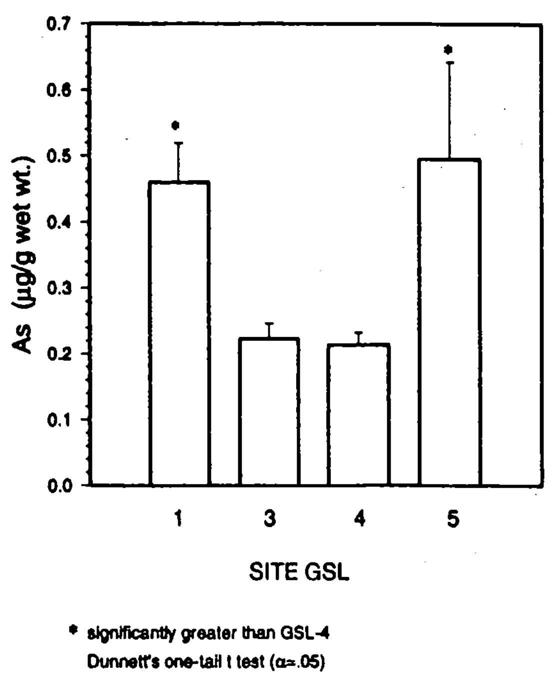
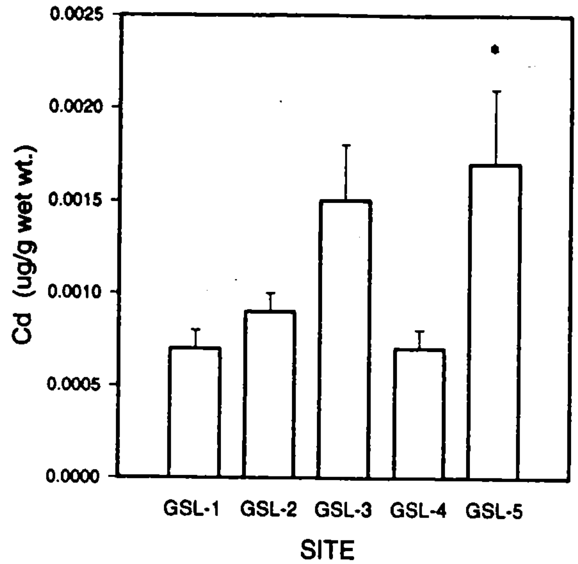
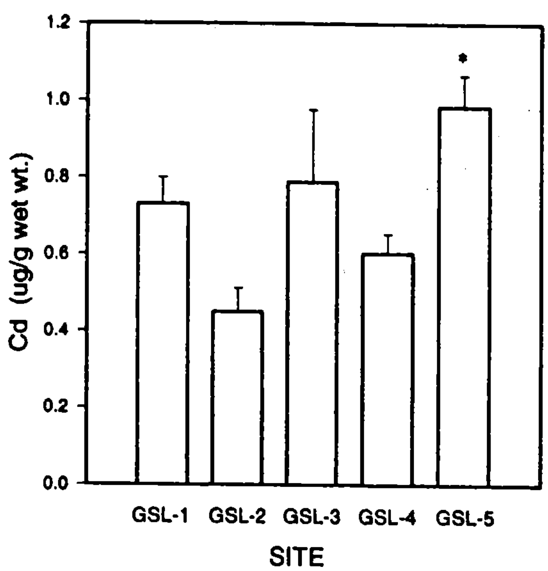


Figure 54. Cadmium in lake whitefish muscle, Yellowknife Bay 1992-93.



* significantly greater than GSL-4
Dunnett's one-tail t test (α=.05)

Figure 55. Cadmium in lake whitefish kidney, Yellowknife Bay 1992-93.



* significantly greater than GSL-4
Dunnett's one-tail t test (α=.05)

Figure 56. Cadmium in northern pike liver, Yellowknife Bay 1992-93.

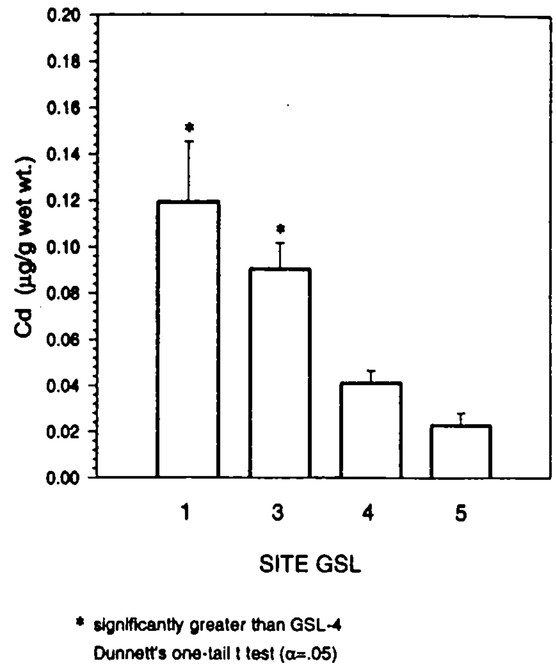


Figure 57. Copper in lake whitefish liver, Yellowknife Bay 1992-93.

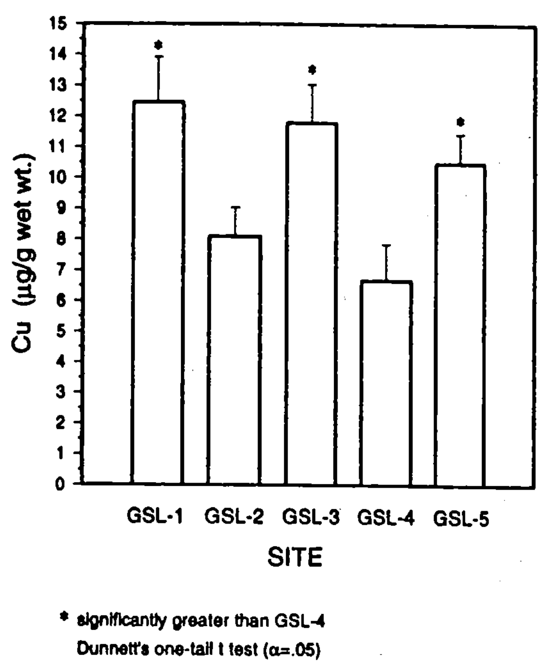
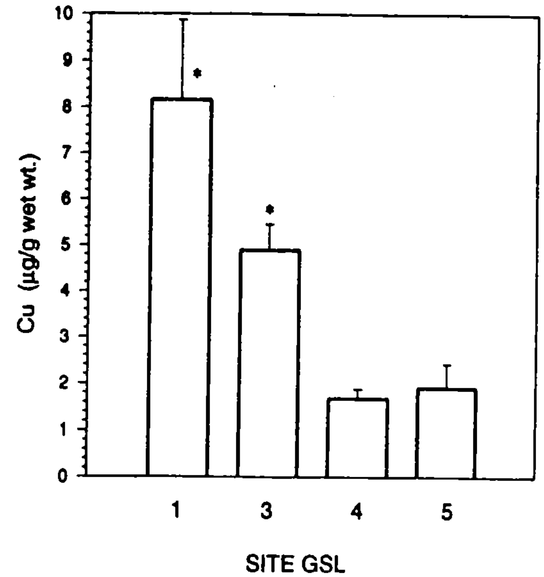
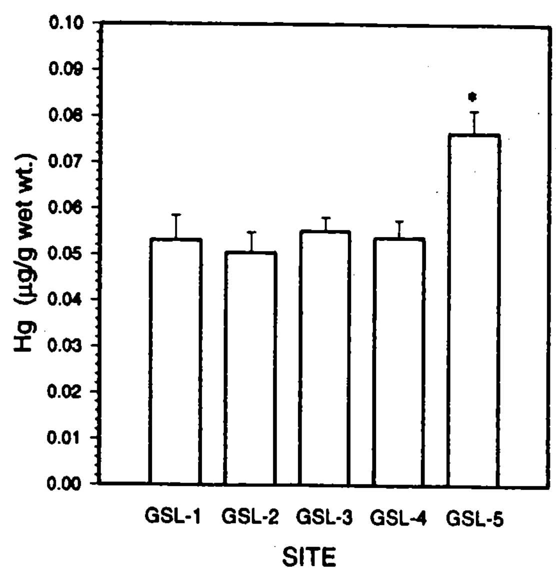


Figure 58. Copper in northern pike liver, Yellowknife Bay 1992-93.



* significantly greater than GSL-4
Dunnett's one-tail t test (α=.05)

Figure 59. Mercury in lake whitefish muscle, Yellowknife Bay 1992-93.



* significantly greater than GSL-4
Dunnett's one-tail t test (α=.05)

Figure 60. Mercury in northern pike muscle, Yellowknife Bay 1992-93.

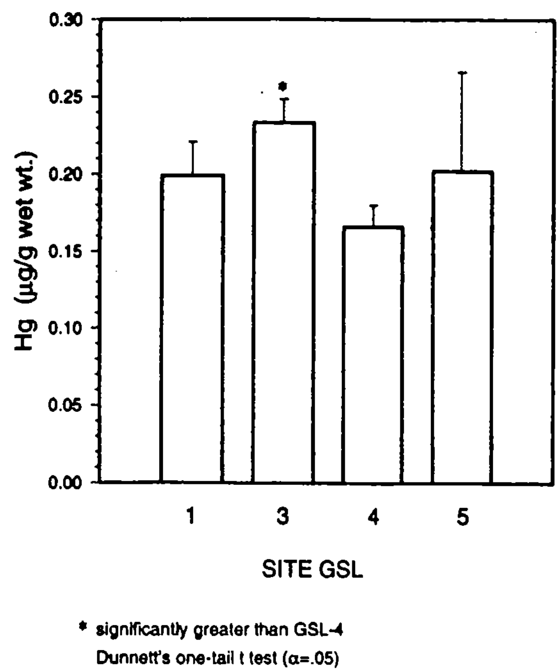


Figure 61. Mercury in northern pike liver, Yellowknife Bay 1992-93.

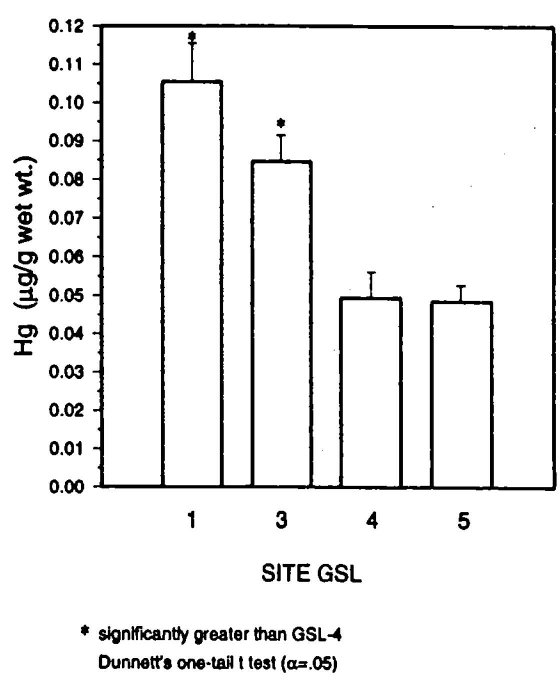
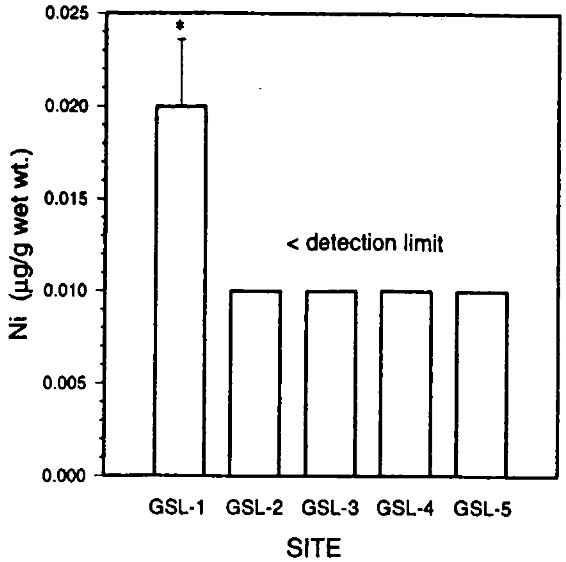
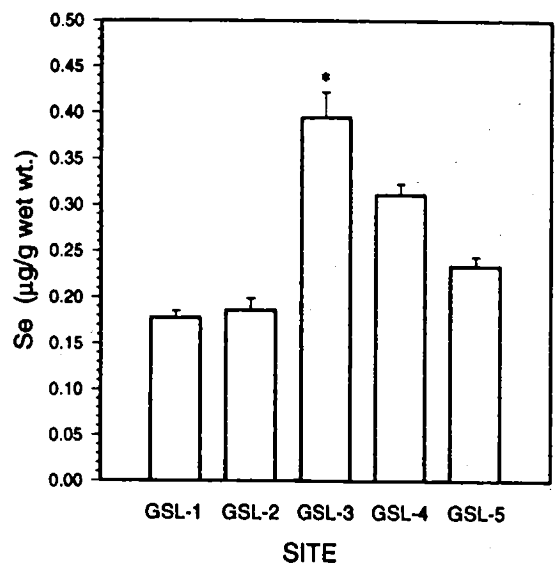


Figure 62. Nickel in lake whitefish muscle, Yellowknife Bay 1992-93.



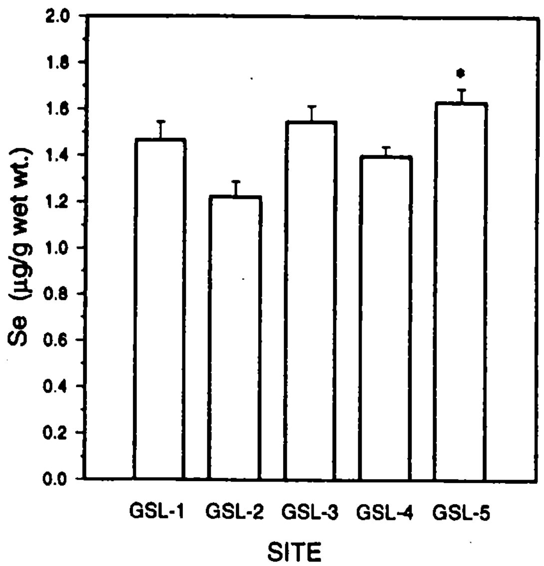
* significantly greater than GSL-4
Dunnett's one-tail t test (α=.05)

Figure 63. Selenium in lake whitefish muscle, Yellowknife Bay 1992-93.



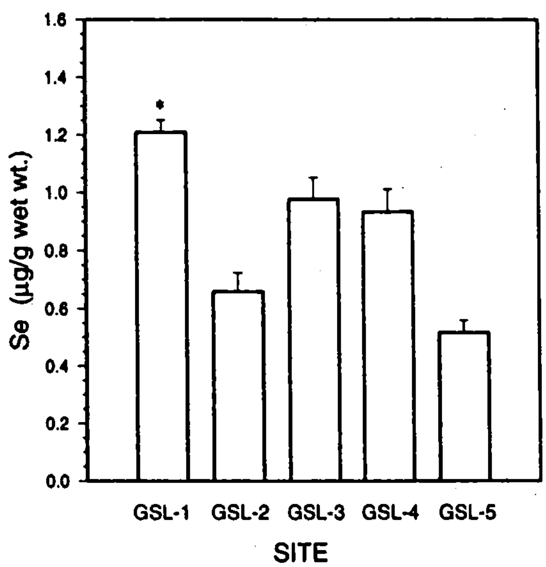
* significantly greater than GSL-4
Dunnett's one-tail t test (α=.05)

Figure 64. Selenium in lake whitefish liver, Yellowknife Bay 1992-93.



* significantly greater than GSL-4
Dunnett's one-tail t test (α=.05)

Figure 65. Selenium in lake whitefish kidney, Yellowknife Bay 1992-93.



* significantly greater than GSL-4
Dunnett's one-tail t test (α=.05)

Figure 66. Selenium in northern pike liver, Yellowknife Bay 1992-93.

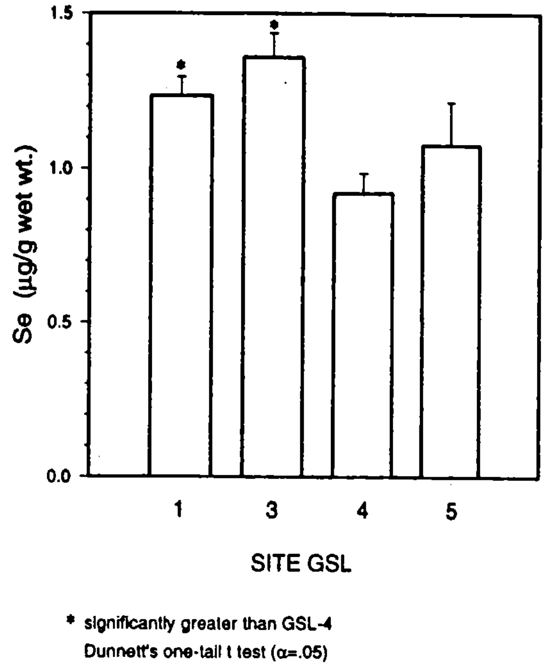


Figure 67. Zinc in lake whitefish liver, Yellowknife Bay 1992-93.

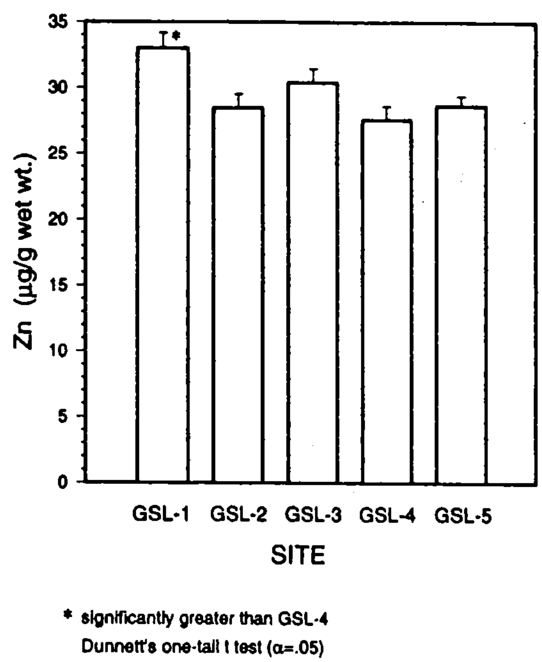


Figure 68. Zinc in lake whitefish kidney, Yellowknife Bay 1992-93.

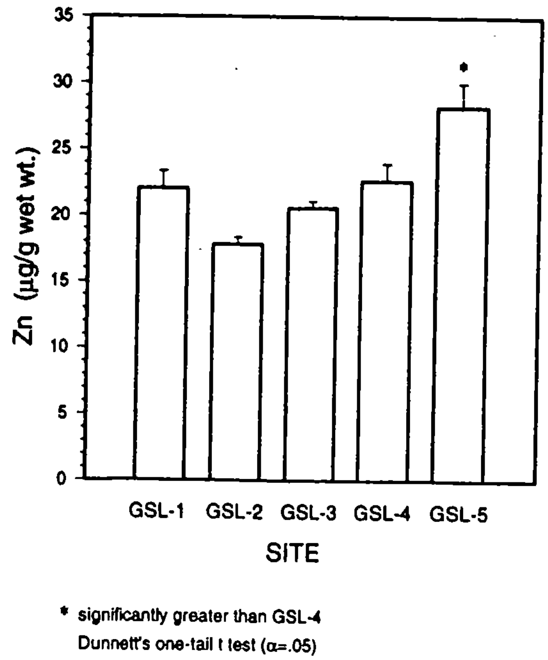


Figure 69. Zinc in northern pike liver, Yellowknife Bay 1992-93.

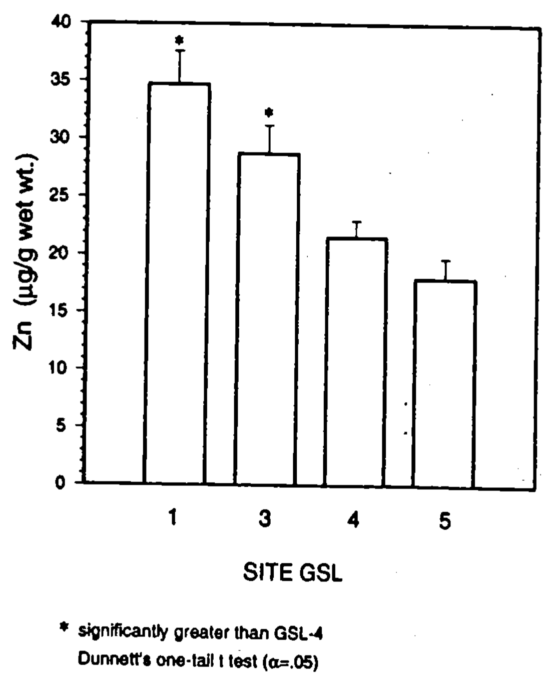
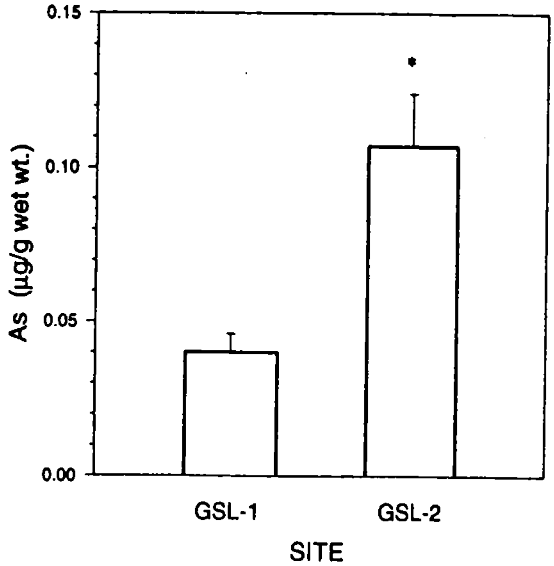
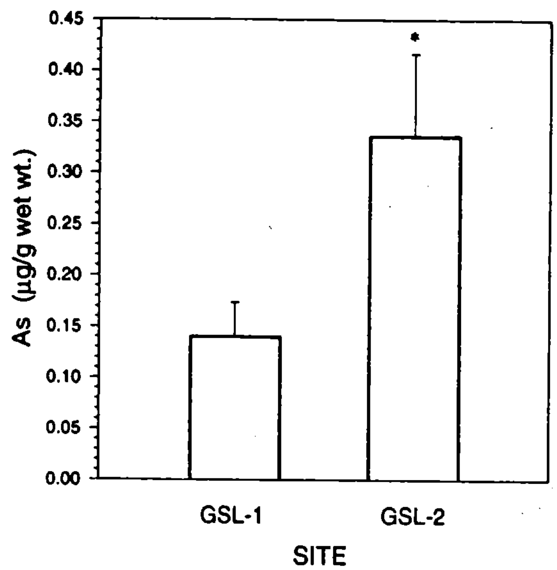


Figure 70. Arsenic in walleye muscle, Yellowknife Bay 1992-93.



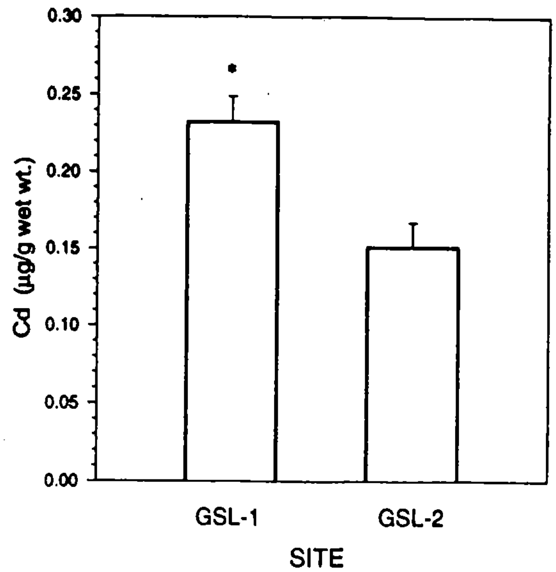
* means significantly different at α=0.05

Figure 71. Arsenic in walleye kidney, Yellowknife Bay 1992-93.



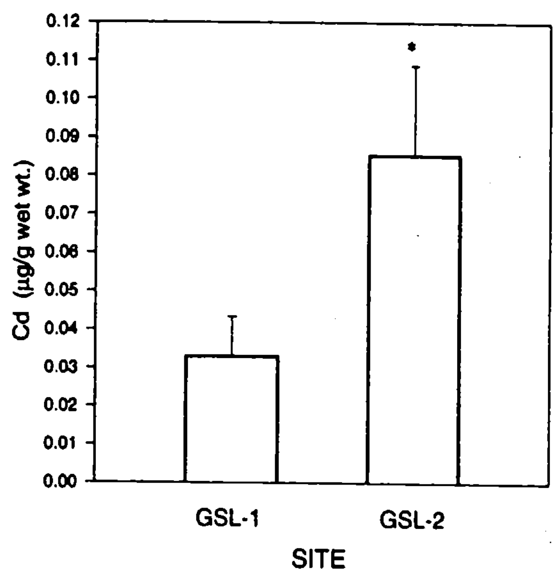
* means significantly different at α=0.05

Figure 72. Cadmium in walleye liver, Yellowknife Bay 1992-93.



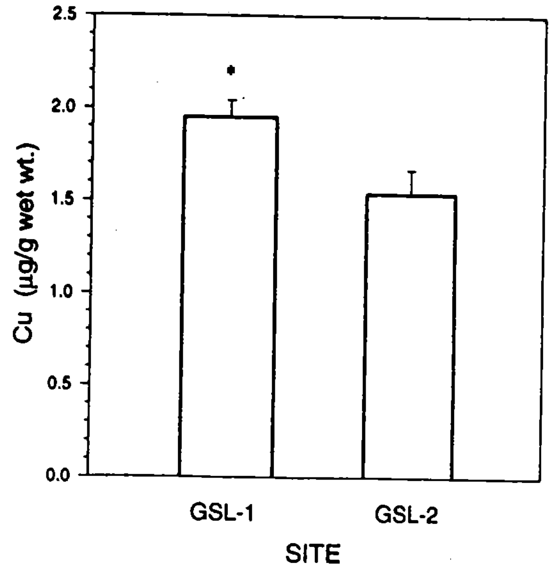
* means significantly different at α=0.05

Figure 73. Cadmium in walleye kidney, Yellowknife Bay 1992-93.



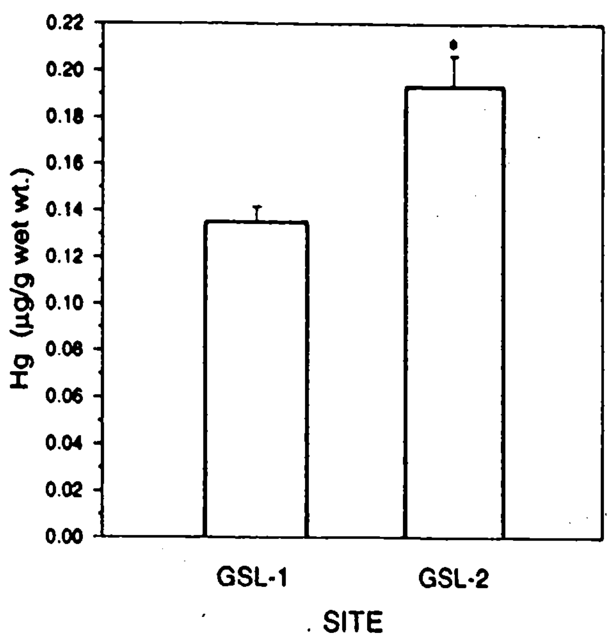
* means significantly different at α=0.05

Figure 74. Copper in walleye liver, Yellowknife Bay 1992-93.



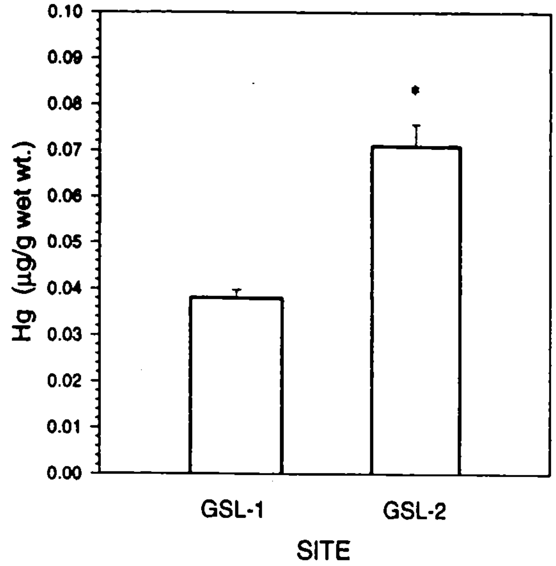
* means significantly different at α=0.05

Figure 75. Mercury in walleye muscle, Yellowknife Bay 1992-93.



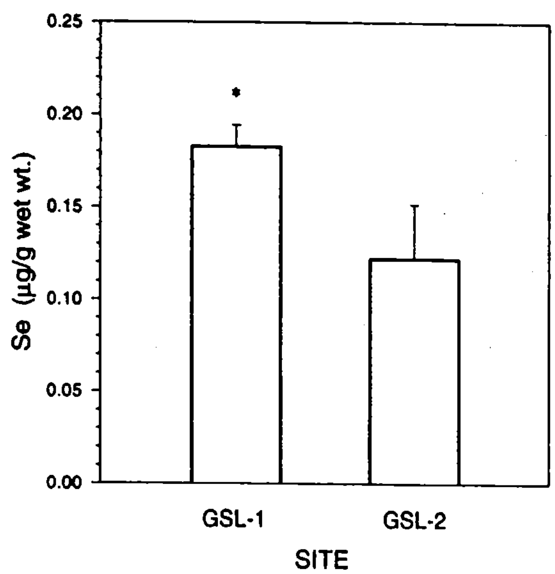
* means significantly different at α=0.05

Figure 76. Mercury in walleye kidney, Yellowknife Bay 1992-93.



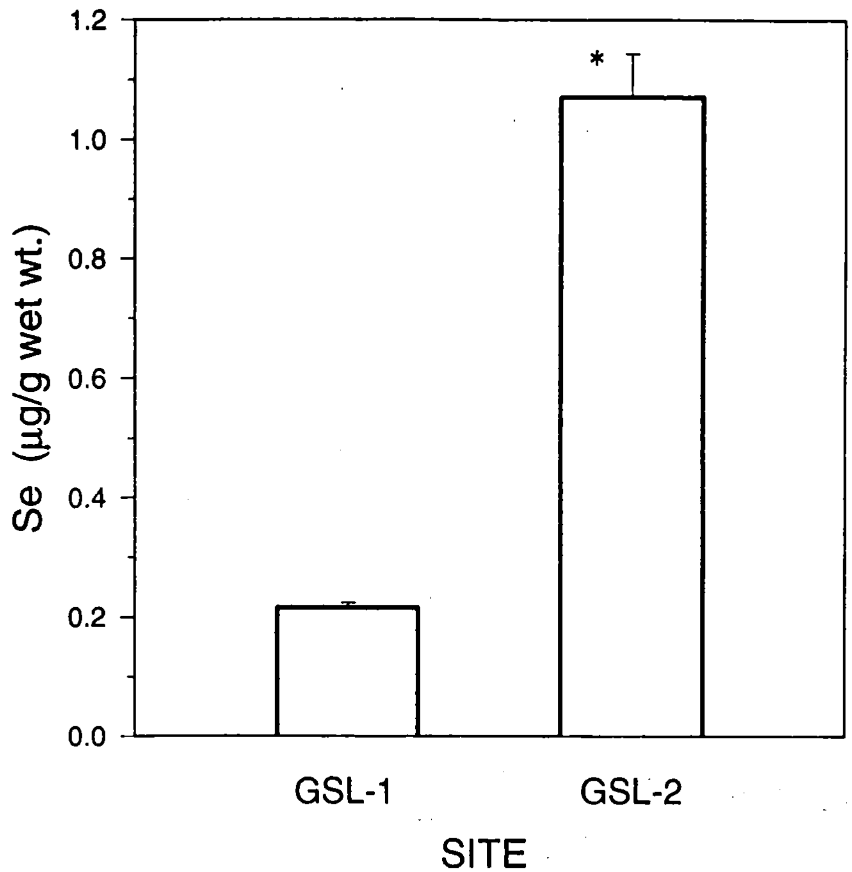
* means significantly different at α=0.05

Figure 77. Selenium in walleye muscle, Yellowknife Bay 1992-93.



* means significantly different at α=0.05

Figure 78. Selenium in walleye kidney, Yellowknife Bay 1992-93.



* means significantly different at α=0.05

4.3.7 Recommendations

1. To determine whether the elevated As, Cu, and Hg concentrations in livers and kidneys of lake whitefish and northern pike are producing chronic, sub-lethal effects, additional numbers of these fish species should be collected at sites GSL-1, GSL-3, GSL-4 and GSL-5. In addition to obtaining information on general parameters, such as fish length, weight, sex and age, livers and kidneys should be analysed for As, Cu and Hg, as well as specific diagnostic tests for As, Cu and Hg toxicity. As described previously these tests consist of evaluating the presence of distinct As-induced histopathological lesions in liver and kidney for arsenic, and of metallothionein concentrations in liver and kidney for Cu and Hg.

2. Because the large fish species analysed in this study are mobile, they probably were not restricted to the fish sampling sites at which they were caught within the Bay. Small forage fish species, such as minnows, dace, sticklebacks and large benthic invertebrates,(ie. molluscs and crayfish) would be more restricted to these sites. Therefore, analyses of As, Cu and Hg, as well as the specific diagnostic tests described above, of these species would provide additional evidence on the biological availability and sub-lethal toxicology of these contaminants. It is recommended that the study be expanded into collecting small forage fish species and large benthic invertebrates from the following sites; GSL-1, GSL-3, GSL-4 and GSL-5. The fish and benthic invertebrates' livers, viscera and hepatopancreas should be analysed for contaminant concentrations, distinct As-induced histopathological lesions and for the metal-binding protein, metallothionein.

4.4 THE LITTORAL ZONE OF YELLOWKNIFE-BACK BAY STUDY AREA

The shores of Yellowknife Bay and Back Bay most likely to be affected by future municipal development were inventoried to identify types of fish habitat. Between July 19 and 21, 1994, the shoreline was slowly navigated and 49 segments were described. A segment was characterized in three sections: the shore, the shoreline and the littoral zone which theoretically includes the shoreline. The shoreline is detailed separately to account for the variations in vegetation and substrate. Each segment was described in as much detail as time permitted. A water depth of two meters delineated the littoral zone. The information collected for each segment and presented in Table 17 on the following summary outlines the general characteristics of the area surveyed. Distances reported are visual estimates. The segments documented are detailed in Figure 79 and photographs in Appendix 23.

Littoral zone

The littoral zone of the area surveyed varies between <1 and 150 meters. Elevated rock outcrops on shore are normally associated with littoral zone ranging between <1 and 35m. Shores of lower slope are generally complemented by a larger littoral zone (40 to 150m).

Substrate

Throughout the littoral zone, soft clay sediments, sometimes associated with harder clay, dominate. Sand or sandy clays are found near shore at various locations (segments #5, 14, 18, 19, 22, 29, 31, 42, 45, 47) and seem to be associated with the presence of inflows or areas under the influence of human activity. Local beds of organic matter are also present but very locally (segments #5, 18, 19, 29). Rocks, boulders and cobbles may extend up to 7 m offshore except in the Willow Flat area (segment #42) where boulders are scattered throughout the littoral zone. The presence of cobbles at the shoreline is common but discontinuous.

Vegetation

Submerged macrophytes are distributed discontinuously and at variable densities throughout the littoral zone. Emergent plants (mainly Equisetum sp. and sedges) are common at the shoreline but sometimes extend more extensively into the littoral zone (e.g. segment #42). Various Graminae species and a few species of trees (Alnus sp., and willows) are present at the shoreline of areas where the shore is more densely vegetated. On shore, trees (black spruce, aspen, birch, willows and alders) and various unidentified plant species colonized the depressions of the rock outcrops.

Fish

Nine sites were seined and visually assessed for the presence of fish. Yearlings of seven species were identified: emerald shiner, northern pike, nine spine stickleback, white sucker, longnose seemed to be more active on July 19 and 20, hot and sunny days, than on July 21 which was overcast. Based on the observations carried during this three day inventory, it seems that most of the vegetated sections of Yellowknife Bay and Back Bay are habitat for at least a few species of fish.

Table 17. Detailed description of the segments inventoried in Yellowknife-Back Bay.

Segment #	State of the Shoreline	Seine	Fish	Littoral Zone: 2m line at (meters)	Littoral Zone: Substrate	Littoral Zone: Vegetation
1	Natural			15-20	Cl - SBC	None
2	Natural			15-20	Cl	SM
3	Natural			30-35	Cl	SM
4	Natural				Cl (soft and hard)-SBC	
5	Natural			15	Cl	SM-discontinuous
6	Disturbed			<10	Cl	
7	Disturbed			10	Cl (hard)	
8	Disturbed	X		100-150	Cl	Equisetum (almost continuous)
9	Natural			30-35	Cl - C (soft and hard)	
10	Natural/Disturbed			7-15*	Cl	SM (thick in front of cabin)
11	Natural			15	Cl - B and C (dense)	
12	Natural			<5	Rocks	
13	Natural			15	Cl	
14	Natural			15	S (<5) - Cl	
15	Natural			5-8	Cl	SM (thick)
16	Natural			15	Cl (Soft and hard)	Isoetes
17	Natural	X	ES, NP (10 cm)	40	Cl	SM
18	Natural	X	unknown fry seen, S	15	Cl- Om - S (near outlet)	SM
19	Natural	X	ES, TP, WS, S, NP(10 cm)	20-25	Cl	SM
20	Natural	X	WS (various sizes)	10-20	Cl- Bedrock (up to 10m off shore)	SM
21	Natural			20	S	SM
22	Natural	X	WS, ES, S, TP	50	S (close to shore) - Cl	SM (throughout)
23	Disturbed			40-50	Cl	SM
24	Disturbed			50-80	Cl	
25	Disturbed		Shoal of unidentified fry seen	40-50	A/ S up to 15m then Cl; B/ Cl	SM
26	Disturbed	X	SE, NP, WS	40-50	Cl	Equisetum (10-25m off shore)-SM A/dense b/ less dense
27	Natural			50-60 / 40 at the point	Cl	A/ SM (Thick);B/ few SM
28	Natural			4-15	20m rock shelf, R-C (4 to 15 m, around 2/3 of island)	few SM
29	Natural				SCl	
[redacted]	Natural	X	ES (2 shoals of ~ 250 fish)	80	S, Om, and flat rock shelf	Equisetum - Sedge (1/2 Bay)
30	Natural			15-20	Cl	SM (thick; extend 4 to 8 m off shore)
31	Natural			40-50	0-30m S to SCl; 30-50m Cl	SM
32	Natural			<10		
33	Natural			<5		
34	Natural			<5; 20 in Bay	Cl	SM
35	Natural			1-5	Cl	
36	Natural			5-20	Cl	SM (few)
37	Disturbed					
38	Natural			20	Cl	
39	Disturbed			1-10	Cl	SM (few)
40	Disturbed			60	Cl	SM (few)
41	Natural			40	Cl	Equisetum, Sedge, Grass, SM (few)
42	Natural	X	NP, ES, WS, LS, S, SS	50-100	S (to 40-50m), Cl (beyond), SB (all over)	Equisetum, Sedge, Grass, SM (few)
43	Natural			50-60	Cl with few rocks	Em (few)
44	Disturbed			20-30	Cl	
45	Disturbed			20-30	Cl	
46	Natural			<2 m sometimes extending out with rocks to 5 m		
47	Disturbed			<5	Bedrock, Rocks standing in SCl	
48	Natural			6-8	R (lots but scattered)	none
49	Natural			<2		none

Substrate
Cl - Clay
SBC - Scattered boulders and cobbles
SB - Scattered boulders
C - Cobbles
B - Boulders
S - Sand
SCL - Sandy clay
Om - Organic matter
R - Rocks

Vegetation
SV - Scarce Vegetation
P - Patches
SM - Emergent macrophytes
BS - Black Spruce
Bi- Birch
W - Willows
A - Aspen
Al - Alder

Fish
ES - Emeral shiner
NP - northern pike
WS - White sucker (yearlings)
LS - Longnose sucker
S - nine spine stickleback
SS - slimy sculpin
TP - trout perch

*15 m in front of cabin

Table 17. continued

Segment #	State of the Shoreline	Shoreline Substrate	Vegetation	On Shore Slope	Substrate	Vegetation slope	Special Features
1	Natural	C	None		Bedrock	SV	
2	Natural						
3	Natural			Steep	Bedrock	BS-Bi-W-in covered areas	
4	Natural						
5	Natural	C - S - Om	Equisetum				Point
6	Disturbed	Crushed Rocks and Gravel					Landing entering water
7	Disturbed		Graminae				Point of gravel beside weedy area
8	Disturbed		Sedge				A stream may enter this bay
9	Natural	B - C			Bedrock		
10	Natural/Disturbed	SB					Cabin on north shore
11	Natural		Sedge (patches)				
12	Natural						
13	Natural						
14	Natural						
15	Natural			Steep			
16	Natural	Cl	Sedge - Isoetes				
17	Natural	Cl - C - SB	Sedge (dense)	Steep	Bedrock		Bay
18	Natural	Om - S near outlet	Sedge (dense)	Steep	Bedrock		Whole Bay is <2m - No Snowmobile sign - Lots of debris in the waters of the littoral zone.
19	Natural	S -Cl - Om		Low	Bedrock		Potential Fish Habitat - Cemetary
20	Natural	R (localized)			Bedrock	Scattered trees	
21	Natural				Bedrock	Bare	
22	Natural						<50 cm in depth at 50m off shore
23	Disturbed						B stretches on shore when undisturbed
24	Disturbed						
25	Disturbed	Occasional rocks	W-Graminae-Sedge-Equisetum (extending up to 20m)				Private docks
26	Disturbed		W-Graminae-Sedge				<2m between Islands - Private docks
27	Natural	A) C (up to 2m from shore); B)	W - Sedge				
28	Natural				Bedrock		
29	Natural	C - B up to 3 m off shore			Bedrock		
[illegible]	Natural						< 1m in hwole bay
30	Natural					W- Bi- BS-	
31	Natural		Sedge		Bedrock	Trees	Houses (2)
32	Natural	Few R-B within 3m of shore			Bedrock	W- Bi- BS-	
33	Natural	Few B		Steep	Bedrock	Bare	Epilithic algae on immersed rocks
34	Natural	B-C	Sedge; Grass in the Bay	moderate	Bedrock		
35	Natural	R and B on Cl		Cliff	Bedrock		
36	Natural	C	None	Steep	Bedrock		
37	Disturbed						
38	Natural		Equisetum, Sedge,			Trees on the north shore	Private docks
39	Disturbed			Flat-Low	Bedrock		
40	Disturbed		None on Rocher's land	Flat-Low	S		Rocher's property - Private dock
41	Natural			Flat		Grass, terrestrial plants	Woodyard - Private docks
42	Natural	S - Cl		Low	S		Willow flat Marsh, Rock shelf near the point; More boulders towards it ; On average emerging plants extend 30-40 meters offshore
42	Natural						
43	Natural			Steep	Bedrock		
44	Disturbed	S to SCl	Sedge patches 10-12 m				Parking of gravel extending in the water
45	Disturbed	S to SCl ; Bay filled in with rocks					Pumping station - Fence on shore sitting on pieces of wood and cobbles
46	Natural			Steep	Bedrock		
47	Disturbed	C-B		Steep	Gravel		Old dock, barge landing, floating fence
48	Natural	Bedrock		Low	Bedrock	few shrub, small plants	Residential area- Private docks
49	Natural	Bedrock		Steep	Bedrock	few shrub and small plants	Epilithic algae on immersed rocks

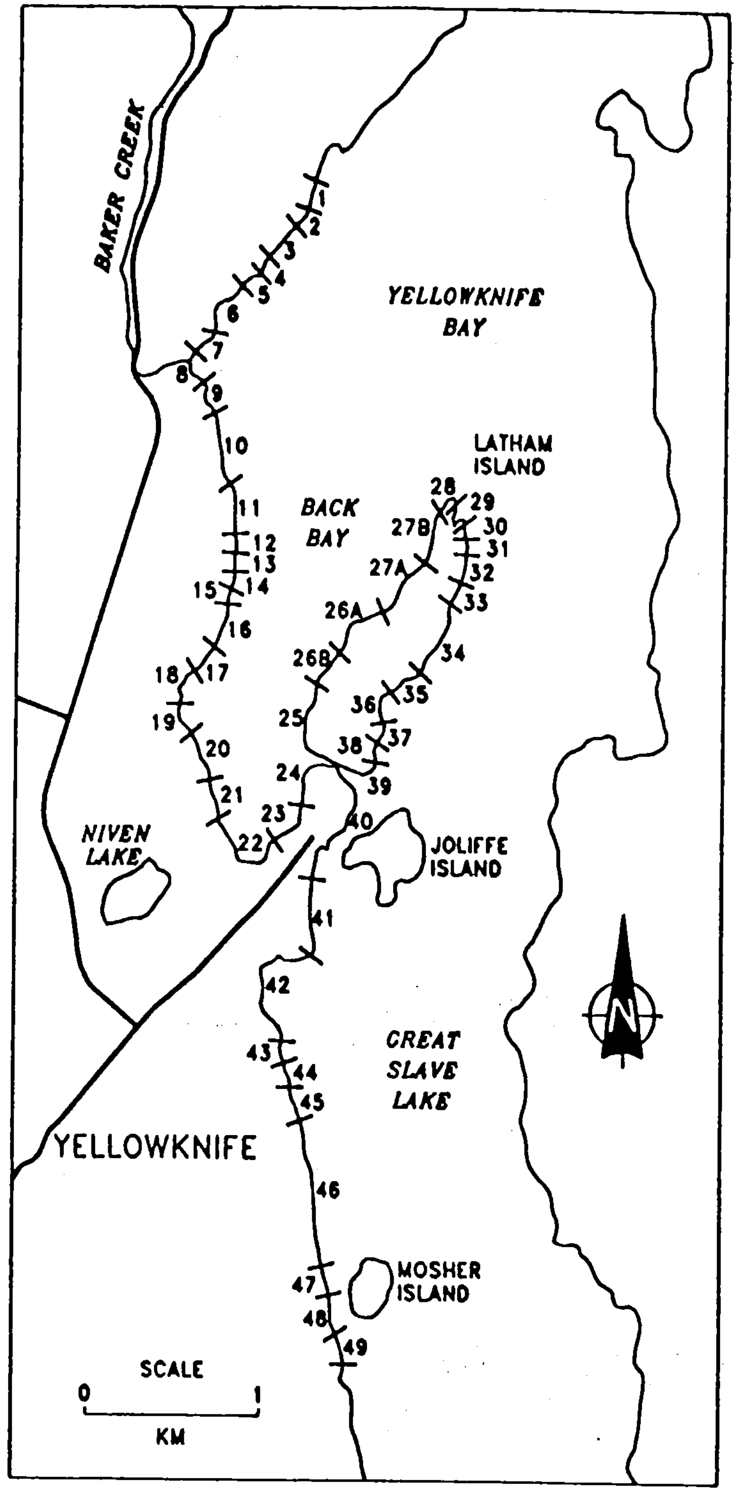
Substrate
Cl - Clay
SBC - Scattered boulders and cobbles
SB - Scattered boulders
C - Cobbles
B - Boulders
S - Sand
SCL - Sandy clay
Om - Organic matter
R - Rocks

Vegetation
SV - Scarce Vegetation
P - Patches
SM - Emergent macrophytes
BS - Black Spruce
Bi- Birch
W - Willows
A - Aspen
Al - Alder

Fish
ES - Emeral shiner
NP - northern pike
WS - White sucker (yearlings)
LS - Longnose sucker
S - nine spine stickleback
SS - slimy sculpin
TP - trout perch

*15 m in front of cabin

Figure 79. Map showing segmented details in the littoral zone of the Yellowknife-Back Bay study area.



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Yellowknifer, March 25, 1992. Saywell, T. Royal Oak fined for Back Bay Pollution

Appendices (1-8)

Water Section

Appendix 1. Water quality data collected from the Yellowknife-Back Bay study area in September 1992.

SAMPLES COLLECTED IN SEPTEMBER 1992																
STATION NAME	YK River	Baker Creek	Niven Lake O/F	Peace R. Flats	Causeway	Ndilo Dock	DFO Jolliffe	Water Intake Pumphouse	MEG @ GSL	PEG @ GSL	Dettah Dock	Dettah Dock	Dettah Dock	Old Giant Tailings	Tip of Latham Is.	Blank (2)
STATION NUMBER	1	2	3	4	5	6	7	8	9	10	11A	11B	11C	12	13	14
PARAMETERS																
pH	7.33	7.36	7.68	7.29	7.2	7.23	7.31	7.51	7.84	7.27	7.74	7.7	7.68	7.26	7.19	5.12
Conductivity (μS/cm)	45	80	380	78	72	83	90	93	192	12000	184	174	171	55	81	1.21
Turbidity (NTU)	3.3	3.5	3.4	5	5.9	3.7	3.4	4.3	2.9	4.1	7.3	7.1	4.5	2.8	3.9	1.1
Color (TCU)	5	5	30	5	5	5	5	5	10	10	5	5	5	5	5	< 5
Suspended Solids (mg/L)	< 3	3	4	< 3	3	3	< 3	< 3	< 3	10	< 3	3	4	< 3	< 3	< 3
Total Dissolved Solids (mg/L)	43	50	287	64	54	62	70	59	129	7240	112	110	109	46	59	3
Calcium (mg/L)	4.3	7.6	37	7.9	7.2	8.7	9.3	9.8	24	1400	21	21	21	5	8.3	< 1
Magnesium (mg/L)	2.9	2.5	16.7	2.5	2.4	2.7	2.8	2.9	5.5	42.4	5	5	5.1	2	2.6	< 0.1
Total Hardness (mg/L)	23	29	161	30	28	33	35	36	83	3670	73	73	73	21	31	< 3
Alkalinity (mg/L)	23	30	113	25	23	27	29	30	73	56	61	61	61	18	26	< 1
Sodium (mg/L)	3.5	3.4	18	3.1	3	3.4	3.6	3.9	8	910	6.1	6.2	6.1	2.2	3.2	0.1
Potassium (mg/L)	0.9	1	4.6	0.9	0.8	0.8	0.8	0.9	0.8	21	0.8	0.9	0.8	0.8	0.8	< 0.1
Chloride (mg/L)	1.5	3.7	33.8	3.3	2.9	3.4	3.6	3.8	6.3	4160	6.2	6.1	6.1	2.1	3.3	< 0.2
Sulphate (mg/L)	3.2	6.9	37.2	7.6	4.8	6.4	7.1	8.3	12.5	130	14.8	14.7	14.5	3.8	6.9	2.1
Total Coliforms(#/100ml)	340	800	1400	6	130	4	640	3600	65	150	1500	320	1400	4	76	NT
Fecal Coliforms(#/100ml)	2	< 2	8	< 2	< 2	< 2	< 2	< 1	< 2	< 2	< 2	< 2	< 2	< 1	< 2	NT
Fecal Strep (#/100ml)	33	122	42	< 2	12	4	2	9	2	< 2	< 2	18	6	< 1	< 2	NT
Ammonia- Nitrogen (mg/L)	< 0.007	0.081	< 0.007	0.015	0.029	0.036	0.036	0.029	< 0.007	4.85	< 0.007	< 0.007	< 0.007	0.016	0.038	< 0.007
NO3-N+NO2-N (mg/L)	< 0.04	0.09	0.13	0.04	0.04	0.05	0.06	0.06	0.04	4.42	< 0.04	< 0.04	< 0.04	< 0.04	0.06	< 0.04
Ortho-Phosphorus (mg/L)	< 0.005	< 0.005	0.287	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.025	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Total Phosphorus (mg/L)	0.01	0.007	0.442	0.016	0.009	0.016	0.009	0.006	0.005	0.022	0.01	0.026	0.013	0.006	0.006	< 0.005
Reac. Silica (mg/L)	0.33	0.65	7.65	0.4	0.54	0.74	9.31	0.94	3.55	1.63	2.07	2.14	2.13	0.35	8.06	< 0.03
Total Cyanide (low)	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Sulphide (mg/L)	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Arsenic (μg/L)	< 0.3	5.7	8.6	4.5	4.3	4.4	4.4	4.6	3.4	31	1.2	1.4	1.2	2.9	< 0.5	< 0.3
Cadmium (μg/L)	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Copper(μg/L)	2	2	6	3	3	3	3	3	4	5	2	3	4	3	3	2
Iron(μg/L)	58	43	526	136	102	69	50	74	110	139	125	99	114	46	52	14
Lead(μg/L)	1	< 1	1	< 1	1	< 1	4	1	2	1	1	< 1	< 1	< 1	< 1	< 1
Mercury (μg/L)	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	0.094	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	-
Nickel(μg/L)	< 1	1	< 1	< 1	1	1	< 1	1	1	23	2	< 1	1	< 1	1	< 1
Zinc(μg/L)	2	1	6	4	3	< 1	4	2	3	2	10	1	4	1	1	1
Chromium(μg/L)	< 1	1	< 1	< 1	< 1	< 1	1	< 1	< 1	1	2	1	< 1	< 1	1	3
Cobalt (μg/L)	< 1	1	1	1	1	1	1	1	< 1	16	< 1	< 1	< 1	< 1	< 1	< 1

"<" = Less than detection

Appendix 2. Water quality data collected from the YellowKnife-Back Bay study area in February/March 1993.

SAMPLES COLLECTED IN FEB/MAR 1993																
Station Name	YK River	Baker Creek	Niven Lake Outflow	Peace R. Flats	Causeway	Ndilo Dock	DFO Jolliffe	Water Intake Pumphouse	MEG @ GSL	PEG @ GSL	PEG @ GSL	PEG @ GSL	Dettah Dock	Giant Old Tailings	Tip of Latham Is.	Blank (10)
Station Number	1	2	3	4	5	6	7	8	9	10A	10B	10C	11	12	13	14
Parameters																
pH	6.67	6.83	6.85	6.87	6.9	6.89	6.99	7.12	7.13	7.03	6.93	6.94	7.09	6.94	6.75	6.16
Conductivity (µS/cm)	45	50	50	52	52	59	60	72	126	300	300	300	104	46	46	1.34
Turbidity (NTU)	1.9	2.1	3.3	1.5	1.4	4	2.1	2.4	3.3	8.7	5.4	6.5	3.3	2.2	2.1	0.6
Color (TCU)	5	10	5	5	5	10	5	5	10	10	10	10	10	5	5	< 5
Suspended Solids (mg/L)	3	3	4	< 3	< 1	3	< 3	< 3	< 3	9	6	7	< 3	3	< 3	< 3
Total Dissolved Solids (mg/L)	40	45	42	37	39	49	52	59	86	175	129	194	56	45	44	< 10
Calcium (mg/L)	4.6	4.9	5.2	5.2	5.2	6.1	6.4	8.2	14.6	37.1	37.4	37.9	11.8	4.6	4.8	< 1
Magnesium (mg/L)	1.7	1.9	2	2	2	2.2	2.1	2.5	3.8	5.5	5.4	5.5	3.4	1.7	1.8	< 0.1
Total Hardness (mg/L)	18.5	19.9	21.2	21.2	21.2	24.5	24.8	31	52.4	115	116	117	44	18.6	19.2	< 3
Alkalinity (mg/L)	16.1	17.6	18.6	18.7	18.6	18.5	21.4	26.3	44.8	75.1	74.9	74.8	37.4	16.4	16.7	0.5
Sodium (mg/L)	1.7	1.7	1.7	1.8	1.9	2.1	2.1	2.7	4.4	14.8	14.5	14.6	3.9	1.7	1.7	0.2
Potassium (mg/L)	1.1	1.1	1.2	1.1	1.1	1.3	0.8	1	1.4	1.8	1.8	1.7	1.1	0.9	1	< 0.1
Chloride (mg/L)	1.39	1.55	1.62	1.68	1.68	1.91	1.97	2.45	4.34	41.45	42.37	42.81	3.6	1.56	1.48	0.12
Sulphate (mg/L)	4	3	3	4	4	4	4	6	12	17	17	17	9	4	4	< 3
Total Coliforms(#/100ml)	20	14	1	1	< 1	2	18	10	2	5	5	5	4	8	1	NT
Fecal Coliforms(#/100ml)	1	7	< 1	< 1	< 1	< 1	< 1	< 1	< 1	1	1	1	1	1	< 1	NT
Fecal Strep (#/100ml)	1	1	< 1	< 1	< 1	< 1	< 1	20	1	< 1	< 1	< 1	< 1	1	< 1	NT
Ammonia- Nitrogen (mg/L)	0.01	0.085	< 0.002	< 0.002	< 0.002	0.015	< 0.002	< 0.002	< 0.002	0.044	0.017	0.012	< 0.002	0.056	< 0.002	< 0.002
NO3-N+NO2-N (mg/L)	0.09	0.083	0.099	0.085	0.096	0.143	0.092	0.109	0.116	0.22	0.218	0.226	0.114	0.083	0.079	0.052
Ortho-Phosphorus (mg/L)	< 0.001	< 0.001	0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	0.001	0.002	0.002	0.001	< 0.001	0.001	< 0.001	< 0.001
Total Phosphorus (mg/L)	0.011	0.005	0.013	0.006	0.006	0.007	0.006	0.006	0.006	0.013	0.015	0.006	0.008	0.006	0.006	< 0.002
Reac Silica (mg/L)	0.494	0.533	0.57	0.571	0.571	0.804	0.724	0.921	1.6	3.8	3.84	3.8	1.24	0.533	0.552	< 0.005
Total Cyanide (low)	0.002	< 0.001	< 0.001	< 0.001	< 0.001	0.002	0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.002	< 0.001	0.001	< 0.001	< 0.001
Sulphide (mg/L)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.05	< 0.05	< 0.05
Arsenic (µg/L)	< 0.3	0.4	1.4	2	0.6	1.9	0.8	1.3	0.8	7.9	6.7	7.9	1	0.3	0.4	< 0.3
Cadmium (µg/L)	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	0.2	< 0.2	< 0.2
Copper(µg/L)	1	3	2	2	2	2	1	2	2	4	3	3	2	1	1	< 1
Iron(µg/L)	42	66	153	50	42	153	55	67	54	366	237	278	124	55	58	< 5
Lead(µg/L)	< 0.7	< 0.7	0.9	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	1	0.7	< 0.7	< 0.7
Mercury(µg/L)	< 0.02	< 0.02	< 0.02	< 0.02	NA	< 0.02	NA	< 0.02	< 0.02	< 0.02	< 0.02	NA	< 0.02	0.02	< 0.02	< 0.02
Nickel(µg/L)	< 1	1	< 1	1	2	2	1	1	1	3	3	4	1	1	1	< 1
Zinc(µg/L)	4	9	1	10	5	4	7	3	3	12	11	14	11	3	< 1	5
Chromium(µg/L)	< 1	1	2	1	2	2	1	2	1	< 1	2	< 1	1	1	1	1
Cobalt (µg/L)	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	1	1	1	< 1	1	< 1	< 1

"<" = Less than detection

Appendix 3. Water quality data collected from the Yellowknife-Back Bay study area in June 1993.

SAMPLES COLLECTED IN JUNE 1993															
Station Name	YK River	YK River	YK River	Baker Creek	Niven L. Outflow	Peace R. Flats	Causeway	Ndilo Dock	DFO Jolliffe	Water Intake Pumphouse	MEG @ GSL	PEG @ GSL	Dettah Dock	Giant Old Tailings	Tip of Latham Is.
Station Number	1A	1B	1C	2	3	4	5	6	7	8	9	10	11	12	13
Parameters															
pH	7.17	7.11	7.16	7.54	7.38	7.43	7.42	7.43	7.56	7.37	7.68	7.51	8.05	7.32	7.52
Conductivity (µS/cm)	51.4	51.6	51.5	156	84	87.8	90.7	79.7	90.5	86.5	154	5470	197	59.9	84
Turbidity (NTU)	3.8	3.2	3.3	15	14	17	17	6.3	3.8	4.3	3.6	5	4.7	6.7	6.9
Color (TCU)	< 5	5	< 5	15	5	7	6	5	< 5	< 5	< 5	12	< 5	5	7
Suspended Solids (mg/L)	39	36	33	114	66	69	74	63	60	60	93	3699	110	42	50
Total Dissolved Solids (mg/L	< 10	< 10	< 10	11	11	19	11	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Calcium (mg/L)	4.5	4.3	4.4	16.8	8.2	8.4	8.8	7.7	8.8	8.7	12	663	22	5.3	8.2
Magnesium (mg/L)	1.76	1.73	1.77	4.67	2.54	2.65	2.72	2.4	2.63	2.55	4.11	19.6	5.24	2	2.48
Total Hardness (mg/L)	18.5	17.9	18.3	61.2	30.9	31.9	33.2	29.1	32.8	32.2	46.9	1736	76.5	21.5	30.7
Alkalinity (mg/L)	14.9	15	15	43.6	24.5	25.5	27.4	23.8	27.3	26	47.8	45.9	63.2	17.9	25.3
Sodium (mg/L)	2.9	2.7	2.7	5.3	3.7	4.2	4	3.6	4.3	3.8	6.1	391.9	73.9	3.1	3.9
Potassium (mg/L)	0.97	0.99	0.97	1.5	1	1.08	1.03	0.96	1.03	0.97	0.96	9.9	0.99	1	0.98
Chloride (mg/L)	1.34	1.35	1.33	5.23	2.7	3	2.7	2.28	2.9	2.7	5	1712	6.4	1.53	2.8
Sulphate (mg/L)	5	5	5	18	9	9	10	7	9	9	15	171	18	6	9
Total Coliforms(#/100ml)	15	5	8	30	10	15	15	5	4	16	8	< 1	< 1	< 1	2
Fecal Coliforms(#/100ml)	< 1	< 1	< 1	10	30	5	< 1	< 1	< 1	68	2	< 1	4	< 1	< 1
Fecal Strep (#/100ml)	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	9	11	< 1	< 1	< 1	< 1
Ammonia- Nitrogen (mg/L)	0.006	0.008	0.006	0.032	0.016	0.02	0.016	0.012	0.002	0.007	< 0.002	0.074	0.002	0.012	0.005
NO3-N+NO2-N (mg/L)	0.021	< 0.008	< 0.008	0.168	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	0.028	0.357	0.032	< 0.008	< 0.008
Ortho-Phosphorus (mg/L)	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	0.001	0.002	0.002	0.011	0	< 0.002	0
Total Phosphorus (mg/L)	0.007	0.006	0.006	0.08	0.022	0.036	0.017	0.01	0.008	0.008	0.005	0.027	0.009	0.008	0.009
Reac. Silica (mg/L)	0.384	0.368	0.357	0.252	0.583	-	-	-	-	-	-	-	-	0.377	-
Total Cyanide (low)	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	0.002	0.001	0.003	0.002	0.001	< 0.004	0.002
Sulphide (mg/L)	0.065	0.068	0.068	0.073	0.055	0.172	0.126	0.225	0.158	0.078	0.308	< 0.05	< 0.05	< 0.05	0.051
Arsenic (µg/L)	0.3	< 0.3	0.3	247	4.8	6.6	3.8	3	< 2.2	2.9	1.4	34.8	1.1	7.8	3.3
Cadmium (µg/L)	< 0.09	< 0.09	< 0.09	< 4	< 0.2	< 0.2	< 0.2	< 0.2	< 0.09	< 0.09	< 0.1	< 0.1	< 0.09	0.1	< 0.09
Copper(µg/L)	0.84	0.78	0.85	14	2	8	3	2	1.45	0.94	< 1	1	1.19	< 1	1.5
Iron(µg/L)	99	105	117	668	836	1840	684	298	152	140	63	285	145	182	344
Lead(µg/L)	< 0.1	< 0.1	< 0.1	7.8	2	5	9	4	< 0.1	< 0.1	< 0.7	< 0.7	< 0.1	< 0.7	0.4
Mercury(µg/L)	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Nickel(µg/L)	0.5	0.9	0.4	< 40	2	5	2	2	0.8	1.1	< 1	10	1.8	< 1	1.4
Zinc(µg/L)	4.3	4.6	3.3	< 12	3	16	4	5	8.3	28.1	< 1	< 1	11.2	< 1	7.1
Chromium(µg/L)	< 0.07	< 0.07	< 0.07	< 2	2	5	4	2	< 0.07	< 0.07	< 1	3	< 0.07	3	0.37
Cobalt (µg/L)	< 0.03	0.06	< 0.03	< 2	< 1	1	< 1	< 1	0.11	0.09	< 1	4	0.05	< 1	0.16

"<" = Less than detection

Appendix 4. Water quality data collected from the Yellowknife-Back Bay study area in August 1993.

SAMPLES COLLECTED IN AUGUST 1993													
Station Name	**YK River**	**Baker Creek**	**Niven L. @ GSL**	**Peace R. Flats**	**Causeway**	**Ndilo Dock**	**DFO Jolliffe**	**Water Intake Pumphouse**	**MEG @ GSL**	**PEG @ GSL**	**Dettah Dock**	**Giant Old Tailings**	**Tip of Latham Is.**
Station Number	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Parameters													
pH	7.38	7.63	9.19	8.44	7.62	7.82	7.95	7.71	7.89	8.3	7.83	7.4	7.62
Conductivity (µS/cm)	48.5	595	87	87	93	122	136	138	196	7008	208	50	125
Turbidity (NTU)	2.6	2.7	2.9	3.4	4.9	2.8	4.5	2.5	3.5	2.4	5.8	2.2	2.9
Color (TCU)	6	< 5	7	10	12	9	7	7	7	9	7	< 5	7
Suspended Solids (mg/L)	6	3	< 3	3	< 3	< 3	< 3	< 3	< 3	3	< 3	< 3	< 3
Total Dissolved Solids (mg/L)	36	366	59	54	75	73	79	84	119	4720	119	42	75
Calcium (mg/L)	4.7	51.1	8.5	8.6	9.2	12.9	14.6	14.7	10.4	830.6	24	4.6	13.3
Magnesium (mg/L)	1.7	11.3	2.5	2.5	2.7	3.4	3.8	3.8	5.4	29.6	5.7	1.8	3.5
Total Hardness (mg/L)	19	174	32	32	34	46	52	52	48	2196	83	19	48
Alkalinity (mg/L)	15.1	38.9	24	24.8	25.8	35.9	41.7	41.9	64.2	45.8	69.1	15.7	35.8
Sodium (mg/L)	1.5	35	3	3	3.2	4.2	4.4	4.5	6.3	496.4	6.7	1.5	4.4
Potassium (mg/L)	0.9	5.4	0.9	1.1	0.9	1.2	0.9	1	0.9	12.6	0.7	0.8	1.1
Chloride (mg/L)	1.48	47.3	3.24	3.17	3.37	4.43	4.61	4.76	6.46	2350	6.96	1.49	4.74
Sulphate (mg/L)	< 3	138	7	7	8	11	11	12	18	193	19	< 3	12
Total Coliforms(#/100ml)	1	2	2	< 1	30	18	88	8	2	< 1	2	24	1
Fecal Coliforms(#/100ml)	< 1	3	< 1	< 1	12	< 1	< 1	< 1	1	< 1	2	18	< 1
Fecal Strep.(#/100ml)	< 1	< 1	< 1	2	< 1	< 1	< 1	24	1	2	< 1	8	< 1
Ammonia- Nitrogen (mg/L)	0.005	5.53	0.005	0.022	0.041	0.049	0.028	0.049	0.008	2.78	0.026	< 0.002	0.092
NO3-N+NO2-N (mg/L)	< 0.008	3.56	< 0.008	< 0.008	0.05	0.08	0.061	0.069	0.039	1.62	0.036	< 0.008	0.106
Ortho-Phosphorus (mg/L)	< 0.002	0.098	0.004	0.002	0.002	< 0.002	0.008	0.005	< 0.002	0.016	< 0.002	< 0.002	0.002
Total Phosphorus (mg/L)	0.007	0.081	0.007	0.013	0.007	0.005	0.01	0.011	0.006	0.016	0.011	0.002	0.006
Reac. Silica (mg/L)	0.291	1.695	0.323	0.142	0.652	1.176	1.512	1.549	2.86	1.39	2.99	0.291	1.271
Total Cyanide (low)	0.001	0.011	0.001	0.002	0.001	0.001	0.001	0.001	0.001	0.003	< 0.002	0.001	0.002
Sulphide (mg/L)	< 0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.2
Arsenic (µg/L)	< 0.3	170	5.9	6.2	5.9	5.5	3.7	4.2	0.6	38.6	0.7	< 0.3	6.9
Cadmium (µg/L)	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	0.2	0.2	< 0.2	< 0.2	< 0.2
Copper(µg/L)	< 1	14	1	1	1	2	1	2	1	4	2	< 1	1
Iron(µg/L)	187	84	193	256	256	145	251	145	69	131	269	68	145
Lead(µg/L)	1.4	< 0.7	< 0.7	< 0.7	< 0.7	2	2	2	1	< 1.4	< 0.7	< 0.7	2
Mercury(µg/L)	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Nickel(µg/L)	< 1	92	2	2	2	2	2	2	3	18	3	2	3
Zinc(µg/L)	< 1	7	< 1	1	< 1	2	2	3	< 1	5	4	< 1	1
Chromium(µg/L)	< 1	< 1	< 1	< 1	< 1	3	3	3	3	6	1	1	3
Cobalt (µg/L)	< 1	63	1	1	1	< 1	< 1	< 1	< 1	9	< 1	< 1	1

"<" = Less than detection

Appendix 5. Water quality data collected from the Yellowknife-Back Bay study area in February 1994.

SAMPLES COLLECTED IN JAN/FEB 1994																
Station Name	YK	Baker CK.	Niven Lake	Peace R.	Causeway	Ndilo	DFO	Water Intake	MEG @	PEG @	Dettah	Dettah	Dettah	Giant Old	Tip of	Field
	River	@ GSL	@ GSL	Flats		Dock	Jolliffe	Pumphouse	GSL	GSL	Dock	Dock	DOck	Tailings	Latham	Blank
Station Number	1	2	3	4	5	6	7	8	9	10	11-1	11-2	11-3	12	13	
Parameters																
pH	6.95	6.91	6.82	6.86	6.91	6.66	6.94	6.94	7.21	7.12	7.08	7.08	7.12	6.87	6.94	5.43
Conductivity (µS/cm)	48.1	49.8	53.8	51.9	52.2	69.7	53.5	62.4	84.8	486.8	76.1	76.2	75.8	47.4	48.6	1.4
Turbidity (NTU)	2.1	1	37.5	1.1	1.1	6	1.8	2.1	1.3	16.6	1.6	1.4	1.4	1.2	1.7	0.1
Color (TCU)	8	< 8	10	10	8	15	8	8	10	20	8	10	8	< 8	10	5
Suspended Solids (mg/L)	< 3	< 3	74	< 3	3	6	3	< 3	3	29	4	3	3	3	6	3
Total Dissolved Solids (mg/L)	34	37	41	24	26	56	40	44	61	304	40	43	37	34	36	< 10
Calcium (mg/L)	4.3	4.4	4.8	4.8	4.8	6.6	5	6.1	8.9	55.9	7.7	7.7	7.7	4.2	4.3	0.09
Magnesium (mg/L)	1.6	1.7	1.8	1.8	1.8	2.3	1.8	2	2.6	6	2.4	2.4	2.4	1.6	1.6	< 0.01
Total Hardness (mg/L)	17	18	19	19	19	27	20	23	33	164	29	29	29	17	17	< 0.1
Alkalinity (mg/L)	15.1	15.6	16.9	16.4	16.4	22.7	16.8	19.6	27.3	78.6	24.6	24.6	24.3	14.7	15	< 0.3
Sodium (mg/L)	1.55	1.6	1.83	1.7	1.75	2.22	1.76	1.96	2.71	23.6	2.53	2.48	2.55	1.61	1.58	< 0.04
Potassium (mg/L)	1.02	0.98	1.28	1.09	1.14	1.1	0.98	1.07	1.05	3.48	0.8	0.9	0.9	1	0.97	< 0.05
Chloride (mg/L)	2.09	1.41	1.46	1.7	1.6	1.45	1.95	2.82	2.26	0.59	1.58	2.82	2.45	1.46	1.6	< 0.56
Sulphate (mg/L)	< 3	< 3	3.1	< 3	< 3	3.7	3.3	4	6.4	18	4.9	4.9	5	3	< 3	< 3
Total Coliforms(#/100ml)	4	2	< 1	< 1	< 1	< 1	1	1	< 1	< 1	< 1	< 2	< 1	3	8	NT
Fecal Coliforms(#/100ml)	< 1	1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 2	< 1	< 1	< 1	NT
Fecal Strep.(#/100ml)	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 2	< 1	1	< 1	NT
Ammonia- Nitrogen (mg/L)	0.026	0.022	0.037	0.032	0.033	0.019	0.009	0.009	0.018	0.055	0.036	0.063	0.028	< 0.017	0.021	< 0.002
NO3-N+NO2-N (mg/L)	0.05	0.068	0.079	0.069	0.063	0.162	0.058	0.073	0.082	0.28	0.074	0.074	0.074	< 0.049	0.055	< 0.008
Ortho-Phosphorus (mg/L)	< 0.002	< 0.002	< 0.002	< 0.001	< 0.001	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Total Phosphorus (mg/L)	0.076	0.005	0.088	0.005	0.005	0.012	0.007	0.007	0.007	0.037	0.007	0.005	0.005	0.011	0.005	< 0.002
Reac. Silica (mg/L)	0.444	0.477	0.653	0.51	0.799	0.749	0.538	0.671	0.946	5.3	0.799	0.795	0.805	0.454	0.46	< 0.005
Total Cyanide (low)	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Sulphide (mg/L)	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Arsenic (µg/L)	< 0.3	0.9	6.9	0.7	0.4	1.4	0.9	0.7	0.6	20.8	0.4	< 0.3	0.4	< 0.3	0.3	< 0.3
Cadmium (µg/L)	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Copper(µg/L)	1	0.9	5.5	1.2	1.2	1.9	1	0.9	0.8	2.8	1.4	1.[illegible]	1.3	0.7	0.7	< 0.1
Iron(µg/L)	47	23	2290	33	< 20	162	42	42	28	1160	< 20	< 20	< 20	23	52	< 20
Manganese(µg/L)	1.5	1.2	42.3	1.2	1.3	6.4	1.9	1.7	1.1	428	1.5	1.5	1.5	1.3	1.2	< 0.1
Lead(µg/L)	0.5	0.3	3.4	0.4	0.6	0.4	0.4	0.3	0.3	1.1	0.6	0.5	0.5	0.2	0.3	0.4
Mercury(µg/L)	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Nickel(µg/L)	0.8	0.8	3.4	0.9	0.9	1.5	0.9	0.9	0.9	7.1	1.1	1.2	1.1	0.8	0.9	0.4
Zinc(µg/L)	4.1	4.3	15.4	55.1	17.8	3.6	9.7	8.1	0.7	8.4	5.1	7.2	6.1	4.3	2.2	0.3
Chromium(µg/L)	0.74	0.4	5.1	1.1	0.7	0.8	1.1	1.2	0.3	2	0.6	0.6	0.5	0.4	0.7	0.2
Cobalt (µg/L)	0.1	< 0.1	1.2	0.1	0.1	0.1	0.1	0.1	< 0.1	4.6	0.1	0.1	0.1	0.1	< 0.1	< 0.1

"<" = Less than detection

Appendix 6. Water quality data collected from Yellowknife-Back Bay study area in March 1994.

SAMPLES COLLECTED IN MARCH 1994																
Station Name	YK River	Baker CK. @ GSL	Niven L. Outflow	Peace R. Flats	Causeway	Ndilo Dock	DFO Jolliffe	DFO Jolliffe	DFO Jolliffe	Water Intake Pumphouse	MEG @ GSL	PEG @ GSL	Dettah Dock	Giant Old Tailings	Tip of Latham	Field Blank
Station Number	1	2	3	4	5	6	7-1	7-2	7-3	8	9	10	11	12	13	
Parameters																
pH	6.8	6.8	6.8	6.74	6.82	6.59	6.89	6.9	6.92	6.94	7.05	6.97	7	6.8	6.94	5.48
Conductivity (µS/cm)	49.6	51.2	53.4	55.1	54.5	6.6	53.2	53	53.4	66.2	80.7	227.3	77.3	50.5	6.9	5.5
Turbidity (NTU)	0.9	0.9	1.1	0.8	1.1	19.9	3	5.3	4.6	1.4	1.5	23	1.6	1.5	1.7	0.6
Color (TCU)	5	7	8	7	7	12	6	6	6	6	< 5	7	6	5	8	< 5
Suspended Solids (mg/L)	3	< 3	< 3	< 3	< 3	11	7	7	6	< 3	3	24	< 3	< 3	< 3	< 3
Total Dissolved Solids (mg/L)	37	34	36	37	37	54	36	37	36	41	51	133	49	36	33	< 10
Calcium (mg/L)	4.5	4.5	4.6	4.9	4.8	6.2	5	5.1	5.1	6.4	8.1	25.7	7.7	4.4	5.1	< 0.1
Magnesium (mg/L)	1.7	1.7	1.8	1.8	1.8	2.5	1.8	1.8	1.9	2.1	2.5	4.1	2.4	1.7	1.8	< 0.01
Total Hardness (mg/L)	18	18	18	20	19	26	20	20	20	25	30	81	29	18	20	0.1
Alkalinity (mg/L)	14.8	15.2	15.7	16.4	16.4	20.9	16.5	16.6	16.5	19.9	24.7	54.5	23.9	14.9	16.3	< 0.3
Sodium (mg/L)	1.52	1.52	1.62	1.64	1.61	1.95	1.65	1.66	1.63	1.92	2.36	8.1	2.29	1.52	1.58	< 0.04
Potassium (mg/L)	1.07	1.08	1.13	1.2	1.08	1.43	1.02	1.01	1.07	1.03	1	1.47	1.06	1.03	1.1	0.05
Chloride (mg/L)	1.39	1.53	1.48	1.49	1.47	1.62	1.44	1.44	1.41	1.62	1.99	24.1	1.93	1.4	1.62	0.6
Sulphate (mg/L)	< 3	< 3	< 3	< 3	< 3	3	3	3	< 3	4	6	12	5	< 3	< 3	< 3
Total Coliforms(#/100ml)	6	3	< 1	2	< 1	7	3	< 1	4	2	3	4	2	3	6	< 1
Fecal Coliforms(#/100ml)	< 2	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 2	< 1	< 1	< 1	< 1
Fecal Strep.(#/100ml)	< 2	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 2	< 1	< 1	< 1	< 1
Ammonia- Nitrogen (mg/L)	0.005	0.011	0.013	0.002	0.002	0.012	0.002	0.006	0.002	0.017	0.007	0.008	0.002	0.01	0.002	0.006
NO3-N+NO2-N (mg/L)	0.062	0.064	0.068	0.095	0.073	0.085	0.064	0.068	0.065	0.073	0.069	0.158	0.065	0.058	0.059	< 0.008
Ortho-Phosphorus (mg/L)	0.003	0.003	0.003	0.003	0.003	0.008	0.004	0.005	0.004	0.004	0.003	0.004	0.004	0.003	0.003	0.003
Total Phosphorus (mg/L)	0.008	0.01	0.009	0.012	0.013	0.034	0.014	0.012	0.011	0.006	0.006	0.034	0.008	0.008	0.006	0.003
Reac. Silica (mg/L)	0.485	0.522	0.516	0.572	0.551	0.475	0.587	0.59	0.589	0.755	0.962	3.09	0.81	0.493	0.57	< 0.005
Total Cyanide (low)	< 0.001	0.001	< 0.001	0.001	0.001	0.002	< 0.001	0.002	0.002	< 0.001	< 0.001	0.002	0.002	< 0.001	< 0.001	< 0.001
Sulphide (mg/L)	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Arsenic (µg/L)	< 0.3	< 0.3	0.4	0.3	0.4	2.1	0.3	0.6	0.6	0.6	0.6	5.6	0.4	0.3	0.4	< 0.3
Cadmium (µg/L)	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.1	< 0.1	< 0.1	< 0.1	0.1
Copper(µg/L)	1.1	1.4	1.6	1.4	3	2.9	1.4	1.4	1.5	1.3	1.1	3.5	1.3	1.7	1.2	0.1
Iron(µg/L)	62	33	34	53	36	903	131	128	134	51	28	805	37	39	44	< 3
Manganese(µg/L)	1.7	1.4	1.6	2.2	2	20.7	3.1	3	3.1	1.6	1.2	79.5	1.4	1.5	1.4	< 0.1
Lead(µg/L)	< 0.2	0.4	0.2	0.3	0.3	< 0.2	0.3	0.3	0.3	0.3	< 0.2	< 0.2	< 0.2	0.3	0.2	< 0.2
Mercury(µg/L)	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.2	< 0.02	< 0.02	< 0.02	0.02
Nickel(µg/L)	0.6	0.6	0.7	0.8	0.9	2.4	0.8	0.7	0.8	0.7	0.7	4.1	0.8	0.6	0.6	0.1
Zinc(µg/L)	4	10.9	11.2	11	13.1	6.1	5.5	6	6	3.6	0.9	21.8	4.6	7.2	2.9	0.5
Chromium(µg/L)	0.5	0.5	0.5	0.7	0.8	2	1.5	8	1.9	0.8	0.7	1.5	0.8	0.8	0.6	0.2
Cobalt (µg/L)	0.1	0.1	0.1	0.1	0.1	0.5	0.1	0.1	0.1	0.1	0.1	1.1	0.1	0.1	0.1	0.1

"<" = Less than detection

Appendix 7. Personnel and Itinerary for each field trip.

COLLECTION #1--OPEN WATER

September 21, 1992 Maximum Air Temperature: 2.9°C
Minimum Air Temperature: -3.2°C

Personnel: (Day 1) Juanetta Peddle, Glen Stephens, Francis Jackson, George Tatsiechele, Albert Doctor.

At 0830, picked up lay samplers, George Tatsiechele (Dettah) and Albert Doctor (Ndilo) while Glen Stephens and Juanetta Peddle went to the lab and loaded the vehicle with the field equipment. We all met at the Department of Fisheries and Oceans (DFO) dock and outfitted two 16' Lund boats with motor and gas before loading the equipment. We headed straight to site #10, Meg-Keg-Peg system. A surface grab sample was taken for water, the sediment samples were taken further downstream in the centre of the outflow channel both the petite ponar and core sample was obtained.

We departed at 1230 for site #11, Dettah dock, triplicate water samples were taken with a Van Dorn water sampler and two sediment samples was taken with the petite ponar, no core sample taken due to a rocky bottom which prevented the corer from penetrating the lake bottom. All the samples were taken 2-3 metres off the dock.

Site #9, Meg Lake Outfall, water samples were taken from right off the shore. One sediment sample was taken by petite ponar approximately 15 feet from shore in 2-3 metres of water. No core sample was taken due to the hard lake bottom. NOTE: The water sample was taken at the outlet, at mouth of small creek entering the lake, the rocks in the area had a orange/red colour on them.

At 1445, site #8 (Emergency Water Pumphouse), the water sample was taken 6 m off the shore in 4 m of water with a Van Dorn. One petite ponar sample was taken and split into three samples from a depth of 6 m of water and one core sample was taken from a depth of 8 metres of water.

We then headed to the Yellowknife river, site #1, water samples were taken 100 metres upstream of the bridge in one metre of water, the petite ponar and core samples were also taken in the same area about 10m from the left bank.

At 1555, site #12, old Giant mine tailing site, a surface water grab sample was taken from a depth of 0.5 of a metre, it was too shallow to use the Van Dorn sampler, a sediment sample was taken with the petite ponar in the middle of the bay 15 metres from shore.

At 1620, we went to site #2, Baker Creek outflow (Giant Mine), the water sample was taken 15 metres from rock outcrop and approximately 15 metres from the dock just out past the berm.

The sediment samples were taken 20 metres from the rock outcrop. Both a petite ponar and corer sample was obtained. We returned to Dept. of Fisheries and Oceans dock at 1745. On the way back a core sample from Baker Creek site was dropped, another sample will be taken again.

September 22, 1992 Maximum Air Temperature: 3.1°C
Minimum Air Temperature: -1.5°C

Personnel: (Day 2) Juanetta Peddle, Glen Stephens, Francis Jackson, George Tatsiechele, Albert Doctor.

We arrived at site #7, 1000 hrs. preceded to take a sediment sample with the corer and ponar and one water quality sample with the horizontal Van Dorn sampler. The press from the Yellowknifer was present at this site, interviews were conducted before sampling took place, and still photos and video footage was also taken during the actual sampling of the site. (See News article "TESTING THE WATERS" Yellowknifer, September 25, 1992) The samples were taken between Jolliffe Island and the DFO dock approximately 15 metres off the west shore of Jolliffe Island.

Site #13, Tip of Latham Island-- one core sediment sample, one petite ponar sediment sample and one water surface grab sample was taken, too shallow to use a horizontal Van Dorn sampler. The samples where taken in 3 metres of water and 10 metres from shore of Latham Island.

The following samples were obtained from site #6, from 30 metres off the dock of Ndilo and in 1 metre of water, a surface grab sample and a sediment sample. The bottom was very weedy and consisted of clay type material. It started to snow and the wind picked up since yesterday.

Site #5--Causeway, the samples were taken from a water depth of 3 metres on the west side of the causeway. A Van Dorn water sample, sediment core sample and petite ponar sample also collected.

Site #4, Peace River Flats, a surface grab sample was taken 7 metres from the shore and the petite ponar sediment sample was taken further out from the shore in 2 metres of water due to it being too weedy in the bay area, no core sample taken because it was to hard to penetrate the bottom with the corer.

Site #3--Niven Lake outfall, water quality samples were taken from the shore at the outflow of Niven Lake. No core samples were taken, one petite ponar sediment sample was obtained from a depth of 3 metres. Went back to Baker Creek to get another core sample and the blanks were also taken at this time. Brought boats and motors back to storage then logged in the water quality and sediment samples back at the lab and filled out sample sheets.

COLLECTION #2--UNDER ICE

February 10, 1993 Maximum Air Temperature: -15.2° C
Minimum Air Temperature: -28.5° C

Personnel: (Day 1) Juanetta Peddle, Glen Stephens, Francis Jackson, Albert Doctor and Jonas Belanchoux.

Note: All water samples were taken through motorized auger drilled holes using the grab sampling technique.

Site #1--Yellowknife River, water sample taken and an attempt to get a sediment sample using the corer was made but the corer froze up. It was decided at that time not to obtain future sediment samples in the winter due to the freezing problem.

Site #12--Old Giant mine tailings release area, grab sample obtained, ice thickness=58 cm and snow depth=20 cm.

Site#2--Baker Creek, collected water sample 30 metres from outlet of Baker Creek, ice thickness=75 cm and snow depth=14 cm.

Site#3--Niven Lake outflow, collected water sample 25 metres off shore, some overflow in the area.

Site#4--Peace River Flats, collected water sample 60-70 metres from shore, ice thickness=1.06 m and snow depth=8 cm.

Site#5--Causeway, collected water sample, ice thickness=88 cm and snow depth=14cm. This area is heavily used by snowmobiles in the winter and planes in the summer and winter months.

Site#6--Ndilo dock, west side of Latham Island, water sample collected between dock and Island west of Latham Island. Ice thickness=90cm and snow depth=20cm.

Site#13--Tip of Latham Island, water sample collected 10 metres off shore. Ice thickness=88 cm and snow depth=18 cm.

Site#7--DFO/Jolliffe Island, water sample collected between Department of Fisheries and Oceans dock and west side of Jolliffe Island. This area used all year around by small aircraft (ie. Twin Otters and Cessna 185's) and snowmobiles. The house boat community is a few hundred metres south of the sampling location. Finished sampling for the day @ 1600 hrs, brought samples back to the lab, added preservatives, logged in samples, filled out field sample sheets and dropped equipment at the warehouse.

February 11, 1993 Maximum Air Temperature: -14.6° C
Minimum Air Temperature: -25.5° C

Personnel: (Day 2) Francis Jackson, Juanetta Peddle, Albert Doctor and Jonas Belanchoux.

Sites #11, Dettah Dock, water sample collected 10 metres from the dock. Ice thickness=82 cm and snow depth=10 cm. Children of Dettah use this as a swimming spot, in addition, the winter road to Yellowknife is near the sampling site (10 metres away) therefore a lot of traffic passes this area.

Site #10, Peg lake outflow at Great Slave Lake, triplicate water samples taken here as well as the blank. Ice thickness=1.2 m and snow depth=90 cm. This area is heavily fished in the summer months for northern pike. Therefore a lot of boat traffic is in the area during the summer and is also snowmobile route.

Site#9, Meg Lake overflow area, water sample collected, ice thickness=94 cm and snow depth= 10 cm. This area was chosen by the community representatives because during the winter, there is a noticeable amount of overflow coming from what seems the Meg lake area.

Site#8, Emergency Water Pumphouse, water sample collected, ice thickness=1.03 m and snow depth= 8 cm.

Finished sampling at 1300 hrs, went back to the lab, added preservatives, logged in samples, filled in lab sample sheets and dropped off equipment and the warehouse.

March 02, 1993 Maximum Air Temperature: -5.7° C
Minimum Air Temperature: -10.6° C

Personnel: Francis Jackson and Albert Doctor. Bacteriological samples collected only.

Went back to all sites and collected bacteriological samples (BacT's) at the request of Mackenzie Regional Health Services. These samples were not collected during the February trip because it was thought to be not necessary because there should be no presence of bacteria from any source, in the water at that time of the year (ice cover). But to make sure the water samples for BacT's were collected.

COLLECTION #3-OPEN WATER

June 22, 1993 Maximum Air Temperature: +16.6° C
Minimum Air Temperature: +09.6° C

Personnel: (Day 1) Francis Jackson and Wayne Puznicki

NOTE: This sampling trip used the horizontal Van Dorn sampler to collect the water samples and a petite ponar to collect the sediment samples. Community representatives not available to assist with field work today, William Doctor did assist with field work on the second day.

Site#1, Yellowknife River, a triplicate water sample taken and two sediment samples collected. Note: There was a strong downstream wind when the samples were collected ≈20-30 kph. No precipitation. Sunny with scattered clouds.

Site#12, Old Giant mine tailings release area, a water and sediment sample was collected. Wind out of the northeast ≈20-30 kph.

Site #2, Baker Creek, one water sample collected and triplicate sediment samples collected as well. Water samples collected in side the breakwater area to avoid any grey water that may be deposited by the Yachts in the area.

Site#3, Niven Lake outflow, one water and sediment sample collected, strong winds blowing directly into the bay, large waves, winds ≈ 30-40 kph.

Site#4, Peace River Flats, one water and sediment sample collected, strong winds blowing directly into the bay, large waves.

Site#5, Causeway, one water and four sediment samples collected, a sheltered area with lighter winds.

Site#6, Ndilo dock area, one water and sediment sample collected, strong northerly winds and large waves.

June 24, 1993 Maximum Air Temperature: +14.9° C
Minimum Air Temperature: +08.5° C

Personnel: (Day 2) Francis Jackson, Wayne Puznicki and William Doctor.

Site#7, DFO/Joliffe Island, one water and sediment sample collected.

Site#8, Emergency Water Pumphouse, one water and sediment sample collected.

Site#9, Meg Overflow area, one water and sediment sample collected.

Site#10, Peg outflow at Great Slave Lake, one water and sediment sample collected.

Site#11, Dettah near the dock at Great Slave Lake, one water and sediment sample collected.

Site#13, Tip of Latham Island, one water and sediment sample collected.

COLLECTION #4-OPEN WATER

August 10, 1993 Maximum Air Temperature: +12.5
Minimum Air Temperature: + 7.8

Personnel: (Day 1) Francis Jackson and Wayne Puznicki

NOTE: The horizontal Van Dorn sampler was used to collect the water samples and a petite ponar to collect the sediment samples. Community representatives were not available to assist with this August field trip.

Site#1, Yellowknife River, one water and a triplicate sediment sample collected.

Site#12, Old Giant Mine Tailings Release area, one water and a triplicate sediment sample collected.

Site#2, Baker Creek, one water and a duplicate sediment sample collected.

Site#3, Niven Lake outflow @ GSL, one water and sediment sample collected.

Site#4, Peace River Flats @ GSL, one water and sediment sample collected.

Site#5, Causeway @ GSL, one water and sediment sample collected.

Site#6, Ndilo dock (west side of Latham Is.), one water and sediment sample collected.

Site#13, Tip of Latham Island, one water and sediment sampled collected. Rescued one common loon caught in fishing net near the sampling site.

One extra water sample was taken on this sampling trip, approximately half way in between Baker Creek @ GSL and the Tip of Latham Island on the same line of site. This was done to check on Total Ammonia movement from the Baker Creek outflow. It was found to be 0.071 ppm as opposed to the Baker Creek value of 5.53 ppm.

Note: On this sampling trip, the water sample taken at Baker Creek was just upstream past the break waters, normally the sample is collected in the break water area.

Site#7, DFO/Joliffe Island, one water and sediment sample collected.

August 11, 1993 Maximum Air Temperature: +14.1
Minimum Air Temperature: + 6.1

Personnel: (Day 2) Francis Jackson and Wayne Puznicki

Site#10, Peg Outflow @ GSL, one water and a triplicate sediment sample collected at this site.

Site#9, Meg outflow @ GSL, one water and a triplicate sediments sample collected.

Site#11, Dettah dock @ GSL, one water and sediment sample collected.

Site#8, Emergency Water Pumphouse @ GSL, one water and a triplicate sediment sample collected.

COLLECTION #5-UNDER ICE

January 31, 1994 Maximum Air Temperature: -16.4
Minimum Air Temperature: -26.2

Personnel: (Day 1) Francis Jackson and Wayne Puznicki

Note: All water samples were taken through motorized auger drilled holes using the grab sampling technique for the following sites:

Site#10, Peg outflow @ GSL. One water sample collected.

Site#9, Meg at GSL. One water sample collected.

Site#11, Dettah. A triplicate water sample and field blank collected.

Site#8, EWI. One water sample collected.

Site#7, DFO/Joliffe Island. One water sample collected

Site#13, Tip of Latham Island. One water sample collected

Site#6, Ndilo dock. One water sample collected.

February 01, 1994 Maximum Air Temperature: -18.1
Minimum Air Temperature: -25.6

Personnel: (Day 2) Francis Jackson and Wayne Puznicki

Site#1. Yk River near the mouth. One water sample collected.

Site#12. Old Giant Tailings release area. One water sample and field blank collected.

Site#2. Baker Creek @ GSL. One water sample collected.

Site#3. Niven Lake outflow @ GSL. One water sample collected.

Site#4. Peace R. Flats @ GSL. One water sample collected.

Site#5. Causeway @ GSL. One water sample collected.

COLLECTION #6-UNDER ICE

March 28, 1994 Maximum Air Temperature: -7.3
Minimum Air Temperature: -18.9

Personnel: (Day 1) Francis Jackson and Wayne Puznicki. Community representatives were not available to assist on field trip.

Note: All water samples were taken through motorized auger drilled holes using the grab sampling technique for the following sites:

Site#10. Peg outflow @ GSL. One water sample collected

Site#9. Meg outflow @ GSL. One water sample collected.

Site #11. Dettah at the dock. One water sample collected.

Site#8. Emergency Water Pumphouse @ GSL. One water sample collected.

Site#7. Between DFO dock and Joliffe Island. A triplicate water sample was collected.

Site#13. Tip of Latham Island. One water sample collected

Site#6. Ndilo dock, west side of Latham Island @ GSL. One water sample collected.

A field blank was collected on this date at Old Giant tailings release area, the roaster was operating on this date as well, there was a strong sulphur smell in the air and the wind was blowing off shore.

March 29, 1994 Maximum Air Temperature: -1.5
Minimum Air Temperature: -13.4

Personnel: (Day 2) Francis Jackson and Wayne Puznicki

Site#1. YK River near the mouth. One water sample collected.

Site#12. Old Giant Tailings Release area. One water sample collected.

Site#2. Baker Creek @ the breakwater (GSL). One water sample collected.

Site#3. Niven Lake outflow @ GSL. One water sample collected.

Site#4. Peace River Flats @ GSL. One water sample collected.

Site#5. Causeway @ GSL. One water sample collected.

Field blank collected at Site #3.

Appendix 8. Health Risk Assessment for water use in the Yellowknife-Back Bay areas conducted by Mackenzie Regional Health Services.

MACKENZIE
REGIONAL HEALTH SERVICE

July 29, 1996

Francis Jackson
Pollution Control Specialist
Indian and Northern Affairs Canada
Box 1500
Yellowknife, NT, X1A 2R3

Frank Hamilton
Senior Health Officer
MacKenzie Regional Health Service
Yellowknife

Dear Mr. Jackson:

RE: YK-BACK BAY Study - Health Assessment (revised)

The Back Bay study results have shown that most of the contaminants that exceed the MAC's are not in locations that would normally have a direct affect on human health. ie. Bakers Creek & Peg Lake. The public should not consume water in these areas.

The faecal and total coliform results are as expected and therefore the public should not be consuming untreated surface water. This is a fact and a policy anywhere in Canada.

Turbidity levels have been elevated which usually becomes a concern for disinfection of drinking water The City must continue to diligently monitor turbidity on a daily basis.

The water quality for recreational purposes is satisfactory.

Frank Hamilton
Senior Health Officer
MacKenzie Regional Health Service

Appendices (9-11)

Sediment Section

Appendix 9. Raw data for sediment samples collected September 1992.

Samples collected in September, 1992.													
Station Name	**Yk River**	**Baker Ck.**				**Niven Lake**	**Peace R. Flats**	**Causeway**	**Ndilo dock**	**DFO/Jolliffe**			
Site Number	**1**	**2**	**2**	**2**	**2**	**3**	**4**	**5**	**6**	**7**	**7**	**7**	
Parameters													
					MEAN								**MEAN**
% Moisture	40.1	40.2	43.2	43.7	**42.367**	19.1	57.1	52.3	39.3	33.9	33.9	33.9	**33.9**
Arsenic	3.88	2660	2480	2510	**2550**	16.1	65.7	92.7	53	34.2	36.7	31.6	**34.167**
Barium	117	94.1	92.3	98.7	**95.033**	23.5	201	175	180	131	131	132	**131.33**
Cadmium	<	0.83	0.81	0.87	**0.8367**	<	<	0.47	<	0.29	<	0.34	**0.21**
Chromium	39.7	51.2	48.6	49.4	**49.733**	14	45	53.6	37.6	33.5	34.5	32.6	**33.533**
Cobalt	9.4	25.2	24.7	24.1	**24.667**	3.1	13.3	13.3	11.4	7.9	7.6	8.2	**7.9**
Copper	17.9	726	436	440	**534**	6.2	55	110	43.8	40.2	41.2	39.3	**40.233**
Lead	6.4	125	109	115	**116.33**	1.6	13.8	43.8	9.7	22.1	29.4	14.9	**22.133**
Mercury	0.008	0.15	0.14	0.12	**0.1367**	0.003	0.024	0 54	0.013	0.029	0.029	0.029	**0.029**
Molybdenum	<	<	<	<	<	<	<	<	<	<	<	<	<
Nickel	23.8	65	59.2	60.2	**61.467**	9.2	32.3	33.6	28.3	23.4	22.5	24.4	**23.433**
Selenium	<	<	<	<	<	<	<	<	<	<	<	<	<
Silver	<	<	<	<	<	<	<	<	<	<	<	<	<
Tin	<	<	<	<	<	<	<	<	<	<	<	<	<
Zinc	56.6	338	325	362	**341.67**	21.3	86.3	108	66.5	66.7	66.5	66.8	**66.667**
Aluminum	16800	19600	18200	19400	**19067**	5340	20600	22400	19700	14800	15200	14300	**14767**
Antimony	<	17	14	15	**15.333**	<	<	<	<	<	<	<	<
Beryllium	<	<	<	<	<	<	<	<	<	<	<	<	<
Boron	42.4	68.9	68.8	67	**68.233**	18	58.4	61	53.2	40.3	40.2	40.4	**40.3**
Calcium	3240	10100	8030	8050	**8726.7**	1640	3790	5040	3870	3270	3310	3220	**3266.7**
Iron	22600	40100	38200	38900	**39067**	9100	29900	31700	28000	21900	21900	21900	**21900**
Magnesium	8230	14000	12900	12700	**13200**	2820	9060	10960	9030	6710	6670	6750	**6710**
Manganese	243	442	405	418	**421.67**	107	464	325	547	238	236	240	**238**
Phosphorus	1430	1700	1760	1730	**1730**	1120	1700	1900	1500	1530	1550	1510	**1530**
Potassium	2870	2020	1970	2320	**2103.3**	473	3420	3060	3080	2180	2470	1890	**2180**
Sodium	304	286	282	339	**302.33**	107	400	420	378	254	284	223	**253.67**
Strontium	22.1	25.2	24.3	27.6	**25.7**	5.3	35.6	30.9	34.9	23.8	25	22.6	**23.8**
Titanium	546	369	370	405	**381.33**	161	518	789	469	296	332	261	**296.33**
Vanadium	35.2	49.2	46.8	48.2	**48.067**	12.6	45.5	49.4	37.3	31.2	32.3	30.1	**31.2**

*****(All results expressed in micrograms per gram (µg/g) on a dry weight basis.)**
*****("<" = Less than detection)**

Appendix 9. continued

Station Name	EWI					MEG	PEG	Dettah			Giant	TLI		
Site Number	**8**	**8**	**8**	**8**		**9**	**10**	**11**	**11**		**12**	**13**	**13**	**13**
Parameters														
					MEAN					**MEAN**				
% Moisture	33.8	39.3	35.2	31.5	**34.95**	25.5	52	16.9	20.7	**18.8**	24.9	35.9	35.9	35.9
Arsenic	109	134	141	103	**121.75**	28.4	125	9.84	5.65	**7.745**	953	8.28	7.68	8.89
Barium	149	133	120	127	**132.25**	35.2	157	19.3	49.2	**34.25**	9.3	186	176	196
Cadmium	<	<	0.26	<	**0.26**	<	0.5	<	<	<	0.44	<	<	<
Chromium	41.9	41.8	41.2	40.6	**41.375**	39.4	45.2	20.2	27	**23.6**	16.8	33.1	31.4	34.7
Cobalt	12.2	12.5	12.1	11.3	**12.025**	8.9	17.7	4	5.1	**4.55**	6.3	8.8	8.6	9.1
Copper	62	62.9	60.3	57.5	**60.675**	10.2	44	14.4	12.9	**13.65**	19.8	22.8	23.1	22.5
Lead	16.3	17.3	16.8	15.7	**16.525**	5.2	10.9	3.2	4.3	**3.75**	32.2	7.3	6.8	7.9
Mercury	0.019	0.02	0.022	0.027	**0.022**	0.006	0.025	0.002	0.002	**0.002**	0.061	0.01	0.01	0.009
Molybdenum	<	<	<	<	<	<	<	<	<	<	<	<	<	<
Nickel	31.1	49.6	30.5	37.5	**37.175**	27	49.8	12.7	15	**13.85**	16.3	21.8	20.6	23
Selenium	<	<	<	<	<	<	0.8	<	<	<	<	<	<	<
Silver	<	<	<	<	<	<	<	<	<	<	<	<	<	<
Tin	<	<	<	<	<	<	<	<	<	<	<	<	<	<
Zinc	74.2	74.7	70.2	69	**72.025**	48.4	111	23.4	26.5	**24.95**	101	48	45.7	50.4
Aluminum	18200	16500	16100	16700	**16875**	13200	21700	5240	9070	**7155**	10400	17900	16600	19200
Antimony	<	<	<	<	<	<	<	<	<	<	<	<	<	<
Beryllium	<	<	<	<	<	<	<	<	<	<	<	<	<	<
Boron	47	45.5	44.1	43.5	**45.025**	42.6	53.4	19.3	28.6	**23.95**	54	43	40.8	45.2
Calcium	3980	3770	3990	3780	**3880**	2250	9210	1360	1870	**1615**	63900	3520	3450	3590
Iron	26200	26400	24100	24300	**25250**	26000	28400	10700	15700	**13200**	39100	24800	23700	25800
Magnesium	8800	8590	8050	8280	**8430**	9210	8730	4030	5690	**4860**	34500	8900	8520	9280
Manganese	359	371	333	339	**350.5**	279	232	116	152	**134**	1300	329	318	340
Phosphorus	1670	1690	1710	1660	**1682.5**	1230	1250	999	938	**968.5**	710	1080	1010	1150
Potassium	2670	2600	2650	2410	**2582.5**	550	2760	428	1210	**819**	<	3350	3110	3590
Sodium	363	352	366	342	**355.75**	127	1846	70	174	**122**	32.9	462	442	482
Strontium	29.7	25.2	25.4	25.7	**26.5**	9.3	178	4.5	8.5	**6.5**	25.9	36.7	33	40.3
Titanium	548	499	536	528	**527.75**	439	72.7	108	269	**188.5**	41.1	300	280	321
Vanadium	38.5	37.3	37.9	36.6	**37.575**	40.6	39.2	14.4	21.9	**18.15**	30.6	31.7	30.3	33.2

*****(All results expressed in micrograms per gram (µg/g) on a dry weight basis.)**
*****("<" = Less than detection)**

Appendix 10. Raw data for sediment samples collected June 1993.

Samples collected in June, 1993.									
Station Name	**Yk River**			**Baker Ck.**				**Niven Lake**	**Peace R. Flats**
Site Number	**1**	**1**	**1**	**2**	**2**	**2**	**2**	**3**	**4**
Parameters									
			MEAN				**MEAN**		
% Moisture	39.1	36.1	**37.6**	30.7	33.6	32.4	**32.23333**	18.7	27.6
Total Organic Carbon	0.74	0.56	**0.65**	0.73	1.14	0.95	**0.94**	0.09	0.32
Arsenic	2.67	2.25	**2.46**	1380	1350	1280	**1336.667**	8.92	12.7
Barium	90.8	87.2	**89**	90.1	97.7	93.1	**93.63333**	26	33.6
Cadmium	<	<	**<**	0.68	0.63	0.6	**0.636667**	<	<
Chromium	30.1	28.1	**29.1**	35.5	37.1	35.1	**35.9**	14.9	13.2
Cobalt	8.7	7.5	**8.1**	23.7	22.7	22.4	**22.93333**	2.9	3.1
Copper	15.1	15	**15.05**	355	320	281	**318.6667**	8.9	20.2
Lead	4.9	4.8	**4.85**	108	90.6	80.2	**92.93333**	2	4.5
Mercury	0.009	0.008	**0.0085**	0.13	0.12	0.11	**0.12**	0.007	0.011
Molybdenum	<	<	**<**	<	<	<	**<**	<	<
Nickel	21	19.7	**20.35**	62.8	63.1	59.7	**61.86667**	9.7	9.7
Selenium	<	<	**<**	<	<	<	**<**	<	<
Silver	<	<	**<**	1.8	1.8	<	**1.8**	<	<
Tin	<	<	**<**	<	<	<	**<**	<	<
Zinc	46.5	42.2	**44.35**	273	275	250	**266**	24.5	46.6
Aluminum	16400	14800	**15600**	19500	19900	19100	**19500**	6090	5950
Antimony	<	<	**<**	140	132	115	**129**	<	<
Beryllium	<	<	**<**	<	<	<	**<**	<	<
Boron	15.1	10.3	**12.7**	11.8	11.6	10.6	**11.33333**	3.7	5.3
Calcium	3430	3180	**3305**	11600	11500	10500	**11200**	2080	2130
Iron	20900	18800	**19850**	35300	36100	34100	**35166.67**	10500	8960
Magnesium	7040	6420	**6730**	12600	12900	12200	**12566.67**	3150	2760
Manganese	227	206	**216.5**	420	405	412	**412.3333**	119	114
Phosphorus	979	957	**968**	1410	1440	1360	**1403.333**	1200	1130
Potassium	3600	3030	**3315**	2890	2950	2650	**2830**	832	923
Sodium	326	272	**299**	309	320	307	**312**	141	167
Strontium	26	23.4	**24.7**	27.3	27.5	27.7	**27.5**	7.4	8.8
Titanium	412	394	**403**	237	222	237	**232**	119	185
Vanadium	39.6	34.7	**37.15**	53.7	53.3	51.8	**52.93333**	17.1	15.8

*****(All results expressed in micrograms per gram (µg/g) on a dry weight basis.)**
*****("<" = Less than detection)**

Appendix 10. continued

Station Name	Causeway					Ndilo dock	DFO/JI	EWI	MEG	PEG	Dettah	Giant	Tip of Latham
Site Number	5	5	5	5	5	6	7	8	9	10	11	12	13
Parameters													
					MEAN								
% Moisture	55.2	49	54.5	54.2	53.225	59	43.4	53.2	29	62.3			
Total Organic Carbon	0.68	0.71	0.92	0.95	0.815	0.7	0.76	1.78	0.36	5.52	50.2	27.9	27.8
Arsenic	93.9	103	116	107	104.98	57.1	89.7	866	58.8	393	7.82	1220	62.1
Barium	150	146	155	131	145.5	114	110	97.3	77.6	158	40	10.6	33.7
Cadmium	0.64	0.65	0.59	0.55	0.6075	0.37	<	0.59	0.31	0.73	0.25	0.34	<
Chromium	51.9	53	55	51	52.725	36.8	35.1	48	40.6	43.8	18.2	5.3	15.1
Cobalt	16.4	14.5	13.4	12.7	14.25	10.7	8.1	28.6	12.4	18.9	5.5	8	3.5
Copper	150	152	155	128	146.25	46.4	131	162	19.4	69.6	18	25.7	25.7
Lead	43	44.1	44.8	41.6	43.375	11.8	28.6	54.4	9.8	9.7	4.7	39.9	5.1
Mercury	0.6	0.56	0.59	0.52	0.5675	0.022	0.046	0.076	0.011	0.028	0.004	0.064	0.009
Molybdenum	<	<	<	<		<	<	<	<	<	<	<	<
Nickel	40.9	39.1	39.5	34.5	38.5	27.2	27.2	56.6	40.6	70.5	21.8	20.4	10
Selenium	<	<	<	<		<	<	<	<	0.6	<	<	<
Silver	<	<	<	<		<	<	<	<	<	<	1.8	<
Tin	<	<	<	<		<	<	<	<	<	<	<	<
Zinc	128	128	121	109	121	68.8	95	254	67.9	108	25.5	115	28.1
Aluminum	25500	25200	26600	23200	25125	18700	16100	20800	16900	29400	6480	11500	7000
Antimony	<	<	<	<		<	<	13	<	<	<	18	<
Beryllium	<	<	<	<		<	<	<	<	<	<	<	<
									<	<	<	<	<
Boron	19.1	19	19.7	16.5	18.575	15.8	14	28	6.2	39.5	10.9	5.3	5.3
Calcium	5210	5150	5370	4980	5177.5	4590	3970	11100	2560	12500	3860	55700	2370
Iron	32100	32300	33800	31500	32425	24800	22300	43000	34800	28700	13600	39000	11200
Magnesium	11590	11500	11900	10700	11423	7900	6660	13400	10600	8360	4750	31400	3370
Manganese	328	316	324	317	321.25	400	249	473	582	206	147	1210	177
Phosphorus	1790	2240	2330	2150	2127.5	1460	1910	1880	1670	1880	1200	931	1140
Potassium	4860	4760	4720	4450	4697.5	4370	2910	2690	1440	5360	2000	559	1080
Sodium	546	531	564	496	534.25	480	351	453	159	1530	200	87	195
Strontium	35.5	35.4	38.1	33.4	35.6	32	28.3	24.3	15	237	12.7	22.2	10.6
Titanium	873	1090	1160	951	1018.5	544	577	633	203	584	346	71	355
Vanadium	62.8	63.8	67.7	59.3	63.4	48	43	62.6	50.3	61.9	29.1	39.9	19.5

***(All results expressed in micrograms per gram (µg/g) on a dry weight basis.)
***("<" = Less than detection)

Appendix 11. Raw data for sediment samples collected August 1993.

Samples collected in August, 1993.												
Station Name	**Yk River**				**Baker Ck.**			**Niven Lake**	**Peace R.Flats**	**Causeway**	**Ndilo dock**	**DFO/JI**
Site Number	**1**	**1**	**1**	**1**	**2**	**2**	**2**	**3**	**4**	**5**	**6**	**7**
Parameters												
				MEAN			**MEAN**					
% Moisture	21.2	21.5	20.3	**21**	14.5	30	**22.25**	21.3	42.9	42.5	33.1	49.3
Total Organic Carbon	0.16	0.3	0.34	**0.2667**	1.5	1.51	**1.505**	0.09	0.35	1.13	0.33	1.39
Arsenic	2.06	2.04	1.98	**2.0267**	1100	2090	**1595**	19.2	21.8	153	14.4	71.3
Barium	43.8	52.3	42.6	**46.233**	71.1	94.5	**82.8**	19.8	42.2	140	160	163
Cadmium	<	<	<	**<**	0.54	0.82	**0.68**	<	0.3	0.64	<	0.27
Chromium	21.9	22.1	20.5	**21.5**	23	34.3	**28.65**	9.5	16	51.9	27.2	41.8
Cobalt	7.2	8.2	6.5	**7.3**	15.3	23.2	**19.25**	3.2	4.1	15.8	8.8	13.9
Copper	9	10.6	8.4	**9.3333**	334	491	**412.5**	11.1	61.6	158	23.2	86.1
Lead	2.5	3	2.8	**2.7667**	71.8	119	**95.4**	2.7	8.3	46.6	6.2	29.2
Mercury	0.005	0.006	0.005	**0.0053**	0.08	0.12	**0.1**	0.005	0.032	0.52	0.034	0.071
Molybdenum	<	<	<	**<**	<	<	**<**	<	<	<	<	<
Nickel	16.6	17.2	16	**16.6**	46	67.6	**56.8**	7.7	13.7	42.9	23	34.2
Selenium	<	<	<	**<**	<	<	**<**	<	<	<	<	<
Silver	<	<	<	**<**	2.1	3.7	**2.9**	<	<	<	<	<
Tin	<	<	<	**<**	<	<	**<**	<	<	<	<	<
Zinc	38	36	30.4	**34.8**	244	343	**293.5**	25.4	78.7	158	52.1	105
Aluminum	11600	12500	10600	**11567**	13500	17600	**15550**	4530	7430	25200	17700	23100
Antimony	<	<	<	**<**	123	199	**161**	<	<	15	<	<
Beryllium	<	<	<	**<**	<	<	**<**	<	<	<	<	<
Boron	8.8	9.8	7.3	**8.6333**	6.6	9.2	**7.9**	65.3	4.9	13.5	10.4	24.1
Calcium	2100	2300	2410	**2270**	6700	10500	**8600**	1710	2280	5030	3300	4460
Iron	18300	19400	17400	**18367**	25400	34600	**30000**	6740	11700	36900	23200	29100
Magnesium	6080	6470	5830	**6126.7**	8540	11600	**10070**	2180	3390	13200	7690	9330
Manganese	158	164	152	**158**	307	426	**366.5**	73	137	350	443	279
Phosphorus	1010	1040	1420	**1156.7**	948	1410	**1179**	896	1750	1800	858	2050
Potassium	2380	2340	1860	**2193.3**	1710	2200	**1955**	706	1340	3460	3790	4180
Sodium	174	204	167	**181.67**	216	306	**261**	143	183	429	369	443
Strontium	11.9	14.7	12.9	**13.167**	21.6	29.6	**25.6**	6.3	9.4	27.1	29.7	36.1
Titanium	300	315	255	**290**	56	259	**157.5**	155	308	722	417	937
Vanadium	28.5	31.1	26.6	**28.733**	34.1	51	**42.55**	12.7	18.3	63.2	37.7	57

***(All results expressed in micrograms per gram (µg/g) on a dry weight basis.)
***("<" = Less than detection)

Appendix 11. continued

Station Name	EWI				MEG				PEG				DETTAH	Giant				TLI
Site Number	8	8	8	8	9	9	9	9	10	10	10	10	11	12	12	12	12	13
Parameters																		
				MEAN				MEAN				MEAN					MEAN	
% Moisture	41.2	41.1	48	43.433	25.2	20.9	23.1	23.06666667	46.3	51.3	48.2	48.6	29.6	24.8	24.9	24.6	24.767	11.4
Total Organic Carbon	1.78	1.57	1.91	1.7533	0.34	0.29	0.36	0.33	2.26	2.04	2.66	2.32	0.04	0.13	0.05	0.04	0.0733	0.19
Arsenic	80.1	622	725	475.7	61.5	50.1	32.8	48.13333333	190	129	138	152.3333	4.44	1100	1070	1050	1073.3	39.8
Barium	72.8	87.8	88.8	83.133	54.2	52	72.2	59.46666667	98	85.8	91.3	91.7	130	8.4	8.4	7.4	8.0667	31.5
Cadmium	0.37	0.46	0.51	0.4467	<	<	<	<	0.48	0.44	0.49	0.47	<	0.35	0.37	0.36	0.36	<
Chromium	36.9	43.3	44.4	41.533	45	42.9	42	43.3	33.9	35.1	30.8	33.26667	29.6	2.5	3	1.7	2.4	12.3
Cobalt	17.4	22.2	24.5	21.367	10.8	10.7	10.9	10.8	15.7	14.3	13.6	14.53333	8.3	6.7	6.8	6.7	6.7333	3.4
Copper	89.1	111	140	113.37	18.3	17.3	16.8	17.46666667	43.6	36.4	39.5	39.83333	19.4	23.6	23.6	23.4	23.533	21.9
Lead	32.2	40.6	57.8	43.533	5.5	5	5.5	5.333333333	7.3	6.4	6.8	6.833333	5.6	34.7	34.3	33.5	34.167	3.7
Mercury	0.054	0.067	0.077	0.066	0.008	0.008	0.008	0.008	0.021	0.016	0.02	0.019	0.006	0.081	0.076	0.079	0.0787	0.005
Molybdenum	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
Nickel	38	45.6	50.2	44.6	40	38	38.6	38.86666667	48.4	42.9	43.2	44.83333	23.1	18.5	17.7	17.6	17.933	9.6
Selenium	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
Silver	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
Tin	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
Zinc	178	256	222	218.67	69.2	67.7	72.2	69.7	78.6	70.2	72.8	73.86667	49	13.5	125	122	86.833	25.4
Aluminum	15200	16700	17700	16533	17300	16700	16300	16766.666667	22500	22200	22000	22233.33	15900	10700	10800	10200	10567	22450
Antimony	13	<	<	<	<	<	<	<	<	<	<	<	<	17	17	33	22.333	<
Beryllium	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
Boron	83.2	54.5	50.2	62.633	7.5	6.6	8.4	7.5	31.5	29.9	27.1	29.5	10.2	3.4	3.8	3.8	3.6667	4.1
Calcium	11000	10100	10100	10400	2180	2260	2960	2467	9320	8880	8710	8970	6670	65400	64000	63500	64300	2340
Iron	30300	35200	38400	34633	36800	34600	35300	35567	27000	27700	24700	26466.67	23500	39500	39000	38100	38867	9030
Magnesium	9870	11100	11600	10857	11200	10500	9990	10563.333333	8150	8110	6970	7743.333	10600	35200	34600	34000	34600	2610
Manganese	359	400	432	397	500	429	613	514	194	208	185	195.6667	305	1310	1280	1260	1283.3	137
Phosphorus	1590	1710	1900	1733.3	1630	1590	1710	1643.3333333	1610	1680	1380	1556.667	1170	910	907	887	901.33	1260
Potassium	2020	2090	2580	2230	1080	867	1330	1092.3333333	3820	7980	3730	5176.667	3270	404	282	176	287.33	994
Sodium	542	500	491	511	117	124	160	133.66666667	1780	1900	1700	1793.333	426	70	79	67	72	206
Strontium	19.6	21.1	21	20.567	10.8	11.6	15.1	12.5	169	143	160	157.3333	22.2	24.4	24.5	23.4	24.1	9.6
Titanium	543	589	631	587.67	250	190	193	211	557	702	469	576	463	43	63.7	41.8	49.5	336
Vanadium	45.6	51.1	53.8	50.167	55	52	58.8	55.266666667	50.8	53.3	46.9	50.33333	38.9	37.1	37.1	36	36.733	17.1

***(All results expressed in micrograms per gram (µg/g) on a dry weight basis.)
***("<" = Less than detection)

Appendix 12: Relative stage of maturity

A description of the relative stages of maturity used for Yellowknife-Back Bay fishes.

Maturity Codes F	Maturity Codes M	Maturity Stage	
1	6	**Immature:**	-virgin fish, gonad thin and threadlike, often incomplete.
2	7	**Maturing:**	-virgin or non-virgin fish not spawning in current year, gonad full length, firm, eggs of small size, gonads partially filling body cavity.
3	8	**Mature:**	-fish spawning in current year, gonads full size filling body cavity, eggs prominent, full size.
4	9	**Ripe:**	-mature fish in spawning condition, eggs translucent, milt or eggs expelled under slight pressure.
5	10	**Spent:**	-mature fish completed spawning, gonads collapsed with ruptured blood vessels prominent.

NOTE:

When gonads appear to be on the margin of two stages they were noted in the tables with two two numbers, eg. 1-2, 5-2 or 7-8.

Appendix 13. Ageing and the thin-slicing method

Scale method

Scales were the first structure used to age lake whitefish (*Coregonus clupeaformis)* and lake cisco (*Coregonus artedii*).
Scales were selected using a dissecting scope to eliminate regenerated scales. Annuli were read directly from the microfiche screen. Two scales were read to confirm the results.

Cleithrum and Operculum bone

The cleithrum and operculum bone was used to age northern pike *(Esox lucius)* and walleye *(Stizosteidon vitreum),* respectively. Bones were placed in boiling water to remove any soft tissues prior to ageing. Once cleaned and air dried, the age was determined by counting annuli through a dissecting scope with transmitted light.

Fin Rays

Used for longnose sucker *(Catostomus catostomus*).
Pectoral fins were dried at room temperature. Once dried they were coated with liquid epoxy and left to harden on a wax sheet for 48 hours. An Isomet saw (diamond blade 4" x 0.004") was used for slicing the proximal section of the fin rays. Three to five slices (0.5 to 1 mm thick) were cut. The sections were then mounted permanently on microscope slides and labelled. Age was read with a microscope at 4X and 10X using transmitted light.

Otoliths

Used to age lake whitefish (*Coregonus clupeaformis*), lake cisco (*Coregonus artedii*), burbot (*Lota lota*), and lake trout (*Salvelinus namaycush*)

Known methods of ageing were tried extensively. One method called the "crack and burn" where the otoliths are split through the nucleus, roasted over a flame and then embedded upright in plasticine to be read with a dissecting scope. The next method is polishing and grinding the otoliths lengthwise then soaked in green methyl solution until it looks like an opaque window which is then read with a dissecting scope. Very old northern fish with virtually no interannual growth were difficult to age precisely with these methods.

There were two disadvantages to the "crack and burn" method; first, when using the cracking process the otoliths were not always cut through the nucleus which would make the first years of growth absent. Secondly, once roasted (a process necessary to highlight the annuli) the otoliths had the tendency to become brittle and crumble when they were put back loose into ageing envelopes hence reducing the storage life and the possibility of reviewing the age. Finally, there was one disadvantage to the "polishing and grinding" and "read-through" method it worked only with very young fish. Older fish aged with that method have shown that after the normal growth period, their otoliths grew in thickness in periphery, therefore grinding applied to render the otolith translucent caused a loss of annuli.

A **thin-slicing method** was developed to circumscribe the disadvantages previously mentioned and to improve accuracy and consistency. The first step consisted of embedding the otoliths in a V-shape trough lined with "Parafilm" plastic and filled with fast-drying epoxy made of resin and hardener (proportion 2:1). This operation was done under the fume hood. Once properly aligned in the mould the otoliths were then left to dry. Twenty four hours later, the "Parafilm" was cut, the epoxy shaft removed and each individual structure was labelled. Two to three days were necessary to attain the suitable rigidity of the epoxy to allow slicing. Eventually the otoliths were individually separated and fastened on the moving arm of the Isomet saw. Using a diamond blade of 0.004 inches by 4 inches and water as a lubricant, each otolith was sliced 4 to 5 times and as thin as possible (≈0.5 mm) near and through the nucleus. Each individual slice was gently rinsed in water and air-dried. Microscope glass slides (1"x 3") were labelled with the sampling number, location of capture, date and species. Each otolith slice was then mounted permanently in the same order it was cut. "Paramount" slide mounting medium was used working under a fume hood.

Finally, once the mounting medium was dried, the slides were read under a microscope. A "Zeiss" microscope was used with 4X and 10X lenses depending on the density of annuli. The reading was done and accepted when two slices showed the same age.

Appendix 14: D.F.O. sampling procedure.

The fish captured were processed in D.F.O.'s Habitat Laboratory in Yellowknife within 5 hours of removal from the water. Sampling was done on wood and/or Teflon cutting boards. The person handling and processing the fish always wear latex gloves.

The fish tissues were all sampled similarly. Dorsal muscle (>100 g) was collected from the left side of the fish with a filleting knife. Livers were removed with care so that no bile was spilled on them. The kidneys were collected using a spoon. Eggs and stomachs were cut out with scissors. Tissues were individually packed in "Whirlpak" (contaminant free) bags, labelled, quickly frozen on dry ice and kept at minus 40°C in D.F.O.'s walk-in freezer until shipping. The samples were then sent frozen on dry ice for heavy metal evaluation.

Appendix 15: Analytical methodology for the determination of metal concentrations in fish tissues by Robert Hunt, Environmental Chemistry Laboratory, Freshwater Institute, Winnipeg.

The following statements apply to all methods detailed below: All acids used were trace metal analysis grade (concentrated) unless otherwise specified. All water was distilled and deionized. Commercial atomic absorption standards, reagent blanks, and standard reference materials were carried through the entire procedure. Test tubes used for digestion were 25 x 200 mm Pyrex glass and were washed with 10% nitric acid , followed by multiple rinses with deionized water, distilled water prior to use. A time and temperature programmable aluminum block test tube heater was used for the digestion.

Mercury (Hot block digestion - cold vapour atomic absorption method)[1]

A small sub-sample of wet tissue (0.2 g) was digested with 5 mL of 4:1 sulfuric:nitric acids at 180° C. for 12 hours, cooled and diluted to 25 mL with water. Elemental mercury was released from this solution with a stannous chloride reductant and carried by a stream of air to a LDC model 3200 Mercury Monitor for atomic absorption detection.

Arsenic (Borohydride reduction method)[2]

A small sub-sample of wet tissue (0.8 g muscle, 0.4 g liver) was digested with nitric (4 mL), sulfuric (0.5 mL) and perchloric (1 mL) acids for 5 hours at 130° C followed by 2 hours at 200° C. After addition of water (15 mL) and hydrochloric acid (7.5 mL), the solution was heated to 90° C for 1 hour, cooled and adjusted to 25 mL with water. Arsine gas was generated from this solution by the automated addition of 2 % sodium borohydride and 10% potassium iodide solutions and swept by a nitrogen stream into an electrically heated quartz tube furnace (800° C) installed in the burner cavity of a Varian SpectrAA-20 atomic absorption spectrophotometer. Similarly, selenium hydride was generated by the automated addition of 2% sodium borohydride followed by detection in the manner described above.

Copper and Zinc

A sub-sample of wet tissue (5 g muscle, 2 g liver/kidney) was digested with nitric (5 mL), sulfuric (0.5 mL) and perchloric (2 mL) acids for 5 hours at 130°C followed by 2 hours at 200° C. After cooling, the sample was adjusted to 25 mL with water and analysed by air-acetylene flame atomic absorption (Varian SpectrAA-20) with deuterium background correction.

Cadmium, Nickel and Lead

Sample digestion was similar to that described for copper and zinc with the exception that the sulfuric acid component reduced to 0.2 mL. Solutions were then analysed by Zeeman background corrected graphite furnace atomic absorption spectrophotometry (Hitachi model Z8200).

Blanks

Reagent blanks were digested and analysed with each batch of samples. Values reported in the following table have been calculated using the formula given below ($\mu g/g$) so that they may be directly compared to the reported sample concentrations. It should be noted that these reagent blank concentrations vary as a function of method sample weight.

$$\text{Blank } (\mu g/g) = [\text{Blank } (\mu g/L) \times 0.025 \text{ L}] / (\text{method sample weight}) \text{ g}$$

Tissue	Cd	Cu	Zn	Hg	As	Ni
muscle	0.0007	0.03	0.06	0.0011	0.02	0.03
kidney and liver	0.0005	0.06	0.15	0.0011	0.03	0.04

References

1. Hendzel, M.R., and D.M. Jamieson, "Determination of mercury in fish", Anal. Chem., 48, 926-928(1976)

2. Vijan, P.N.,and G.R. Wood. 1974. "An automated submicrogram determination of arsenic in atmospheric particulate matter by flameless atomic absorption spectrophotometry." , A.A. Newsletter 13: 33-37.

Appendices 16-22

Tissue metal and biological results for individual fish samples.

Appendix 23

Photographs of littoral zones throughout the Yellowknife-Back Bay Study Area.

Appendix 16a. Biological descriptors and metal concentrations in the muscle of lake whitefish caught in the Yellowknife-Back Bay area of Great Slave Lake 1992-93.

Lake whitefish *Coregonus clupeaformis* (Mitchill)			Metals (Detection limits ppm)								Biological parameters							
Date sampled	Location	Sample no.	As (0.05)	Cd (0.0001)	Cu (0.10)	Hg (0.005)	Ni (0.02)	Pb (0.03)	Se (0.05)	Zn (0.05)	Length	Weight	Maturity	Scale method	Otolith method	Accepted Age	k-factor	liver wt.
8/25/92	GSL-1	1	0.1	0.0015	0.22	0.04	< 0.02	< 0.03	0.2	3.09	420	1104	8	7	9	9	1.49	-
8/25/92	GSL-1	2	0.08	0.0008	0.21	0.035	< 0.02	< 0.03	0.17	2.66	380	739	7-8	11	10	10	1.35	-
8/25/92	GSL-1	3	0.14	0.0008	0.17	0.048	< 0.02	< 0.03	0.11	3.36	365	754	3	12	13	13	1.55	-
8/25/92	GSL-1	4	0.17	0.0007	0.2	0.069	< 0.02	< 0.03	0.1	2.97	372	588	1	15	16	16	1.14	-
8/25/92	GSL-1	5	0.08	0.0017	0.54	0.048	< 0.02	< 0.03	0.07	4.59	399	1077	8	11	15	15	1.70	-
8/26/92	GSL-1	70	0.17	0.0004	0.2	0.063	0.03	< 0.03	0.26	2.36	408	894	8	10	10	10	1.32	-
8/26/92	GSL-1	71	0.1	0.0008	0.2	0.066	< 0.02	< 0.03	0.2	2.49	406	947	3	10	13	13	1.42	-
8/26/92	GSL-1	72	0.14	0.0006	0.22	0.035	0.03	< 0.03	0.12	2.55	376	-	3	13	10	10	-	-
8/26/92	GSL-1	73	< 0.05	0.0005	0.21	0.081	< 0.02	< 0.03	0.18	2.77	440	1289	3	9	8	8	1.51	-
8/26/92	GSL-1	74	0.06	0.0006	0.24	0.032	0.03	< 0.03	0.18	2.48	374	791	8	13	8	8	1.51	-
8/26/92	GSL-1	75	< 0.05	0.0004	0.27	0.058	< 0.02	< 0.03	0.2	2.62	372	606	1-2	8	7	7	1.18	-
8/26/92	GSL-1	76	0.07	0.0004	0.27	0.041	< 0.02	< 0.03	0.14	2.9	367	598	6	10	10	10	1.21	-
8/26/92	GSL-1	77	0.12	0.0006	0.22	0.087	0.03	< 0.03	0.1	2.87	405	789	2	15	14	14	1.19	-
8/26/92	GSL-1	78	0.16	0.0005	0.28	0.033	0.03	< 0.03	0.13	2.75	408	938	2	11	9	9	1.38	-
8/26/92	GSL-1	79	0.06	0.0006	0.55	0.029	0.05	< 0.03	0.26	2.53	422	1093	8	10	9	9	1.45	-
8/26/92	GSL-1	80	0.12	0.0004	0.22	0.04	0.04	< 0.03	0.18	2.73	395	936	3	13	11	11	1.52	-
8/26/92	GSL-1	81	< 0.05	0.0005	0.24	0.066	< 0.02	< 0.03	0.12	2.86	325	431	2	7	5	5	1.26	-
8/26/92	GSL-1	82	< 0.05	0.0003	0.16	0.035	0.03	< 0.03	0.19	2.22	411	968	8	11	12	12	1.39	-
8/26/92	GSL-1	83	0.05	0.0005	0.18	0.03	< 0.02	< 0.03	0.21	2.44	420	1120	8	11	9	9	1.51	-
8/26/92	GSL-1	84	0.1	0.0005	0.14	0.051	< 0.02	< 0.03	0.18	2.9	399	851	2	13	14	14	1.34	-
8/26/92	GSL-1	85	< 0.05	0.0005	0.3	0.048	< 0.02	< 0.03	0.18	2.98	424	1055	8	14	11	11	1.38	-
8/26/92	GSL-1	86	0.08	0.0003	0.29	0.047	< 0.02	< 0.03	0.19	3.09	367	626	8	10	8	8	1.27	-
8/26/92	GSL-1	87	0.31	0.0005	0.19	0.094	< 0.02	< 0.03	0.23	2.5	412	991	8	13	11	11	1.42	-
8/26/92	GSL-1	88	0.08	0.0005	0.16	0.033	0.12	< 0.03	0.22	4.26	416	1061	8	12	9	9	1.47	-
8/26/92	GSL-1	89	0.07	0.0004	0.15	0.019	< 0.02	< 0.03	0.19	2.26	388	810	8	12	8	8	1.39	-
8/26/92	GSL-1	90	0.2	0.001	0.18	0.045	< 0.02	< 0.03	0.15	2.63	374	753	8	13	13	13	1.44	-
8/26/92	GSL-1	91	0.17	0.0005	0.23	0.06	< 0.02	< 0.03	0.17	2.6	395	961	8	12	13	13	1.56	-
8/26/92	GSL-1	92	0.11	0.0006	0.27	0.053	0.03	< 0.03	0.2	3.31	412	1118	8	12	9	9	1.60	-
8/26/92	GSL-1	93	0.14	0.0014	0.25	0.05	< 0.02	< 0.03	0.19	4.19	413	894	8	10	7	7	1.27	-
8/26/92	GSL-1	94	< 0.05	0.0006	0.2	0.028	0.03	< 0.03	0.22	2.52	373	748	8	12	10	10	1.44	-
3/12/93	GSL-1	349	0.06	0.001	0.19	0.037	< 0.02	< 0.03	0.2	3.28	346	520	6	9	-	9	1.26	-
3/12/93	GSL-1	350	0.17	0.001	0.25	0.036	< 0.02	< 0.03	0.24	3.32	324	420	6	10	-	10	1.23	-
3/12/93	GSL-1	351	0.21	0.0001	0.26	0.083	< 0.02	< 0.03	0.21	2.46	402	869	7	13	-	13	1.34	-
3/12/93	GSL-1	352	0.06	0.001	0.18	0.223	< 0.02	< 0.03	0.11	2.26	419	887	7	11	-	11	1.21	-
3/12/93	GSL-1	353	0.12	0.003	0.29	0.047	< 0.02	< 0.03	0.13	3.65	325	451	6	8	-	8	1.31	-
3/12/93	GSL-1	354	0.22	0.001	0.21	0.047	< 0.02	< 0.03	0.19	2.48	374	810	1	13	-	13	1.55	-
3/12/93	GSL-1	355	0.33	0.001	0.21	0.044	< 0.02	< 0.03	0.22	2.76	377	783	6-7	13	-	13	1.46	-
3/12/93	GSL-1	356	0.09	0.001	0.3	0.038	< 0.02	< 0.03	0.2	3.09	299	480	6	9	-	9	1.80	-
8/25/92	GSL-2	20	0.11	0.0006	0.2	0.041	< 0.02	< 0.03	0.29	2.92	412	965	8	9	6	6	1.38	-
8/25/92	GSL-2	21	0.31	0.0009	0.21	0.067	< 0.02	< 0.03	0.24	2.53	421	1126	3	14	16	16	1.51	-
8/25/92	GSL-2	22	0.16	0.0009	0.28	0.053	< 0.02	< 0.03	0.16	2.67	399	989	3	15	15	15	1.56	-
8/25/92	GSL-2	23	0.32	0.0016	0.41	0.054	< 0.02	< 0.03	0.17	2.88	367	702	2-3	12	13	13	1.42	-
8/25/92	GSL-2	24	0.09	0.0005	0.24	0.045	< 0.02	< 0.03	0.26	2.34	434	1126	7	1	10	10	1.38	-
8/25/92	GSL-2	25	0.11	0.0008	0.22	0.05	< 0.02	< 0.03	0.34	2.42	408	914	8	11	9	9	1.35	-
8/25/92	GSL-2	26	0.18	0.0011	0.21	0.037	< 0.02	< 0.03	0.14	2.65	425	895	8	12	13	13	1.17	-
8/25/92	GSL-2	27	0.35	0.001	0.17	0.018	< 0.02	< 0.03	0.16	2.43	406	992	3	11	15	15	1.48	-
8/25/92	GSL-2	28	0.14	0.001	0.24	0.045	< 0.02	< 0.03	0.23	2.34	361	655	7-8	9	7	7	1.39	-
8/25/92	GSL-2	29	0.28	0.0016	0.19	0.045	< 0.02	< 0.03	0.25	2.45	405	815	8	13	14	14	1.23	-
8/25/92	GSL-2	30	0.47	0.0011	0.21	0.046	< 0.02	< 0.03	0.14	2.42	400	877	3	14	13	13	1.37	-
8/25/92	GSL-2	31	0.25	0.0012	0.18	0.053	< 0.02	< 0.03	0.2	2.17	379	823	3	11	14	14	1.51	-
8/25/92	GSL-2	32	0.1	0.0012	0.29	0.04	< 0.02	< 0.03	0.2	2.85	401	910	3	11	10	10	1.41	-
8/25/92	GSL-2	33	0.3	0.0015	0.31	0.054	< 0.02	< 0.03	0.2	2.94	367	689	3	11	12	12	1.39	-
8/25/92	GSL-2	34	0.43	0.0018	0.29	0.017	< 0.02	< 0.03	0.17	2.33	374	755	3	15	14	14	1.44	-
8/26/92	GSL-2	113	0.55	0.0012	0.2	0.043	< 0.02	< 0.03	0.05	2.65	395	871	3	12	14	14	1.41	-
8/26/92	GSL-2	114	< 0.05	0.001	0.28	0.052	< 0.02	< 0.03	0.15	2.54	399	816	3	11	14	14	1.28	-

Appendix 16a. continued

Lake whitefish *Coregonus clupeaformis* (Mitchill)			Metals (Detection limits ppm)								Biological parameters							
Date sampled	Location	Sample no.	As (0.05)	Cd (0.0001)	Cu (0.10)	Hg (0.005)	Ni (0.02)	Pb (0.03)	Se (0.05)	Zn (0.05)	Length	Weight	Maturity	Scale method	Otolith method	Accepted Age	k-factor	liver wt.
8/26/92	GSL-2	115	0.29	0.0006	0.23	0.037	< 0.02	< 0.03	0.16	2.73	359	617	8	10	9	9	1.33	-
8/26/92	GSL-2	116	0.41	0.0005	0.24	0.043	< 0.02	< 0.03	0.11	2.68	358	640	8	10	11	11	1.39	-
8/26/92	GSL-2	117	0.15	0.0005	0.25	0.054	< 0.02	< 0.03	0.07	2.6	394	902	3	13	11	11	1.47	-
8/26/92	GSL-2	118	0.05	0.0004	0.27	0.031	< 0.02	< 0.03	0.18	2.39	392	782	3	9	9	9	1.30	-
8/26/92	GSL-2	119	0.21	0.0005	0.22	0.05	< 0.02	< 0.03	0.18	2.31	374	757	3	12	13	13	1.45	-
8/26/92	GSL-2	120	0.18	0.0006	0.22	0.02	< 0.02	< 0.03	0.09	2.58	370	696	3	10	13	13	1.37	-
8/26/92	GSL-2	121	0.38	0.0002	0.25	0.042	< 0.02	< 0.03	0.16	2.54	425	1081	3	14	11	11	1.41	-
8/26/92	GSL-2	122	0.3	0.001	0.25	0.05	< 0.02	< 0.03	0.15	2.28	417	918	8	12	12	12	1.27	-
3/12/93	GSL-2	364	0.07	0.001	0.18	0.083	< 0.02	< 0.03	0.1	2.49	397	902	2	14	-	14	1.44	-
3/12/93	GSL-2	365	0.06	0.001	0.22	0.155	< 0.02	< 0.03	0.23	2.54	432	1045	7	15	-	15	1.30	-
3/12/93	GSL-2	366	0.47	0.001	0.28	0.066	< 0.02	< 0.03	0.31	3.74	391	845	2	10	-	10	1.41	-
3/12/93	GSL-2	367	0.13	0.001	0.22	0.061	< 0.02	< 0.03	0.31	2.79	354	583	2	9	-	9	1.31	-
3/12/93	GSL-2	368	0.07	0.001	0.18	0.06	< 0.02	< 0.03	0.17	2.89	450	1409	3	14	-	14	1.55	-
8/25/92	GSL-3	40	0.17	0.001	0.22	0.048	< 0.02	< 0.03	0.27	2.33	434	1317	3	8	8	8	1.61	-
8/25/92	GSL-3	41	0.12	0.0014	0.17	0.068	< 0.02	< 0.03	0.19	2.81	458	1217	2	11	16	16	1.27	-
8/25/92	GSL-3	42	0.22	0.0018	0.38	0.059	< 0.02	< 0.03	0.42	2.62	435	1244	2	12	11	11	1.51	-
8/25/92	GSL-3	43	1.11	0.0006	0.2	0.082	< 0.02	< 0.03	0.34	2.06	423	1173	8	13	13	13	1.55	-
8/25/92	GSL-3	44	0.44	0.0013	0.22	0.067	< 0.02	< 0.03	0.36	2.31	406	927	3	13	13	13	1.39	-
8/25/92	GSL-3	45	0.38	0.0007	0.15	0.057	< 0.02	< 0.03	0.49	1.3	425	1255	2	13	6	6	1.63	-
8/25/92	GSL-3	46	0.19	0.0014	0.29	0.056	< 0.02	< 0.03	0.33	2.8	478	1459	2	13	14	14	1.34	-
8/25/92	GSL-3	47	0.29	0.0016	0.23	0.051	< 0.02	< 0.03	0.46	2.41	368	645	6	12	7	7	1.29	-
8/25/92	GSL-3	48	0.16	0.0014	0.45	0.03	< 0.02	< 0.03	0.39	2.27	392	827	2	9	8	8	1.37	-
8/25/92	GSL-3	49	0.09	0.0011	0.33	0.033	< 0.02	< 0.03	0.5	2.68	402	842	8	12	7	7	1.30	-
8/25/92	GSL-3	50	0.22	0.0015	0.58	0.068	< 0.02	< 0.03	0.69	2.85	437	1282	2	14	21	21	1.54	-
8/25/92	GSL-3	51	0.06	0.0011	0.25	0.041	< 0.02	< 0.03	0.82	2.31	371	693	2	9	8	8	1.36	-
8/25/92	GSL-3	57	0.31	0.0016	0.22	0.069	< 0.02	< 0.03	0.41	2.14	408	956	3	11	12	12	1.41	-
8/25/92	GSL-3	58	0.17	0.0015	0.21	0.037	< 0.02	< 0.03	0.27	2.07	439	1183	8	12	13	13	1.40	-
8/25/92	GSL-3	59	0.1	0.0018	0.23	0.058	< 0.02	< 0.03	0.29	2.36	380	434	8	12	10	10	0.79	-
8/25/92	GSL-3	60	0.31	0.0016	0.2	0.069	< 0.02	< 0.03	0.45	2.08	415	1116	3	13	13	13	1.56	-
8/25/92	GSL-3	61	0.27	0.0009	0.2	0.058	< 0.02	< 0.03	0.16	2.42	437	1263	3	13	12	12	1.51	-
8/25/92	GSL-3	62	0.16	0.0006	0.19	0.063	< 0.02	< 0.03	0.52	2.5	406	934	3	13	9	9	1.40	-
8/25/92	GSL-3	63	0.16	0.0019	0.19	0.027	< 0.02	< 0.03	0.53	2.39	443	1281	n/a	13	13	13	1.47	-
8/25/92	GSL-3	64	0.05	0.0016	0.23	0.035	< 0.02	< 0.03	0.65	2.75	340	502	1	10	8	8	1.28	-
8/25/92	GSL-3	65	< 0.05	0.0011	0.24	0.035	< 0.02	< 0.03	0.72	2.64	298	377	6	8	6	6	1.42	-
8/25/92	GSL-3	66	< 0.05	0.0014	0.24	0.053	< 0.02	< 0.03	0.76	2.19	390	855	3	10	10	10	1.44	-
5/5/93	GSL-3	219	0.29	0.0008	0.25	0.045	< 0.02	< 0.03	0.23	2.95	403	992	7	12	-	12	1.52	-
5/5/93	GSL-3	220	0.38	0.001	0.23	0.04	< 0.02	< 0.03	0.3	3.36	404	894	1-2	10	-	10	1.36	-
5/5/93	GSL-3	221	0.35	0.0003	0.16	0.035	< 0.02	< 0.03	0.35	4.95	405	951	7	8	-	8	1.43	-
5/5/93	GSL-3	227	0.13	0.0003	0.55	0.118	< 0.02	< 0.03	0.27	2.53	421	1015	3-4	11	-	11	1.36	-
5/5/93	GSL-3	228	0.11	0.0005	0.28	0.049	< 0.02	< 0.03	0.29	3.13	415	1018	6	13	-	13	1.42	-
5/5/93	GSL-3	229	0.5	0.0003	0.18	0.045	< 0.02	< 0.03	0.47	3.08	440	1178	3-4	11	-	11	1.38	-
5/5/93	GSL-3	230	0.42	0.0007	0.55	0.047	< 0.02	< 0.03	0.22	2.79	431	1247	3-4	13	-	13	1.56	-
5/5/93	GSL-3	231	0.33	0.0017	0.77	0.044	< 0.02	< 0.03	0.38	2.99	387	802	3	8	-	8	1.38	-
5/5/93	GSL-3	232	0.28	0.0007	0.55	0.09	< 0.02	< 0.03	0.44	2.45	490	828	6	8	-	8	0.70	-
5/5/93	GSL-3	233	0.16	0.0007	0.7	0.068	< 0.02	< 0.03	0.39	2.8	376	707	7	8	-	8	1.33	-
3/7/93	GSL-3	303	0.43	0.008	0.4	0.049	< 0.02	< 0.03	0.17	2.48	451	1478	7	12	-	12	1.61	-
3/7/93	GSL-3	304	0.39	0.005	0.29	0.057	< 0.02	< 0.03	0.26	2.59	432	1012	2	11	-	11	1.26	-
3/7/93	GSL-3	305	0.21	0.007	0.24	0.052	< 0.02	< 0.03	0.21	2.73	430	1211	2	11	-	11	1.52	-
3/8/93	GSL-3	319	0.11	0.0001	0.13	0.081	< 0.02	< 0.03	0.3	2.82	457	1415	2	14	-	14	1.48	-
3/8/93	GSL-3	320	0.2	0.001	0.22	0.055	< 0.02	< 0.03	0.29	3.53	459	1340	7	13	-	13	1.39	-
5/5/93	GSL-4	239	0.16	0.0003	0.31	0.037	< 0.02	< 0.03	0.34	2.83	382	786	1	10	-	10	1.41	-
5/5/93	GSL-4	240	0.29	0.0001	0.4	0.079	< 0.02	< 0.03	0.38	2.36	384	851	6	12	-	12	1.50	-
5/5/93	GSL-4	241	0.14	0.0001	0.25	0.044	< 0.02	< 0.03	0.27	2.4	315	380	6	7	-	7	1.22	-
5/5/93	GSL-4	242	0.14	0.0001	0.64	0.068	< 0.02	< 0.03	0.32	2.54	882	741	2	13	-	13	0.11	-
5/5/93	GSL-4	243	0.08	0.0001	0.49	0.049	< 0.02	< 0.03	0.36	2.87	334	500	6	10	-	10	1.34	-
5/5/93	GSL-4	244	0.2	0.0001	0.22	0.037	< 0.02	< 0.03	0.26	2.44	545	535	1	10	-	10	0.33	-
5/5/93	GSL-4	245	0.06	0.0005	0.61	0.095	< 0.02	< 0.03	0.17	2.33	383	852	1	13	-	13	1.52	-
5/5/93	GSL-4	246	0.14	0.0005	0.25	0.042	< 0.02	< 0.03	0.2	2.95	301	350	6	10	-	10	1.28	-
5/5/93	GSL-4	247	0.19	0.0001	0.29	0.038	< 0.02	< 0.03	0.2	2.64	404	961	11	10	-	10	1.46	-
5/5/93	GSL-4	248	0.14	0.0001	0.61	0.054	< 0.02	< 0.03	0.35	3.75	294	319	6	7	-	7	1.26	-
5/5/93	GSL-4	249	0.06	0.0001	0.27	0.049	< 0.02	< 0.03	0.36	2.75	394	748	7	9	-	9	1.22	-
5/5/93	GSL-4	250	0.25	0.0003	0.27	0.035	< 0.02	< 0.03	0.29	2.96	320	487	3	7	-	7	1.49	-
5/5/93	GSL-4	251	0.13	0.0002	0.22	0.046	< 0.02	< 0.03	0.29	2.67	319	394	1	9	-	9	1.21	-
3/7/93	GSL-4	269	0.15	0.0017	1.17	0.037	< 0.02	< 0.03	0.28	3.04	415	900	2	11	-	11	1.26	-
3/7/93	GSL-4	270	0.16	0.001	0.85	0.054	< 0.02	< 0.03	0.32	2.59	435	1214	1	14	-	14	1.47	-

Appendix 16a continued.

Lake whitefish
***Coregonus clupeaformis* (Mitchill)**

			Metals (Detection limits ppm)								Biological parameters								
Date Sampled	Location	Sample No.	As (0.05)	Cd (0.0001)	Cu (0.10)	Hg (0.005)	Ni (0.02)	Pb (0.03)	Se (0.05)	Zn (0.05)	Length	Weight	Maturity	Scale method	Otolith method	Accepted Age	k-factor	liver wt.
3/7/93	GSL-4	271	0.3	0.0009	0.68	0.04	< 0.02	< 0.03	0.24	2.98	399	977	3	12	-	12	1.54	-
3/7/93	GSL-4	272	0.17	0.0011	1.09	0.042	< 0.02	< 0.03	0.26	2.69	431	1010	2	9	-	9	1.26	-
3/7/93	GSL-4	273	0.21	0.001	1.41	0.032	< 0.02	< 0.03	0.34	2.51	326	1152	7	11	-	11	3.33	-
3/7/93	GSL-4	274	0.13	0.001	0.23	0.035	< 0.02	< 0.03	0.31	2.58	390	771	2	8	-	8	1.30	-
3/7/93	GSL-4	275	0.06	0.0011	0.23	0.11	< 0.02	< 0.03	0.34	2.51	368	585	2	11	-	11	1.17	-
3/7/93	GSL-4	276	0.11	0.0009	0.22	0.068	< 0.02	< 0.03	0.29	2.55	360	594	6	7	-	7	1.27	-
6/17/93	GSL-4	399	0.1	0.001	0.19	0.049	< 0.02	< 0.03	0.22	2.89	411	902	2	8	-	8	1.30	-
6/17/93	GSL-4	400	0.04	0.001	0.22	0.07	< 0.02	< 0.03	0.33	3.38	406	920	7	11	-	11	1.37	-
6/17/93	GSL-4	401	0.22	0.001	0.17	0.104	< 0.02	< 0.03	0.4	3.34	397	705	6	9	-	9	1.13	-
6/17/93	GSL-4	402	0.21	0.001	0.4	0.031	< 0.02	< 0.03	0.37	3.14	401	918	2	13	-	13	1.42	-
6/17/93	GSL-4	403	0.39	0.001	0.27	0.044	< 0.02	< 0.03	0.43	3.27	429	1130	3	10	-	10	1.43	-
6/17/93	GSL-4	404	0.13	0.002	0.23	0.041	< 0.02	< 0.03	0.4	3.05	343	550	2	9	-	9	1.36	-
6/17/93	GSL-4	405	0.05	0.001	0.16	0.072	< 0.02	< 0.03	0.37	2.66	395	773	7	14	-	14	1.25	-
6/17/93	GSL-4	406	0.1	0.001	0.24	0.051	< 0.02	< 0.03	0.35	2.79	362	691	2	12	-	12	1.46	-
6/17/93	GSL-4	407	0.32	0.001	0.2	0.059	< 0.02	< 0.03	0.28	2.47	397	938	7	11	-	11	1.50	-
12/1/92	GSL-5	128	0.18	0.0023	0.28	0.11	< 0.02	< 0.03	0.32	2.59	410	969	10	7	-	7	1.41	9.6
12/1/92	GSL-5	129	0.09	0.0016	0.43	0.086	< 0.02	< 0.03	0.27	2.78	488	1565	10	13	-	13	1.35	14.6
12/1/92	GSL-5	130	0.17	0.0248	0.41	0.063	< 0.02	< 0.03	0.19	2.55	424	974	10	11	-	11	1.28	7.2
12/1/92	GSL-5	131	0.05	0.0005	0.87	0.045	< 0.02	< 0.03	0.26	3.54	401	871	9	9	-	9	1.35	5.7
12/1/92	GSL-5	132	0.06	0.0005	0.71	0.076	< 0.02	< 0.03	0.22	3.21	386	774	10	11	-	11	1.35	5.8
12/1/92	GSL-5	133	0.15	0.0003	0.24	0.125	< 0.02	< 0.03	0.14	2.51	436	1191	5-2	9	-	9	1.44	22.1
12/1/92	GSL-5	134	0.19	0.0008	0.44	0.065	< 0.02	< 0.03	0.32	3.1	408	907	7	9	-	9	1.34	8.5
12/1/92	GSL-5	135	0.08	0.0006	0.41	0.189	< 0.02	< 0.03	0.19	3.22	431	906	5	11	-	11	1.13	10
12/1/92	GSL-5	136	0.13	0.0007	0.42	0.119	< 0.02	< 0.03	0.29	2.4	404	872	9-10	13	-	13	1.32	7.4
12/1/92	GSL-5	137	0.28	0.0005	0.39	0.082	< 0.02	< 0.03	0.28	2.24	435	1043	9-10	11	-	11	1.27	8.3
12/1/92	GSL-5	138	0.19	0.0004	0.68	0.03	< 0.02	< 0.03	0.35	2.76	363	634	9	8	-	8	1.33	6
12/1/92	GSL-5	139	0.1	0.0005	0.6	0.077	< 0.02	< 0.03	0.11	3.07	325	402	1-2	8	-	8	1.17	5.8
12/1/92	GSL-5	140	0.13	0.0007	0.44	0.043	< 0.02	< 0.03	0.19	2.1	402	808	10	9	-	9	1.24	5.6
12/1/92	GSL-5	141	0.15	0.0006	0.44	0.074	< 0.02	< 0.03	0.2	2.7	435	1041	9	11	-	11	1.26	9.5
12/1/92	GSL-5	142	0.13	0.0005	0.52	0.063	< 0.02	< 0.03	0.15	2.68	340	524	2	8	-	8	1.33	6.5
12/2/92	GSL-5	145	0.11	0.0009	0.23	0.05	< 0.02	< 0.03	0.41	2.01	443	1295	10	11	11	11	1.49	18.8
12/2/92	GSL-5	146	0.2	0.0013	0.23	0.058	< 0.02	< 0.03	0.2	1.79	397	866	10	11	14	14	1.38	9.8
12/2/92	GSL-5	147	0.18	0.0011	0.2	0.033	< 0.02	< 0.03	0.21	2.7	320	391	6	9	10	10	1.19	4
12/2/92	GSL-5	148	0.1	0.0023	0.39	0.139	< 0.02	< 0.03	0.17	4.29	427	885	5	9	19	19	1.14	11.3
12/2/92	GSL-5	149	0.54	0.0001	0.19	0.071	< 0.02	< 0.03	0.09	1.9	369	668	5	10	11	11	1.33	6.7
12/2/92	GSL-5	150	0.28	0.0029	0.22	0.079	< 0.02	< 0.03	0.19	1.92	387	808	10	12	15	15	1.39	7.9
12/2/92	GSL-5	151	0.06	0.0029	0.29	0.077	< 0.02	< 0.03	0.26	2.27	440	1073	5	9	15	15	1.26	10.8
12/2/92	GSL-5	152	0.18	0.0013	0.32	0.04	< 0.02	< 0.03	0.24	2.53	348	570	1	11	12	12	1.35	6.8

Appendix 16a. continued

Lake whitefish *Coregonus clupeaformis* (Mitchill)			Metals (Detection limits ppm)								Biological parameters							
Date Sampled	Location	Sample No.	As (0.05)	Cd (0.0001)	Cu (0.10)	Hg (0.005)	Ni (0.02)	Pb (0.03)	Se (0.05)	Zn (0.05)	Length	Weight	Maturity	Scale method	Otolith method	Accepted Age	k-factor	liver wt.
12/2/92	GSL-5	153	0.32	0.0023	0.29	0.036	< 0.02	< 0.03	0.29	3.36	421	993	5	14	14	14	1.33	15.3
12/2/92	GSL-5	154	0.06	0.0024	0.67	0.04	< 0.02	< 0.03	0.23	2.26	416	997	9	12	18	18	1.38	11.5
12/2/92	GSL-5	155	0.43	0.0022	0.33	0.072	< 0.02	< 0.03	0.3	2.43	433	1143	2	12	14	14	1.41	11.4
12/2/92	GSL-5	156	0.1	0.0026	0.45	0.11	< 0.02	< 0.03	0.24	2.37	421	1027	10	12	17	17	1.38	10.5
12/2/92	GSL-5	157	0.28	0.0024	0.26	0.057	< 0.02	< 0.03	0.25	2.67	382	800	2	13	14	14	1.44	10
12/2/92	GSL-5	158	0.2	0.0027	0.24	0.052	< 0.02	< 0.03	0.27	2.57	391	837	2	11	13	13	1.40	11.1
12/2/92	GSL-5	159	0.09	0.001	0.3	0.041	< 0.02	< 0.03	0.24	1.99	452	1193	9	11	12	12	1.29	12.2
12/2/92	GSL-5	160	0.13	0.0018	0.53	0.13	< 0.02	< 0.03	0.19	3.29	440	1206	5	12	23	23	1.42	18.5
12/2/92	GSL-5	161	0.2	0.0001	0.3	0.069	< 0.02	< 0.03	0.18	2.64	296	352	6	9	11	11	1.36	4.5
12/2/92	GSL-5	162	0.04	0.0013	0.56	0.068	< 0.02	< 0.03	0.31	3.4	427	954	5	9	10	10	1.23	8.3
12/2/92	GSL-5	163	0.21	0.0023	0.57	0.064	< 0.02	< 0.03	0.23	2.95	399	889	10	10	11	11	1.40	11.1
12/2/92	GSL-5	164	0.06	0.0026	0.46	0.062	< 0.02	< 0.03	0.23	2.89	465	1284	5	12	14	14	1.28	20.8
12/2/92	GSL-5	165	0.12	0.0016	0.28	0.073	< 0.02	< 0.03	0.19	2.19	412	932	5	11	13	13	1.33	14.8
12/2/92	GSL-5	166	0.07	0.001	0.31	0.058	< 0.02	< 0.03	0.21	2.63	395	829	4	10	10	10	1.35	6.8
12/2/92	GSL-5	167	0.39	0.0034	0.27	0.059	< 0.02	< 0.03	0.17	2.28	397	829	5	11	13	13	1.32	14.1
12/2/92	GSL-5	168	0.45	0.0018	0.21	0.061	< 0.02	< 0.03	0.27	2.41	374	726	2	10	14	14	1.39	11.2
12/2/92	GSL-5	169	0.14	0.0015	0.3	0.163	< 0.02	< 0.03	0.13	2.8	423	1098	5	11	18	18	1.45	22.6
12/2/92	GSL-5	170	0.16	0.0031	0.29	0.029	< 0.02	< 0.03	0.16	2.58	325	440	6	8	8	8	1.28	8.7
12/2/92	GSL-5	171	0.19	0.0024	0.24	0.036	< 0.02	< 0.03	0.11	2.68	320	383	1	6	8	8	1.17	7.4
12/2/92	GSL-5	172	0.11	0.0018	0.24	0.224	< 0.02	< 0.03	0.23	2.53	415	1021	2	11	15	15	1.43	15.8
12/2/92	GSL-5	173	0.21	0.0015	0.48	0.058	< 0.02	< 0.03	0.2	2.34	370	750	7	11	15	15	1.48	8.5
12/2/92	GSL-5	174	0.41	0.002	0.26	0.051	< 0.02	< 0.03	0.18	2.45	435	1006	5	9	9	9	1.22	11.7
10/3/92	GSL-5	204	0.02	0.0006	0.51	0.066	< 0.02	< 0.03	0.29	2.74	408	881	8	10	-	10	1.30	7.2
10/3/92	GSL-5	205	0.26	0.0006	0.38	0.13	< 0.02	< 0.03	0.26	3.86	404	803	2	9	-	9	1.22	13.1
10/3/92	GSL-5	206	0.06	0.0006	0.24	0.089	< 0.02	< 0.03	0.38	2.42	390	796	7	9	-	9	1.34	8.1
10/3/92	GSL-5	207	0.03	0.0005	0.36	0.096	< 0.02	< 0.03	0.38	2.14	406	913	7	9	-	9	1.36	7.4
10/3/92	GSL-5	208	0.1	0.0007	0.39	0.121	< 0.02	< 0.03	0.17	3.94	410	937	5	13	-	13	1.36	16
10/3/92	GSL-5	209	0.03	0.0006	0.46	0.046	< 0.02	< 0.03	0.21	2.7	395	816	7	11	-	11	1.32	10.4
10/3/92	GSL-5	210	0.09	0.0006	0.4	0.058	< 0.02	< 0.03	0.29	2.75	452	1413	10-7	10	-	10	1.53	14.2
10/3/92	GSL-5	211	0.18	0.0005	0.51	0.09	< 0.02	< 0.03	0.42	2.46	445	1250	7	12	-	12	1.42	10.6
10/3/92	GSL-5	212	0.08	0.0006	0.43	0.074	< 0.02	< 0.03	0.17	2.14	392	825	9	11	-	11	1.37	6.8
10/3/92	GSL-5	213	0.08	0.0006	0.63	0.042	< 0.02	< 0.03	0.27	2.42	427	1144	10	11	-	11	1.47	16
10/3/92	GSL-5	214	0.1	0.0005	0.35	0.047	< 0.02	< 0.03	0.19	2.44	328	473	9	7	-	7	1.34	5.3
10/3/92	GSL-5	215	0.03	0.0007	0.38	0.079	< 0.02	< 0.03	0.46	2.63	430	1135	10	10	-	10	1.43	9.6
10/3/92	GSL-5	216	0.08	0.0012	0.36	0.052	< 0.02	< 0.03	0.16	2.81	452	1160	10	13	-	13	1.26	13.2
10/3/92	GSL-5	217	0.04	0.0007	0.78	0.117	< 0.02	< 0.03	0.12	3.28	437	1180	5	14	-	14	1.41	12.2
10/3/92	GSL-5	218	0.12	0.0007	0.59	0.069	< 0.02	< 0.03	0.19	2.73	423	909	5	11	-	11	1.20	9

Appendix 16b. Metal concentrations in lake whitefish liver caught in the Yellowknife-Back Bay area. (1992-93)

Lake Whitefish *Coregonus clupeaformis*										
			Metals (Detection limits ppm)							
Date sampled	Location	Sample No.	As (0.05)	Cd (0.0001)	Cu (0.10)	Hg (0.005)	Ni (0.02)	Pb (0.03)	Se (0.05)	Zn (0.05)
8/25/92	GSL-1	1	0.15	0.17	31.52	0.077	1.15	< 0.05	2.06	40.13
8/25/92	GSL-1	2	0.17	0.28	22.01	0.087	0.2	< 0.05	2.14	44.01
8/25/92	GSL-1	3	0.13	0.07	12.47	0.038	0.31	< 0.05	1.08	31.49
8/25/92	GSL-1	4	0.13	0.12	9.2	0.126	0.24	< 0.05	1.09	48.26
8/25/92	GSL-1	5	0.22	0.09	12.79	0.097	0.37	< 0.05	1.57	29.81
8/26/92	GSL-1	70	0.39	0.05	41.86	0.055	0.06	< 0.05	1.91	35.1
8/26/92	GSL-1	71	0.3	0.07	5.79	0.082	0.41	< 0.05	1.5	27.3
8/26/92	GSL-1	72	0.22	0.11	6.86	0.037	0.14	< 0.05	1.2	27.27
8/26/92	GSL-1	73	0.28	0.02	8.43	0.077	0.12	< 0.05	1.32	38.3
8/26/92	GSL-1	74	0.25	0.14	18.58	0.041	0.06	< 0.05	1.62	34.7
8/26/92	GSL-1	75	0.44	0.1	6.53	0.072	0.1	< 0.05	1.47	32.83
8/26/92	GSL-1	76	0.38	0.18	8.75	0.061	0.04	< 0.05	1.09	32.47
8/26/92	GSL-1	77	0.23	0.13	8.93	0.088	0.08	< 0.05	1.16	41.26
8/26/92	GSL-1	78	0.45	0.16	19.63	0.06	0.08	< 0.05	1.96	33.39
8/26/92	GSL-1	79	0.24	0.2	23.89	0.05	0.07	< 0.05	2.05	33.73
8/26/92	GSL-1	80	0.3	0.08	11.97	0.031	0.04	< 0.05	1.24	27.54
8/26/92	GSL-1	81	0.21	0.06	2.53	0.076	0.07	< 0.05	1.35	28.05
8/26/92	GSL-1	82	0.47	0.2	15.11	0.066	0.11	< 0.05	2.68	35.85
8/26/92	GSL-1	83	0.4	0.09	3.06	0.045	0.12	< 0.05	1.37	38.24
8/26/92	GSL-1	84	0.19	0.3	8.9	0.053	0.07	< 0.05	1.46	41.93
8/26/92	GSL-1	85	0.33	0.11	10.28	0.062	0.09	< 0.05	1.94	31.16
8/26/92	GSL-1	86	0.26	0.05	6.24	0.11	0.06	< 0.05	-	45.35
8/26/92	GSL-1	87	0.19	0.03	4.83	0.075	0.05	< 0.05	-	23.8
8/26/92	GSL-1	88	0.23	0.12	19.71	0.037	0.04	< 0.05	-	38.21
8/26/92	GSL-1	89	0.35	0.24	33.52	0.043	0.05	< 0.05	-	46.07
8/26/92	GSL-1	90	0.35	0.16	10.13	0.057	0.04	< 0.05	-	34.08
8/26/92	GSL-1	91	0.33	0.08	2.52	0.046	0.07	< 0.05	-	23.4
8/26/92	GSL-1	92	0.17	0.07	12.97	0.034	0.04	< 0.05	-	29.4
8/26/92	GSL-1	93	0.08	0.06	23.39	0.069	0.09	< 0.05	-	41.16
8/26/92	GSL-1	94	0.1	0.14	10.11	0.042	0.04	< 0.05	-	34.62
3/12/93	GSL-1	349	0.53	0.09	9.07	0.066	0.04	< 0.05	1.55	34.83
3/12/93	GSL-1	350	0.16	0.06	4.45	0.049	0.04	0.08	1.03	22.82
3/12/93	GSL-1	351	0.18	0.24	7.72	0.103	0.04	< 0.05	1.03	20.91
3/12/93	GSL-1	352	0.19	0.05	4.65	0.244	0.04	< 0.05	1.06	24.95
3/12/93	GSL-1	353	0.32	0.07	7.92	0.076	0.04	< 0.05	0.87	26.89
3/12/93	GSL-1	354	0.17	0.12	9.66	0.078	0.04	< 0.05	1.13	22.16
3/12/93	GSL-1	355	0.35	0.09	13.32	0.076	0.04	< 0.05	1.29	25.6
3/12/93	GSL-1	356	0.12	0.21	3.87	0.041	0.05	< 0.05	1.28	26.79
8/25/92	GSL-2	20	0.15	0.08	8.74	0.071	0.04	< 0.05	-	30.76
8/25/92	GSL-2	21	0.42	0.08	6.89	0.092	0.05	< 0.05	-	30.03
8/25/92	GSL-2	22	0.34	0.02	3.93	0.118	0.05	< 0.05	-	23.61
8/25/92	GSL-2	23	0.38	0.05	6.75	0.079	0.44	< 0.05	-	29.52
8/25/92	GSL-2	24	0.13	0.02	9.28	0.095	0.1	< 0.05	-	27.26
8/25/92	GSL-2	25	0.19	0.05	10.75	0.086	0.08	< 0.05	-	31.45
8/25/92	GSL-2	26	0.39	0.00	12.9	0.101	0.05	< 0.05	-	27.09
8/25/92	GSL-2	27	0.54	0.04	11.66	0.08	0.06	< 0.05	-	26.65
8/25/92	GSL-2	28	0.24	0.02	1.34	0.078	0.06	< 0.05	-	23.17
8/25/92	GSL-2	29	0.4	0.12	6.02	0.12	0.04	< 0.05	-	25.99
8/25/92	GSL-2	30	0.56	0.05	4.89	0.081	0.08	< 0.05	-	24.9
8/25/92	GSL-2	31	0.27	0.01	3.55	0.066	0.1	< 0.05	-	22.78
8/25/92	GSL-2	32	0.25	0.06	3.15	0.068	0.06	< 0.05	-	32.54
8/25/92	GSL-2	33	0.31	0.07	2.96	0.096	0.41	< 0.05	-	22.06
8/25/92	GSL-2	34	0.31	0.09	4.75	0.095	0.1	< 0.05	-	24.12

Appendix 16b. continued

Lake Whitefish Coregonus clupeaformis										
			Metals (Detection limits ppm)							
Date sampled	Location	Sample No.	As (0.05)	Cd (0.0001)	Cu (0.10)	Hg (0.005)	Ni (0.02)	Pb (0.03)	Se (0.05)	Zn (0.05)
8/26/92	GSL-2	113	0.84	0.09	5.27	0.073	0.04	< 0.05	1.1	28.54
8/26/92	GSL-2	114	0.45	0.11	22.23	0.08	0.05	< 0.05	1.3	33.41
8/26/92	GSL-2	115	0.29	0.16	8.11	0.09	0.04	< 0.05	-	31.6
8/26/92	GSL-2	116	0.21	0.07	6.24	0.068	0.04	< 0.05	-	25.54
8/26/92	GSL-2	117	0.21	0.03	4.94	0.081	0.04	< 0.05	-	22.94
8/26/92	GSL-2	118	0.16	0.05	13.01	0.04	0.04	< 0.05	-	32.95
8/26/92	GSL-2	119	0.19	0.03	3.24	0.069	0.04	< 0.05	-	21.09
8/26/92	GSL-2	120	0.38	0.03	5.7	0.054	0.04	< 0.05	-	22.53
8/26/92	GSL-2	121	0.28	0.03	7.97	0.07	0.06	< 0.05	-	28.23
8/26/92	GSL-2	122	0.25	0.18	21.05	0.158	0.05	< 0.05	-	41.06
3/12/93	GSL-2	364	0.24	0.18	6.34	0.115	0.04	0.09	1.28	40.12
3/12/93	GSL-2	365	0.09	0.21	19.28	0.265	0.04	< 0.05	1.44	43.12
3/12/93	GSL-2	366	0.4	0.08	6.49	0.103	0.05	< 0.05	1.2	21.87
3/12/93	GSL-2	367	0.2	0.13	6.83	0.049	0.04	< 0.05	1.33	30.58
3/12/93	GSL-2	368	0.1	0.35	8.23	0.096	0.04	< 0.05	0.91	28.59
8/25/92	GSL-3	40	0.27	0.02	13.14	0.049	0.04	< 0.05	1.62	31.54
8/25/92	GSL-3	41	0.33	0.22	14.33	0.103	0.04	< 0.05	1.85	24.96
8/25/92	GSL-3	42	0.23	0.11	9.01	0.053	0.04	< 0.05	1.65	31.8
8/25/92	GSL-3	43	0.53	0.25	22.91	0.02	0.06	< 0.05	2.48	38.36
8/25/92	GSL-3	44	0.45	0.08	14.37	0.056	0.04	< 0.05	1.81	32.9
8/25/92	GSL-3	45	0.21	0.03	6.89	0.054	0.04	< 0.05	1.8	41.5
8/25/92	GSL-3	46	0.37	0.18	33.7	0.057	0.12	< 0.05	1.75	42.47
8/25/92	GSL-3	47	0.13	0.04	5.29	0.059	0.04	< 0.05	1.77	24.71
8/25/92	GSL-3	48	0.15	0.08	9.27	0.04	0.04	< 0.05	1.84	27.54
8/25/92	GSL-3	49	0.12	0.17	24.27	0.048	0.13	< 0.05	1.83	33.65
8/25/92	GSL-3	50	0.12	0.56	11.82	0.169	0.08	< 0.05	2.26	35.08
8/25/92	GSL-3	51	0.19	0.12	7.87	0.055	0.06	< 0.05	1.82	29.25
8/25/92	GSL-3	57	0.05	0.08	3.86	0.079	0.04	< 0.05	-	23.99
8/25/92	GSL-3	58	0.45	0.24	25.37	0.118	0.06	< 0.05	-	44.19
8/25/92	GSL-3	59	0.27	0.05	6.89	0.068	0.04	< 0.05	-	27.04
8/25/92	GSL-3	60	0.05	0.12	12.06	0.064	0.04	< 0.05	-	27.57
8/25/92	GSL-3	61	0.18	0.12	16.12	0.049	0.04	< 0.05	-	25.99
8/25/92	GSL-3	62	0.19	0.07	4.56	0.066	0.04	< 0.05	-	28.85
8/25/92	GSL-3	63	0.21	0.08	9.49	0.035	0.04	< 0.05	0.94	24.06
8/25/92	GSL-3	64	0.2	0.13	5.25	0.041	0.06	< 0.05	-	39.37
8/25/92	GSL-3	65	0.18	0.25	6.2	0.06	0.04	< 0.05	-	32.34
8/25/92	GSL-3	66	0.1	0.1	5.09	0.049	0.04	< 0.05	-	35.48
5/5/93	GSL-3	219	0.09	0.21	14.23	0.034	0.07	< 0.05	1.25	28.09
5/5/93	GSL-3	220	0.08	0.16	5.08	0.069	0.09	< 0.05	1.65	30.16
5/5/93	GSL-3	221	0.05	0.24	6.16	0.042	0.09	< 0.05	1.37	33.68
5/5/93	GSL-3	227	0.1	0.08	5.99	0.079	0.06	< 0.05	0.97	22.08
5/5/93	GSL-3	228	0.09	0.07	6.89	0.085	0.11	< 0.05	0.99	21.83
5/5/93	GSL-3	229	0.17	0.07	4.49	0.099	0.26	< 0.05	1.59	27.69
5/5/93	GSL-3	230	0.19	0.15	8.05	0.114	0.36	< 0.05	1.12	27.71
5/5/93	GSL-3	231	0.11	0.05	4.71	0.057	0.15	< 0.05	1.25	25.54
5/5/93	GSL-3	232	0.05	0.05	7.75	0.048	0.04	< 0.05	1.24	18.47
5/5/93	GSL-3	233	0.08	0.07	12.48	0.031	0.06	< 0.05	1.42	43.02
3/7/93	GSL-3	303	0.26	0.07	16.03	0.059	0.1	< 0.05	1.29	23.93
3/7/93	GSL-3	304	0.17	0.08	16.35	0.064	0.13	< 0.05	1.42	27.52
3/7/93	GSL-3	305	0.23	0.12	9.48	0.098	0.1	< 0.05	1.38	25.83
3/8/93	GSL-3	319	0.34	0.16	19.35	0.105	0.05	< 0.05	1.39	33.55
3/8/93	GSL-3	320	0.37	0.21	31.3	0.088	0.07	< 0.05	1.56	33.02

Appendix 16b. continued

Lake whitefish Coregonus clupeaformis (Mitchill)			Metals (Detection limits ppm)							
Date Sampled	Location Location	Sample No.	As (0.05)	Cd (0.0001)	Cu (0.10)	Hg (0.005)	Ni (0.02)	Pb (0.03)	Se (0.05)	Zn (0.05)
5/5/93	GSL-4	239	0.1	0.067	7.71	0.028	0.04	0.05	1.59	27.08
5/5/93	GSL-4	240	0.08	0.086	4.88	0.073	0.09	0.05	1.63	24.68
5/5/93	GSL-4	241	0.07	0.044	6.22	0.066	0.04	0.05	1.82	34.06
5/5/93	GSL-4	242	0.05	0.078	6.94	0.08	0.04	0.05	1.46	30.79
5/5/93	GSL-4	243	0.05	0.044	3.98	0.07	0.04	0.05	1.36	18.85
5/5/93	GSL-4	244	0.05	0.158	3.97	0.09	0.04	0.05	1.23	25.29
5/5/93	GSL-4	245	0.09	0.073	3.2	0.118	0.14	0.05	1.52	18.71
5/5/93	GSL-4	246	0.07	0.103	4.28	0.068	0.42	0.05	1.23	21.57
5/5/93	GSL-4	247	0.19	0.065	3.89	0.045	0.04	0.05	0.85	22.71
5/5/93	GSL-4	248	0.18	0.071	3.66	0.081	0.04	0.05	1.47	28.6
5/5/93	GSL-4	249	0.09	0.102	11.85	0.068	0.04	0.05	1.7	29.14
5/5/93	GSL-4	250	0.13	0.071	3.52	0.04	0.04	0.05	1.32	24.93
5/5/93	GSL-4	251	0.12	0.027	4.21	0.056	0.05	0.05	1.59	37.48
3/7/93	GSL-4	269	0.15	0.372	7.52	0.043	0.04	0.05	1.64	31.67
3/7/93	GSL-4	270	0.12	0.061	8.07	0.072	0.05	0.05	1.44	21
3/7/93	GSL-4	271	0.13	0.113	6.77	0.061	0.08	0.05	0.89	18.3
3/7/93	GSL-4	272	0.24	0.122	37.43	0.051	0.09	0.05	1.2	38.47
3/7/93	GSL-4	273	0.05	0.196	6.48	0.042	0.08	0.05	1.45	27.78
3/7/93	GSL-4	274	0.34	0.201	9.28	0.047	0.3	0.05	1.16	30.77
3/7/93	GSL-4	275	0.17	0.055	2.59	0.091	0.33	0.05	1.46	27.12
3/7/93	GSL-4	276	0.3	0.055	2.9	0.08	0.11	0.05	1.21	20.4
6/17/93	GSL-4	399	0.24	0.195	14	0.078	0.07	0.05	1.09	33.45
6/17/93	GSL-4	400	0.1	0.17	2.26	0.159	0.05	0.05	1.67	27.72
6/17/93	GSL-4	401	0.07	0.145	3.53	0.116	0.04	0.05	1.44	26.03
6/17/93	GSL-4	402	0.08	0.129	4.9	0.063	0.05	0.05	1.44	24.03
6/17/93	GSL-4	403	0.26	0.113	5.57	0.074	0.04	0.05	1.4	26.03
6/17/93	GSL-4	404	0.06	0.162	1.95	0.1	0.04	0.05	1.61	35.15
6/17/93	GSL-4	405	0.09	0.03	6.1	0.149	0.04	0.05	1.15	30.74
6/17/93	GSL-4	406	0.15	0.1	3.32	0.106	0.07	0.05	1.55	31.22
6/17/93	GSL-4	407	0.2	0.168	9.3	0.126	0.07	0.05	1.45	33.79
12/1/92	GSL-5	128	1.17	0.016	10.73	0.077	0.21	0.05	1.47	31.46
12/1/92	GSL-5	129	1.07	0.098	32.18	0.087	0.13	0.05	2.37	35.15
12/1/92	GSL-5	130	0.7	0.025	18.11	0.038	0.11	0.05	2.54	41.8
12/1/92	GSL-5	131	0.7	0.072	12.19	0.126	0.11	0.05	2.22	31.84
12/1/92	GSL-5	132	0.61	0.046	5.98	0.097	0.1	0.05	2.07	31.73
12/1/92	GSL-5	133	0.87	0.089	8.18	0.026	0.14	0.05	0.8	17.81
12/1/92	GSL-5	134	0.62	0.037	7.18	0.064	0.22	0.05	1.8	26.86
12/1/92	GSL-5	135	0.71	0.04	4.89	0.09	0.14	0.05	1.14	31.34
12/1/92	GSL-5	136	0.63	0.065	11.18	0.066	0.04	0.05	2.47	48.72
12/1/92	GSL-5	137	0.59	0.086	17.34	0.083	0.04	0.05	2.17	28.38
12/1/92	GSL-5	138	0.81	0.032	6.39	0.071	0.04	0.05	2.18	24.65
12/1/92	GSL-5	139	1.06	0.042	2.75	0.059	0.04	0.05	1.3	24
12/1/92	GSL-5	140	1.15	0.078	7.28	0.061	0.09	0.05	1.68	32.7
12/1/92	GSL-5	141	1.12	0.072	5.24	0.064	0.47	0.05	2.14	25.15
12/1/92	GSL-5	142	0.77	0.05	4.14	0.067	0.04	0.05	1.37	26.4
12/2/92	GSL-5	145	0.59	0.048	12.57	0.063	0.04	0.05	1.89	27.29

Appendix 16b. continued

Lake whitefish Coregonus clupeaformis (Mitchill)										
			Metals (Detection limits ppm)							
Date Sampled	Location Location	Sample No.	As (0.05)	Cd (0.0001)	Cu (0.10)	Hg (0.005)	Ni (0.02)	Pb (0.03)	Se (0.05)	Zn (0.05)
12/2/92	GSL-5	146	0.85	0.045	10.44	0.062	0.04	0.05	1.34	23.51
12/2/92	GSL-5	147	1.03	0.066	6.34	0.071	0.64	0.05	1.72	32.04
12/2/92	GSL-5	148	1.11	0.035	3.74	0.092	0.04	0.05	2.07	27.87
12/2/92	GSL-5	149	0.81	0.102	8.07	0.118	0.25	0.05	1.15	27.25
12/2/92	GSL-5	150	0.94	0.073	10.79	0.079	0.1	0.05	1.79	22.7
12/2/92	GSL-5	151	0.85	0.076	7.71	0.095	0.12	0.05	1.14	28.65
12/2/92	GSL-5	152	1.13	0.064	5.67	0.086	0.18	0.05	1.16	21.85
12/2/92	GSL-5	153	0.71	0.036	12.27	0.101	0.42	0.05	1.54	26.8
12/2/92	GSL-5	154	0.58	0.081	7.19	0.08	0.07	0.05	1.91	27.3
12/2/92	GSL-5	155	0.8	0.082	10.89	0.078	0.12	0.05	1.81	23.69
12/2/92	GSL-5	156	0.64	0.168	11.49	0.12	0.14	0.05	2.15	28
12/2/92	GSL-5	157	0.67	0.065	8.6	0.081	0.04	0.05	1.54	32.26
12/2/92	GSL-5	158	0.99	0.041	4.87	0.066	0.04	0.05	1.31	22.56
12/2/92	GSL-5	159	0.77	0.066	19.86	0.068	0.04	0.05	2.12	28.57
12/2/92	GSL-5	160	0.52	0.106	30.58	0.096	0.05	0.05	1.84	33
12/2/92	GSL-5	161	0.86	0.078	4.17	0.095	0.6	0.05	1.63	28.07
12/2/92	GSL-5	162	0.46	0.093	11.2	0.038	0.04	0.05	1.72	32.39
12/2/92	GSL-5	163	0.58	0.071	7.83	0.09	0.22	0.05	1.89	34.25
12/2/92	GSL-5	164	0.69	0.114	29.66	0.022	0.06	0.05	1.21	23.13
12/2/92	GSL-5	165	0.57	0.056	12.71	0.081	0.11	0.05	1.23	30.69
12/2/92	GSL-5	166	0.52	0.115	5.45	0.09	0.07	0.05	1.42	26.6
12/2/92	GSL-5	167	0.61	0.074	4.95	0.049	0.04	0.05	1.01	20.74
12/2/92	GSL-5	168	0.83	0.083	7.25	0.103	0.04	0.05	1.44	30.37
12/2/92	GSL-5	169	0.76	0.094	3.73	0.053	0.04	0.05	1.2	25.82
12/2/92	GSL-5	170	0.67	0.04	2.25	0.02	0.07	0.05	0.82	16.85
12/2/92	GSL-5	171	0.75	0.051	2.42	0.056	0.04	0.05	1.04	19.19
12/2/92	GSL-5	172	0.59	0.046	1.75	0.054	0.04	0.05	1.14	24.18
12/2/92	GSL-5	173	0.67	0.055	6.27	0.057	0.04	0.05	1.31	25.56
12/2/92	GSL-5	174	0.58	0.072	5.24	0.059	0.04	0.05	1.35	25.88
10/3/92	GSL-5	204	0.06	0.167	5.45	0.088	0.04	0.15	1.21	25.12
10/3/92	GSL-5	205	0.15	0.223	24.5	0.06	0.04	0.15	1.23	35.41
10/3/92	GSL-5	206	0.12	0.175	21.58	0.05	0.04	0.05	2.04	36.92
10/3/92	GSL-5	207	0.09	0.219	11.56	0.031	0.04	0.05	2.17	28.02
10/3/92	GSL-5	208	0.11	0.245	9.61	0.076	0.04	0.05	1.42	33.38
10/3/92	GSL-5	209	0.07	0.14	1.05	0.066	0.04	0.05	1.62	21.82
10/3/92	GSL-5	210	0.12	0.103	10.97	0.045	0.04	0.05	2.1	26.86
10/3/92	GSL-5	211	0.08	0.214	11.36	0.053	0.04	0.05	2.43	34.23
10/3/92	GSL-5	212	0.25	0.183	12.31	0.062	0.04	0.06	1.43	28.93
10/3/92	GSL-5	213	0.06	0.161	12.84	0.11	0.04	0.05	1.52	26.21
10/3/92	GSL-5	214	0.13	0.189	6.37	0.075	0.04	0.05	1.37	31.94
10/3/92	GSL-5	215	0.03	0.186	7.24	0.037	0.08	0.05	2.19	27.14
10/3/92	GSL-5	216	0.21	0.331	30.43	0.043	0.04	0.05	2.23	40.72
10/3/92	GSL-5	217	0.08	0.164	13.21	0.057	0.07	0.05	1.07	31.83
10/3/92	GSL-5	218	0.11	0.099	20.87	0.046	0.09	0.05	1.5	34.61

Appendix 16c. Metal concentrations in lake whitefish kidney caught in the Yellowknife Bay 1992-93.

Lake whitefish Coregonus clupeaformis (Mitchill)										
			Metals (Detection limits ppm)							
Date Sampled	Location	Sample No.	As (0.05)	Cd (0.0001)	Cu (0.10)	Hg (0.005)	Ni (0.02)	Pb (0.03)	Se (0.05)	Zn (0.05)
8/25/92	GSL-1	1	0.06	0.227	0.76	0.06	0.15	-	1.85	18.27
8/25/92	GSL-1	2	0.33	0.329	0.63	0.053	0.14	-	1.12	24.26
8/25/92	GSL-1	3	-	0.618	0.93	0.053	0.17	-	-	22.16
8/25/92	GSL-1	4	0.36	0.166	0.8	0.051	0.16	-	1.32	31.36
8/25/92	GSL-1	5	< 0.05	0.031	0.95	0.064	0.23	-	1.5	17.79
8/26/92	GSL-1	70	0.15	0.477	0.66	0.052	0.15	-	1.32	15.9
8/26/92	GSL-1	71	0.07	1.275	0.82	0.063	0.28	-	1.02	17.17
8/26/92	GSL-1	72	0.46	0.37	1.35	0.043	0.33	-	0.95	13.8
8/26/92	GSL-1	73	< 0.05	0.456	0.56	0.097	0.16	-	1.12	18.52
8/26/92	GSL-1	74	0.05	0.62	0.62	0.042	0.11	-	1.15	17.25
8/26/92	GSL-1	75	< 0.05	0.841	0.92	0.061	0.09	-	1.11	20.88
8/26/92	GSL-1	76	0.28	0.489	0.72	0.027	0.16	-	0.96	24.3
8/26/92	GSL-1	77	0.12	1.25	0.62	0.075	0.24	-	0.82	33.06
8/26/92	GSL-1	78	0.4	0.914	0.99	0.026	0.51	-	0.84	18.68
8/26/92	GSL-1	79	0.5	0.995	0.65	0.029	0.35	-	1.11	15.05
8/26/92	GSL-1	80	0.06	1.023	0.78	0.029	0.23	-	1.35	17.15
8/26/92	GSL-1	81	0.11	0.365	1.26	0.059	0.14	-	1.08	21.17
8/26/92	GSL-1	82	0.44	1.572	0.85	0.056	0.36	-	1.69	23.82
8/26/92	GSL-1	83	0.9	1.185	0.69	0.038	0.22	-	1.13	27.94
8/26/92	GSL-1	84	0.88	0.698	0.75	0.056	0.29	-	1.54	16.28
8/26/92	GSL-1	85	0.33	1.623	0.78	0.035	0.17	-	1.39	16.14
8/26/92	GSL-1	86	0.23	0.447	1.03	0.068	0.12	-	1.36	60.86
8/26/92	GSL-1	87	0.53	0.362	0.76	0.109	0.09	-	1.56	17.56
8/26/92	GSL-1	88	0.31	0.483	0.74	0.029	0.19	-	1.45	22.38
8/26/92	GSL-1	89	0.33	1.094	0.75	0.034	0.27	-	1.22	24.05
8/26/92	GSL-1	90	1.39	1.17	1.31	0.043	0.41	-	1.42	21.74
8/26/92	GSL-1	91	0.36	0.476	0.46	0.064	0.08	-	0.91	15.34
8/26/92	GSL-1	92	0.2	0.46	0.83	0.044	0.12	-	1.05	18.61
8/26/92	GSL-1	93	0.19	0.364	0.6	0.034	0.12	-	1.02	23.79
8/26/92	GSL-1	94	0.14	0.515	0.61	0.04	0.08	-	1.03	17.2
3/12/93	GSL-1	349	0.5	-	-	0.061	-	N.S.	1.66	-
3/12/93	GSL-1	350	0.31	0.574	0.55	0.048	0.27	N.S.	1.27	25.26
3/12/93	GSL-1	351	0.33	1.722	0.81	0.072	0.33	N.S.	1.29	23.79
3/12/93	GSL-1	352	0.86	0.757	0.8	0.207	0.13	N.S.	0.94	18.81
3/12/93	GSL-1	353	0.39	0.549	0.74	0.051	0.24	N.S.	1.04	25.89
3/12/93	GSL-1	354	0.33	0.943	0.66	0.05	0.34	N.S.	1.26	23.51
3/12/93	GSL-1	355	0.36	0.523	0.89	0.042	0.18	N.S.	0.97	22.03
3/12/93	GSL-1	356	0.19	1.06	0.61	0.106	0.32	N.S.	0.92	23.62
8/25/92	GSL-2	20	0.09	0.001	0.63	0.069	0.1	-	0.38	18.48
8/25/92	GSL-2	21	0.28	0.034	0.55	0.094	0.27	-	0.45	19.74
8/25/92	GSL-2	22	0.19	0.195	0.58	0.078	0.13	-	0.3	18.2
8/25/92	GSL-2	23	0.18	0.587	0.81	0.076	0.13	-	0.37	16.26
8/25/92	GSL-2	24	0.18	0.192	0.65	0.083	0.2	-	0.46	20.19
8/25/92	GSL-2	25	0.11	0.229	0.66	0.068	0.18	-	0.49	16.37
8/25/92	GSL-2	26	0.28	0.209	0.47	0.083	0.12	-	0.53	20.52
8/25/92	GSL-2	27	0.27	0.665	0.5	0.086	0.04	-	0.25	14.35
8/25/92	GSL-2	28	0.1	0.119	0.39	0.048	0.31	-	0.36	16.5
8/25/92	GSL-2	29	0.34	0.581	0.84	0.079	0.16	-	0.54	15.32
8/25/92	GSL-2	30	0.32	0.723	0.7	0.076	0.21	-	0.36	16.3
8/25/92	GSL-2	31	0.28	0.253	0.66	0.061	0.15	-	0.55	18
8/25/92	GSL-2	32	0.12	0.228	0.44	0.068	0.17	-	0.52	19.72
8/25/92	GSL-2	33	0.38	0.631	0.66	0.112	0.29	-	0.49	18.43
8/25/92	GSL-2	34	-	1.257	1.07	0.106	0.16	-	-	14.62
8/26/92	GSL-2	113	0.52	0.755	0.72	-	0.12	-	0.75	14.32
8/26/92	GSL-2	114	1.01	0.63	0.73	0.086	0.27	-	0.85	18.04

Appendix 16c. continued

Lake whitefish Coregonus clupeaformis (Mitchill)										
			Metals (Detection limits ppm)							
Date Sampled	Location	Sample No.	As (0.05)	Cd (0.0001)	Cu (0.10)	Hg (0.005)	Ni (0.02)	Pb (0.03)	Se (0.05)	Zn (0.05)
8/26/92	GSL-2	115	0.58	0.331	0.75	0.05	0.14	-	0.71	20.74
8/26/92	GSL-2	116	0.72	0.061	0.55	0.056	0.13	-	0.65	15.76
8/26/92	GSL-2	117	0.54	0.296	0.51	0.086	0.07	-	0.6	14.06
8/26/92	GSL-2	118	0.51	0.537	0.63	0.053	0.11	-	0.8	15.51
8/26/92	GSL-2	119	0.56	0.192	0.58	0.077	0.1	-	0.58	15.94
8/26/92	GSL-2	120	0.62	0.54	1.43	0.055	0.11	-	0.91	18.79
8/26/92	GSL-2	121	0.7	0.41	1	0.083	0.17	-	0.65	19.9
8/26/92	GSL-2	122	0.62	0.536	0.67	0.176	0.18	-	0.66	18.97
3/12/93	GSL-2	364	0.78	-	-	0.11	-	N.S.	1.35	-
3/12/93	GSL-2	365	-	-	-	0.117	-	N.S.	-	-
3/12/93	GSL-2	366	0.59	0.788	0.78	0.066	0.31	N.S.	1.1	19.08
3/12/93	GSL-2	367	0.57	-	-	0.065	-	N.S.	1.87	-
3/12/93	GSL-2	368	0.48	1.156	0.5	0.048	0.42	-	0.89	26.73
8/25/92	GSL-3	40	0.24	0.121	0.49	0.062	0.22	-	0.56	20.63
8/25/92	GSL-3	41	0.54	1.121	0.95	0.136	0.39	-	1.18	18.81
8/25/92	GSL-3	42	0.13	1.335	1.06	0.06	0.35	-	1.05	24.4
8/25/92	GSL-3	43	0.09	0.31	0.56	0.131	0.3	-	0.64	21.34
8/25/92	GSL-3	44	0.08	0.395	0.55	0.062	0.22	-	0.97	20.63
8/25/92	GSL-3	45	< 0.05	0.232	0.81	0.046	0.11	-	1.18	22.62
8/25/92	GSL-3	46	0.46	1.274	0.73	0.065	0.46	-	1.23	17.95
8/25/92	GSL-3	47	0.14	0.538	0.74	0.054	0.16	-	0.95	19.53
8/25/92	GSL-3	48	0.29	0.305	0.61	0.046	0.23	-	1.09	17.9
8/25/92	GSL-3	49	0.21	0.663	0.78	0.039	0.2	-	0.78	19.72
8/25/92	GSL-3	50	3.43	2.166	0.8	0.187	0.53	-	2.01	22.75
8/25/92	GSL-3	51	0.35	0.207	0.39	0.048	0.17	-	1.05	14.44
8/25/92	GSL-3	57	0.34	0.16	0.53	0.079	0.25	-	1.12	24.49
8/25/92	GSL-3	58	0.12	0.116	0.53	0.057	0.25	-	0.67	22.21
8/25/92	GSL-3	59	0.06	0.063	0.57	0.062	0.07	-	1.38	17.73
8/25/92	GSL-3	60	0.21	0.079	1.44	0.044	0.06	-	0.98	16.96
8/25/92	GSL-3	61	0.26	0.223	0.56	0.064	0.21	-	0.8	18.55
8/25/92	GSL-3	62	0.07	0.09	0.59	0.068	0.1	-	0.26	19.3
8/25/92	GSL-3	63	0.05	0.132	0.58	0.041	0.11	-	1.07	17.17
8/25/92	GSL-3	64	0.15	0.182	0.77	0.035	0.3	-	1.55	21.69
8/25/92	GSL-3	65	0.5	0.229	1.18	0.043	0.36	-	1.31	22.4
8/25/92	GSL-3	66	0.12	0.076	0.53	0.102	0.12	-	1.91	26.48
5/5/93	GSL-3	219	0.08	0.13	0.53	0.049	0.09	-	0.02	14.95
5/5/93	GSL-3	220	-	3.671	0.63	0.034	0.53	-	-	28.05
5/5/93	GSL-3	221	0.13	0.332	0.66	0.043	0.14	-	0.48	20.93
5/5/93	GSL-3	227	0.06	0.347	0.63	0.146	0.24	-	0.92	19.91
5/5/93	GSL-3	228	0.09	0.63	0.68	0.026	0.5	-	0.49	19.28
5/5/93	GSL-3	229	0.1	0.528	0.528	0.06	0.41	-	0.9	18.33
5/5/93	GSL-3	230	0.34	1.019	0.72	0.041	0.2	-	1.2	24.21
5/5/93	GSL-3	231	0.16	0.432	0.81	0.077	0.4	-	0.91	21.44
5/5/93	GSL-3	232	0.08	0.607	1.58	0.086	0.52	-	1.1	20.99
5/5/93	GSL-3	233	< 0.05	0.26	0.89	0.047	0.06	-	1.16	26.79
3/7/93	GSL-3	303	0.13	5.895	0.69	0.058	0.21	-	0.01	19.31
3/7/93	GSL-3	304	0.11	0.267	0.42	0.046	0.27	-	0.66	16.77
3/7/93	GSL-3	305	-	1.509	1.23	0.075	0.4	-	-	23.07
3/8/93	GSL-3	319	0.38	1.892	0.56	0.039	0.5	N.S.	1.28	18.82
3/8/93	GSL-3	320	0.36	1.61	0.72	0.082	0.47	-	1.33	21.12
5/5/93	GSL-4	239	0.11	0.682	0.74	0.039	0.15	-	1.15	19.44
5/5/93	GSL-4	240	0.06	0.388	0.73	0.027	0.05	-	0.77	16.44
5/5/93	GSL-4	241	-	0.381	0.62	0.044	0.08	-	-	25.99
5/5/93	GSL-4	242	0.12	0.469	0.76	0.049	0.22	-	1	25.56
5/5/93	GSL-4	243	-	0.529	0.94	0.054	0.3	-	-	25.21

Appendix 16c. continued

Lake Whitefish *Coregonus clupeaformis*										
			Metals (Detection limits ppm)							
Date Sampled	Location Location	Sample No.	As (0.05)	Cd (0.0001)	Cu (0.10)	Hg (0.005)	Ni (0.02)	Pb (0.03)	Se (0.05)	Zn (0.05)
5/5/93	GSL-4	244	-	0.69	0.71	0.063	0.28	-	-	22.63
5/5/93	GSL-4	245	0.19	0.863	0.74	0.091	0.48	-	1.01	19.95
5/5/93	GSL-4	246	-	0.6	0.8	0.046	0.43	-	-	23.95
5/5/93	GSL-4	247	0.09	0.197	0.52	0.036	0.21	-	0.02	21.05
5/5/93	GSL-4	248	-	0.534	1.11	0.052	0.24	-	-	28.38
5/5/93	GSL-4	249	-	0.972	1.49	0.053	0.4	-	-	52.78
5/5/93	GSL-4	250	-	-	-	0.038	-	N.S.	-	-
5/5/93	GSL-4	251	-	0.408	0.67	0.064	0.22	-	-	23.71
3/7/93	GSL-4	269	0.11	0.728	0.58	0.058	0.39	-	0.62	20.7
3/7/93	GSL-4	270	0.07	0.502	0.65	0.095	0.13	-	0.21	19.98
3/7/93	GSL-4	271	0.26	0.707	0.76	0.431	0.33	-	0.83	16.06
3/7/93	GSL-4	272	0.13	1.626	0.78	0.057	-	-	0.62	26.8
3/7/93	GSL-4	273	0.11	0.561	0.51	0.055	-	-	0.96	22.88
3/7/93	GSL-4	274	-	0.868	0.82	0.059	-	-	-	22.57
3/7/93	GSL-4	275	0.06	0.547	0.69	0.144	-	-	0.98	18.16
3/7/93	GSL-4	276	0.05	0.562	1.08	0.121	-	-	0.66	20.81
6/17/93	GSL-4	399	0.65	0.643	0.35	0.056	0.39		0.98	25.96
6/17/93	GSL-4	400	0.19	0.685	0.99	0.157	0.19	N.S.	1.38	23.6
6/17/93	GSL-4	401	0.13	0.197	0.65	0.068	0.09	-	1.25	16.99
6/17/93	GSL-4	402	0.45	0.57	0.45	0.069	0.21	N.S.	1.13	20.34
6/17/93	GSL-4	403	0.41	0.251	0.86	0.076	0.19	N.S.	1.16	13.21
6/17/93	GSL-4	404	0.16	0.411	0.38	0.044	0.1	N.S.	1.13	17.27
6/17/93	GSL-4	405	0.13	0.66	0.63	0.119	0.23	N.S.	1.51	31.68
6/17/93	GSL-4	406	0.28	0.573	2.44	0.063	0.29	N.S.	1.04	19.05
6/17/93	GSL-4	407	0.24	0.666	0.65	0.062	0.16	-	1.19	15.53
12/1/92	GSL-5	128	0.18	0.232	0.77	0.045	0.32	-	0.79	62.27
12/1/92	GSL-5	129	0.16	1.168	0.8	0.091	0.15	-	0.62	31.39
12/1/92	GSL-5	130	-	0.578	0.66	0.061	0.13	-	-	37.11
12/1/92	GSL-5	131	0.07	0.62	0.66	0.039	0.3	-	1.26	29.03
12/1/92	GSL-5	132	0.08	0.326	0.62	0.068	0.05	-	0.5	32.33
12/1/92	GSL-5	133	2.65	1.49	0.85	0.126	0.44	-	0.64	21.8
12/1/92	GSL-5	134	0.25	0.627	0.64	0.055	0.12	-	0.65	28.59
12/1/92	GSL-5	135	0.63	0.883	0.65	0.149	0.34	-	0.38	31.42
12/1/92	GSL-5	136	0.25	0.999	0.83	0.127	0.25	-	0.72	34.55
12/1/92	GSL-5	137	0.26	1.026	0.74	0.036	0.2	-	0.64	19.92
12/1/92	GSL-5	138	0.3	0.34	0.59	0.069	0.13	-	0.74	29.69
12/1/92	GSL-5	139	-	0.302	0.81	0.03	0.31	-	-	26.69
12/1/92	GSL-5	140	-	0.34	0.43	0.11	0.18	-	-	26.31
12/1/92	GSL-5	141	0.97	1.625	0.76	0.031	0.2	-	0.64	21.15
12/1/92	GSL-5	142	0.53	0.81	0.89	0.12	0.23	-	0.54	27.75
12/2/92	GSL-5	145	0.11	0.886	0.79	0.039	0.16	-	0.52	25.04
12/2/92	GSL-5	146	0.28	1.03	0.72	0.044	0.23	-	0.47	27.35
12/2/92	GSL-5	147	-	0.837	0.92	0.072	0.27	-	-	28.12

Appendix16c. continued

Lake Whitefish Coregonus clupeaformis										
			Metals (Detection limits ppm)							
Date Sampled	Location Location	Sample No.	As (0.05)	Cd (0.0001)	Cu (0.10)	Hg (0.005)	Ni (0.02)	Pb (0.03)	Se (0.05)	Zn (0.05)
12/2/92	GSL-5	148	1.35	1.302	0.87	0.152	0.22	-	0.95	32.81
12/2/92	GSL-5	149	0.36	1.829	0.96	0.096	0.28	-	0.58	25.58
12/2/92	GSL-5	150	1.48	1.52	0.73	0.138	0.36	-	1.09	21.35
12/2/92	GSL-5	151	0.16	1.338	0.54	0.093	0.38	-	0.6	23.55
12/2/92	GSL-5	152	0.32	0.581	0.65	0.049	0.37	-	0.64	22.45
12/2/92	GSL-5	153	0.59	0.347	0.51	0.057	0.33	-	0.64	21.24
12/2/92	GSL-5	154	0.34	0.729	0.59	0.056	0.25	-	0.63	26.63
12/2/92	GSL-5	155	0.46	0.887	0.69	0.032	0.19	-	0.79	22.78
12/2/92	GSL-5	156	1	2.455	0.61	0.128	0.17	-	0.95	9.84
12/2/92	GSL-5	157	0.33	1.511	1.02	0.096	0.38	-	0.55	23.8
12/2/92	GSL-5	158	0.37	0.469	0.59	0.033	0.29	-	0.64	22.76
12/2/92	GSL-5	159	0.18	1.511	0.76	0.068	0.38	-	0.73	26.1944
12/2/92	GSL-5	160	0.97	3.409	1.15	0.115	0.54	-	0.63	30.4
12/2/92	GSL-5	161	-	0.695	1.02	0.068	0.5	-	-	29.16
12/2/92	GSL-5	162	-	1.181	0.6	0.08	0.31	-	-	23.73
12/2/92	GSL-5	163	1.14	0.902	0.94	0.038	0.39	-	0.72	27.56
12/2/92	GSL-5	164	0.46	2.69	0.64	0.157	0.23	-	0.63	24.88
12/2/92	GSL-5	165	0.59	0.615	0.71	0.07	0.31	-	0.5	28.93
12/2/92	GSL-5	166	0.13	1.251	0.54	0.049	0.5	-	0.61	22.66
12/2/92	GSL-5	167	0.39	0.524	0.62	0.068	0.28	-	0.35	25.5
12/2/92	GSL-5	168	0.43	0.288	0.51	0.092	0.26	-	0.64	24.11
12/2/92	GSL-5	169	1.31	0.914	1.41	0.265	0.5	-	0.45	32.69
12/2/92	GSL-5	170	-	0.58	0.78	0.029	0.47	-	-	22.72
12/2/92	GSL-5	171	-	0.566	0.91	0.042	0.35	-	-	27.59
12/2/92	GSL-5	172	0.51	0.751	0.99	0.199	0.17	-	0.41	28.04
12/2/92	GSL-5	173	0.23	0.54	0.59	0.048	0.17	-	0.48	20.29
12/2/92	GSL-5	174	0.32	0.467	0.56	0.26	0.33	-	0.39	22.97
10/3/92	GSL-5	204	0.05	0.814	0.78	0.045	0.29	-	0.39	25.44
10/3/92	GSL-5	205	-	1.712	1	0.205	0.8	-	-	60.29
10/3/92	GSL-5	206	0.1	0.274	0.48	0.06	0.39	-	0.02	23.96
10/3/92	GSL-5	207	0.05	0.443	0.45	0.068	0.11	-	0.03	15.43
10/3/92	GSL-5	208	0.51	2.17	0.9	0.157	0.43	-	0.02	114.01
10/3/92	GSL-5	209	0.05	0.718	0.71	0.048	0.2	-	0.02	29.15
10/3/92	GSL-5	210	-	0.665	0.68	0.064	0.2	-	0.02	20.03
10/3/92	GSL-5	211	0.16	0.484	0.69	0.165	0.44	-	0.02	22.6
10/3/92	GSL-5	212	1.05	1.101	0.77	0.042	0.42	-	0.78	24.58
10/3/92	GSL-5	213	0.11	1.018	0.76	0.037	0.24	-	0.72	24.06
10/3/92	GSL-5	214	-	0.698	0.86	0.041	0.42	-	-	26.47
10/3/92	GSL-5	215	0.09	0.599	0.64	0.08	0.24	-	0.02	26.93
10/3/92	GSL-5	216	0.2	1.557	0.74	0.138	0.57	-	0.02	23.3
10/3/92	GSL-5	217	0.71	1.915	0.85	0.17	0.15	-	0.02	28.26
10/3/92	GSL-5	218	0.15	0.887	0.7	0.073	0.25	-	0.02	20.54

Appendix 16d. Metal concentrations in eggs of lake whitefish caught in Yellowknife-Back Bay area of Great Slave Lake in 1992 and 1993.

Lake whitefish Coregonus clupeaformis (Mitchill)									
			Metals (Detection limits ppm)						
Date Sampled	Location	Sample No.	As (0.05)	Cd (0.0001)	Cu (0.10)	Hg (0.05)	Ni (0.02)	Se (0.05)	Zn (0.05)
08/25/92	GSL-1	4	0.07	-	-	-	-	0.71	-
8/26/92	GSL-1	71	0.08	0.002	1.38	0.011	0.14	2.14	29.14
8/26/92	GSL-1	72	0.34	0.002	1.12	0.008	0.03	2.27	29.55
8/26/92	GSL-1	73	0.24	0	0.87	0.009	0.05	3.09	31.89
08/26/92	GSL-1	75	0.05	-	-	-	-	1.14	-
08/26/92	GSL-1	77	0.11	-	-	-	-	0.94	-
8/26/92	GSL-1	80	0.4	0.001	1.07	0.006	0.07	3.01	29.57
8/26/92	GSL-1	83	0.38	0.001	0.88	0.01	0.02	2.84	31.62
8/26/92	GSL-1	91	0.44	0.002	1.21	0.004	0.06	1.45	31.91
8/25/92	GSL-2	21	0.18	0.003	0.77	0.007	0.02	1.72	29.25
8/25/92	GSL-2	22	0.32	0.002	0.9	0.004	0.07	1.08	31.07
8/25/92	GSL-2	23	0.37	0.004	0.83	0.007	0.05	1.88	31.82
8/25/92	GSL-2	27	0.45	0.002	0.67	0.007	-	1.37	34.01
8/25/92	GSL-2	30	0.51	0.002	1.11	0.007	0.06	1.14	28.48
8/25/92	GSL-2	31	0.32	0.002	0.96	0.006	0.04	1.86	33.53
8/25/92	GSL-2	32	0.1	0.001	1.21	0.006	0.05	2.72	35.01
8/25/92	GSL-2	33	0.32	0.002	0.96	0.008	0.03	1.59	27.81
8/25/92	GSL-2	34	0.17	0.002	0.92	0.007	0.04	1.43	24.32
8/26/92	GSL-2	113	0.29	0.002	0.88	0.006	0.02	1.41	28.28
8/26/92	GSL-2	114	0.14	0.001	1.23	0.005	0.02	2.48	35.21
8/26/92	GSL-2	117	0.34	0.003	0.89	0.005	0.02	1.65	33.54
8/26/92	GSL-2	118	0.17	0.002	0.93	0.003	0.02	3.76	33.44
8/26/92	GSL-2	119	0.3	0.002	0.96	0.007	0.04	1.96	25.28
8/26/92	GSL-2	120	0.34	0.003	0.8	0.008	0.02	1.52	27.71
8/26/92	GSL-2	121	0.38	0.002	0.95	0.006	0.02	2.22	29.75
8/25/92	GSL-3	40	0.19	0.002	0.95	0.005	0.02	3.1	29.28
08/25/92	GSL-3	41	0.1	-	-	-	-	0.8	-
8/25/92	GSL-3	42	0.2	0.002	1.08	0.007	0.02	3.07	33.36
8/25/92	GSL-3	44	0.38	0.002	0.93	0.007	0.04	2.04	34.5
08/25/92	GSL3	45	0.08	-	-	-	-	1.7	-
08/25/92	GSL-3	46	0.12	-	-	-	-	0.9	-
08/25/92	GSL-3	48	0.17	-	-	-	-	2.42	-
08/25/92	GSL-3	50	0.21	-	-	-	-	2.32	-
08/25/92	GSL-3	51	0.06	-	-	-	-	1.82	-
8/25/92	GSL-3	57	0.4	0.001	0.83	0.007	0.02	1.8	26.22
8/25/92	GSL-3	60	0.36	0.001	0.86	0.003	0.03	1.79	31.03
8/25/92	GSL-3	61	0.17	0.002	1.1	0.005	0.02	1.99	33.54
8/25/92	GSL-3	62	0.05	0.002	1.12	0.007	0.02	2.85	33.59
8/25/92	GSL-3	63	0.05	0.003	0.75	0.005	0.02	1.52	26.51
8/25/92	GSL-3	66	0.05	0.003	1.19	0.005	0.04	3.28	50.09

Appendix 16e. Metal concentrations in the stomach of lake whitefish caught in Yellowknife Bay 1992-93.

Lake whitefish Coregonus clupeaformis					
			Metals (Detection limits ppm)		
Date Sampled	**Location**	**Sample No.**	**Hg (0.05)**	**Se (0.05)**	**As (0.05)**
8/25/92	GSL-1	1	0.032	0.58	0.08
8/25/92	GSL-1	2	0.031	0.5	0.17
8/25/92	GSL-1	3	0.037	0.32	0.17
8/25/92	GSL-1	4	0.056	0.22	0.1
8/25/92	GSL-1	5	0.041	0.46	0.2
8/26/92	GSL-1	70	0.024	0.6	0.05
8/26/92	GSL-1	71	0.053	0.47	0.05
8/26/92	GSL-1	72	0.031	0.29	0.17
8/26/92	GSL-1	73	0.058	0.55	0.05
8/26/92	GSL-1	74	0.019	0.42	0.43
8/26/92	GSL-1	75	0.031	0.47	0.07
8/26/92	GSL-1	76	0.032	0.41	0.13
8/26/92	GSL-1	77	0.054	0.35	0.09
8/26/92	GSL-1	78	0.029	0.37	0.26
8/26/92	GSL-1	79	0.033	0.51	0.08
8/26/92	GSL-1	80	0.024	0.53	0.22
8/26/92	GSL-1	81	0.056	0.29	0.15
8/26/92	GSL-1	82	0.03	0.58	0.09
8/26/92	GSL-1	83	0.033	0.5	0.1
8/26/92	GSL-1	84	0.043	0.28	0.24
8/26/92	GSL-1	85	0.024	0.52	0.06
8/26/92	GSL-1	86	0.039	0.54	0.05
8/26/92	GSL-1	87	0.067	0.58	0.05
8/26/92	GSL-1	88	0.022	0.39	0.05
8/26/92	GSL-1	89	0.016	0.48	0.18
8/26/92	GSL-1	90	0.031	0.38	0.4
8/26/92	GSL-1	91	0.041	0.47	0.43
8/26/92	GSL-1	92	0.038	0.34	0.07
8/26/92	GSL-1	93	0.033	0.65	0.05
8/26/92	GSL-1	94	0.015	0.58	0.05
8/25/92	GSL-2	20	0.057	0.24	0.05
8/25/92	GSL-2	21	0.037	0.14	0.49
8/25/92	GSL-2	22	0.036	0.16	0.25
8/25/92	GSL-2	23	0.038	0.76	0.59
8/25/92	GSL-2	24	0.033	0.29	0.05
8/25/92	GSL-2	25	0.045	0.48	0.05
8/25/92	GSL-2	26	0.04	0.38	0.16
8/25/92	GSL-2	27	0.034	0.1	0.35
8/25/92	GSL-2	28	0.064	0.23	0.05

Appendix 16e. continued

Lake whitefish Coregonus clupeaformis					
			Metals (Detection limits ppm)		
Date Sampled	Location	Sample No.	Hg (0.05)	Se (0.05)	As (0.05)
8/25/92	GSL-2	29	0.039	0.39	0.4
8/25/92	GSL-2	30	0.036	0.22	0.34
8/25/92	GSL-2	31	0.031	0.32	0.08
8/25/92	GSL-2	32	0.033	0.5	0.05
8/25/92	GSL-2	33	0.036	0.23	0.15
8/25/92	GSL-2	34	0.056	0.34	0.21
8/26/92	GSL-2	113	0.033	0.36	0.32
8/26/92	GSL-2	114	0.046	0.37	0.19
8/26/92	GSL-2	115	0.03	0.51	0.23
8/26/92	GSL-2	116	0.03	0.24	0.48
8/26/92	GSL-2	117	0.018	0.34	0.19
8/26/92	GSL-2	118	0.041	0.47	0.08
8/26/92	GSL-2	119	0.027	0.38	0.13
8/26/92	GSL-2	120	0.025	0.25	0.17
8/26/92	GSL-2	121	0.041	0.35	0.16
8/26/92	GSL-2	122	0.046	0.5	0.17
8/25/92	GSL-3	40	0.046	0.24	0.07
8/25/92	GSL-3	41	0.04	0.23	0.14
8/25/92	GSL-3	42	0.041	0.17	0.44
8/25/92	GSL-3	43	0.026	0.2	0.12
8/25/92	GSL-3	44	0.067	0.33	0.11
8/25/92	GSL-3	45	0.036	0.53	0.05
8/25/92	GSL-3	46	0.051	0.22	0.16
8/25/92	GSL-3	47	0.044	0.15	0.35
8/25/92	GSL-3	48	0.046	0.1	0.21
8/25/92	GSL-3	49	0.02	0.25	0.08
8/25/92	GSL-3	50	0.028	0.12	0.26
8/25/92	GSL-3	51	0.097	0.31	0.06
8/25/92	GSL-3	57	0.023	0.54	0.2
8/25/92	GSL-3	58	0.065	0.37	0.1
8/25/92	GSL-3	59	0.046	0.33	0.05
8/25/92	GSL-3	60	0.045	0.14	0.26
8/25/92	GSL-3	61	0.06	0.18	0.15
8/25/92	GSL-3	62	0.046	0.25	0.05
8/25/92	GSL-3	63	0.056	0.08	0.14
8/25/92	GSL-3	64	0.031	0.18	0.11
8/25/92	GSL-3	65	0.021	0.35	0.05
8/25/92	GSL-3	66	0.043	0.41	0.05

Appendix 17a. Biological descriptors and metal concentrations in the muscle of northern pike caught in Yellowknife Bay 1992-93.

Northern pike Esox lucius (Linnaeus)			Metals (Detection limit ppm)								Biological parameters							
Date Sampled	Location Location	Sample No.	As (0.05)	Cd (0.0001)	Cu (0.10)	Hg (0.05)	Ni (0.02)	Pb (0.03)	Se (0.05)	Zn (0.05)	Length	Weight	Maturity	Scale Method	Otolith Method	Accepted Age	k-factor	liver wt.
8/26/92	GSL-1	95	0.22	0.0004	0.65	0.193	< 0.02	< 0.03	0.13	3.35	540	993	2	7	-	7	0.63	-
8/26/92	GSL-1	96	0.2	0.0006	0.33	0.114	< 0.02	< 0.03	0.09	5.87	633	1717	2	7	-	7	0.68	-
8/26/92	GSL-1	97	0.13	0.0007	0.25	0.17	< 0.02	< 0.03	0.13	4.69	515	909	2	6	-	6	0.67	-
8/26/92	GSL-1	98	0.14	0.0006	0.41	0.224	< 0.02	< 0.03	0.14	3.66	584	1620	7	8	-	8	0.81	-
8/26/92	GSL-1	99	0.16	0.001	0.17	0.182	< 0.02	< 0.03	0.07	5.42	563	1334	2	7	-	7	0.75	-
8/26/92	GSL-1	100	0.09	0.0017	0.4	0.092	< 0.02	< 0.03	< 0.05	4	587	1177	2	6	-	6	0.58	-
8/26/92	GSL-1	101	0.15	0.0004	0.48	0.187	< 0.02	< 0.03	< 0.05	3.11	545	1150	2	4	-	4	0.71	-
8/26/92	GSL-1	102	0.15	0.0006	0.19	0.175	< 0.02	< 0.03	0.09	2.9	578	1320	2	8	-	8	0.68	-
8/26/92	GSL-1	103	0.09	0.0008	0.26	0.189	< 0.02	< 0.03	0.11	2.84	550	1341	7	7	-	7	0.81	-
6/11/93	GSL-1	376	0.36	0.002	0.25	0.301	< 0.02	< 0.03	0.16	2.62	645	1960	2	12	-	12	0.73	-
6/12/93	GSL-1	393	0.16	0.003	0.29	0.251	< 0.02	< 0.03	0.16	3.19	657	2123	8	11	-	11	0.75	-
6/12/93	GSL-1	394	0.24	0.001	0.23	0.103	< 0.02	< 0.03	0.2	3.55	531	908	5-2	6	-	6	0.61	-
7/5/93	GSL-1	417	0.22	0.001	0.26	0.157	< 0.02	< 0.03	0.22	3.67	592	1505	2	6	-	6	0.73	-
7/5/93	GSL-1	418	0.46	0.002	0.25	0.443	< 0.02	< 0.03	0.21	2.81	545	1210	7	13	-	13	0.75	-
7/5/93	GSL-1	419	0.17	0.001	0.22	0.129	< 0.02	< 0.03	0.24	3.53	635	1903	7	11	-	11	0.74	-
8/31/93	GSL-1	440	0.29	0.002	0.27	0.275	< 0.02	< 0.03	0.19	2.92	583	1301	7-8	9	-	9	0.66	-
8/26/92	GSL-2	126	0.12	0.0005	0.31	0.219	< 0.02	< 0.03	< 0.05	2.13	610	1720	7	7	-	7	0.76	-
8/25/92	GSL-3	55	0.3	0.0003	0.28	0.168	< 0.02	< 0.03	0.44	2.85	630	2068	7	9	-	9	0.83	-
8/25/92	GSL-3	56	0.8	0.0004	0.76	0.289	< 0.02	< 0.03	0.27	3.07	745	3058	7	11	-	11	0.74	-
8/25/92	GSL-3	67	0.07	0.0007	0.59	0.198	< 0.02	< 0.03	0.6	4.34	615	1175	7	7	-	7	0.51	-
8/25/92	GSL-3	68	0.09	0.0007	0.52	0.164	< 0.02	< 0.03	0.55	2.3	625	1945	7	9	-	9	0.80	-
5/5/93	GSL-3	226	0.35	0.0016	0.84	0.467	< 0.02	< 0.03	0.19	3.68	784	4107	8	19	-	19	0.85	-
3/7/93	GSL-3	300	0.25	0.0008	0.42	0.268	< 0.02	< 0.03	0.14	3.97	636	2054	3	9	-	9	0.80	-
3/7/93	GSL-3	301	0.12	0.0007	0.47	0.088	< 0.02	< 0.03	0.2	3.98	603	1695	7	5	-	5	0.77	-
3/7/93	GSL-3	302	0.2	0.006	0.43	0.169	< 0.02	< 0.03	0.16	3.44	663	2165	3	7	-	7	0.74	-
3/8/93	GSL-3	321	0.18	0.001	0.17	0.216	< 0.02	< 0.03	0.24	3.29	666	2522	3	8	-	8	0.85	-
3/8/93	GSL-3	322	0.14	0.0001	0.22	0.182	< 0.02	< 0.03	0.21	4.23	619	2039	3	6	-	6	0.86	-
3/8/93	GSL-3	323	0.18	0.001	0.21	0.205	< 0.02	< 0.03	0.21	2.86	617	1812	7	9	-	9	0.77	-
6/18/93	GSL-3	408	0.32	0.002	0.37	0.303	< 0.02	< 0.03	0.26	2.52	623	1563	7	8	-	8	0.65	-
6/18/93	GSL-3	409	0.11	0.002	0.2	0.211	< 0.02	< 0.03	0.22	2.86	719	2988	5-1	8	-	8	0.80	-
6/18/93	GSL-3	410	0.09	0.001	0.19	0.176	< 0.02	< 0.03	0.17	3.61	568	1394	3	4	-	4	0.76	-
6/18/93	GSL-3	411	0.43	0.002	0.2	0.18	< 0.02	< 0.03	0.25	3.58	569	1245	5-1	7	-	7	0.68	-
6/18/93	GSL-3	412	0.22	0.001	0.21	0.233	< 0.02	< 0.03	0.22	3.65	757	3339	5-1	8	-	8	0.77	-
6/18/93	GSL-3	413	0.03	0.001	0.18	0.235	< 0.02	< 0.03	0.18	4.62	576	1168	2	7	-	7	0.61	-
6/18/93	GSL-3	414	0.19	0.002	0.21	0.265	< 0.02	< 0.03	0.24	2.72	577	1735	7	7	-	7	0.90	-
6/18/93	GSL-3	415	0.22	0.001	0.19	0.281	< 0.02	< 0.03	0.18	3.31	690	2333	7	10	-	10	0.71	-
6/18/93	GSL-3	416	0.11	0.002	0.18	0.25	< 0.02	< 0.03	0.26	2.6	587	1074	2	8	-	8	0.53	-
8/30/93	GSL-3	420	0.19	0.001	0.33	0.23	< 0.02	< 0.03	0.23	4.08	656	2108	2	10	-	10	0.75	-
8/30/93	GSL-3	421	0.22	0.001	0.21	0.233	< 0.02	< 0.03	0.2	3.34	595	1592	7	12	-	12	0.76	-
8/30/93	GSL-3	422	0.23	0.003	0.28	0.457	< 0.02	< 0.03	0.22	4.11	669	2106	7	13	-	13	0.70	-
8/30/93	GSL-3	423	0.21	0.001	0.28	0.139	< 0.02	< 0.03	0.29	3.44	496	892	6-7	5	-	5	0.73	-
8/30/93	GSL-3	424	0.14	0.001	0.27	0.132	< 0.02	< 0.03	0.24	5.75	584	1525	2	7	-	7	0.77	-
8/31/93	GSL-3	425	0.36	0.001	0.22	0.284	< 0.02	< 0.03	0.21	3.24	626	1524	2	7	-	7	0.62	-
8/31/93	GSL-3	426	0.3	0.002	0.32	0.236	< 0.02	< 0.03	0.29	2.88	640	1967	7	8	-	8	0.75	-
8/31/93	GSL-3	427	0.15	0.002	0.3	0.277	< 0.02	< 0.03	0.22	3.58	613	1692	8	9	-	9	0.73	-
8/31/93	GSL-3	428	0.12	0.001	0.27	0.125	< 0.02	< 0.03	0.26	3.29	528	1054	7	4	-	4	0.72	-
8/31/93	GSL-3	429	0.21	0.001	0.3	0.164	< 0.02	< 0.03	0.2	4.31	781	1559	2	6	-	6	0.33	-
8/31/93	GSL-3	430	0.21	0.002	0.29	0.28	< 0.02	< 0.03	0.22	3.94	618	1882	7-8	10	-	10	0.80	-
8/31/93	GSL-3	431	0.22	0.001	0.26	0.367	< 0.02	< 0.03	0.27	4.26	785	3119	2-3	11	-	11	0.64	-
5/5/93	GSL-4	252	0.44	0.0006	0.39	0.169	< 0.02	< 0.03	0.18	4.64	667	2510	3-4	7	-	7	0.85	-
5/5/93	GSL-4	253	0.11	0.0004	0.54	0.105	< 0.02	< 0.03	0.22	3.88	515	1074	7-8	5	-	5	0.79	-
5/5/93	GSL-4	254	0.12	0.0006	0.32	0.119	< 0.02	< 0.03	0.24	3.73	536	1227	3-4	4	-	4	0.80	-
3/6/93	GSL-4	255	0.11	0.0003	0.27	0.102	< 0.02	< 0.03	0.24	3.45	490	988	7-8	4	-	4	0.84	-
3/6/93	GSL-4	256	0.13	0.0012	0.32	0.184	< 0.02	< 0.03	0.25	3.47	645	1883	7-8	8	-	8	0.70	-
3/6/93	GSL-4	257	0.13	0.0001	0.35	0.098	< 0.02	< 0.03	0.21	4.16	479	988	6	3	-	3	0.90	-

Appendix 17a. continued

Northern pike Esox lucius (Linnaeus)			Metals (Detection limit ppm)								Biological parameters							
Date Sampled	Location Location	Sample No.	As (0.05)	Cd (0.0001)	Cu (0.10)	Hg (0.05)	Ni (0.02)	Pb (0.03)	Se (0.05)	Zn (0.05)	Length	Weight	Maturity	Scale Method	Otolith Method	Accepted Age	k-factor	liver wt.
3/6/93	GSL-4	258	0.12	0.001	0.25	0.185	< 0.02	< 0.03	0.27	3.75	621	1828	3-4	7	-	7	0.76	-
3/6/93	GSL-4	259	0.08	0.0005	0.26	0.113	< 0.02	< 0.03	0.26	3.29	472	491	7	4	-	4	0.47	-
3/6/93	GSL-4	260	0.09	0.0002	0.4	0.125	< 0.02	< 0.03	0.28	5.49	473	911	6	5	-	5	0.86	-
3/7/93	GSL-4	277	0.14	0.0017	0.99	0.251	< 0.02	< 0.03	0.21	4.48	653	2198	3	8	-	8	0.79	-
3/7/93	GSL-4	278	0.15	0.0011	0.79	0.11	< 0.02	< 0.03	0.22	4.61	556	1471	3	4	-	4	0.86	-
3/7/93	GSL-4	279	0.12	0.0016	0.47	0.105	< 0.02	< 0.03	0.19	3.54	520	1155	3	5	-	5	0.82	-
3/7/93	GSL-4	280	0.14	0.0008	0.47	0.107	< 0.02	< 0.03	0.18	4.16	496	860	7	4	-	4	0.70	-
3/7/93	GSL-4	281	0.11	0.001	0.53	0.076	< 0.02	< 0.03	0.21	2.66	537	1225	3	4	-	4	0.79	-
3/7/93	GSL-4	282	0.08	0.0008	0.52	0.092	< 0.02	< 0.03	0.19	3.37	539	1193	3	5	-	5	0.76	-
3/7/93	GSL-4	283	0.18	0.0015	0.22	0.123	< 0.02	< 0.03	0.19	2.93	599	1855	3	7	-	7	0.86	-
3/7/93	GSL-4	284	0.3	0.0224	0.49	0.253	< 0.02	< 0.03	0.15	3.84	520	1155	3	6	-	6	0.82	-
3/7/93	GSL-4	285	0.15	0.0004	0.3	0.113	< 0.02	< 0.03	0.26	3.44	562	1407	7	6	-	6	0.79	-
3/7/93	GSL-4	286	0.17	0.0015	0.42	0.161	< 0.02	< 0.03	0.24	3.52	560	1379	7	8	-	8	0.79	-
3/7/93	GSL-4	287	0.18	0.0027	0.38	0.205	< 0.02	< 0.03	0.24	3.26	529	1254	7	7	-	7	0.85	-
3/7/93	GSL-4	288	0.12	0.0011	0.37	0.202	< 0.02	< 0.03	0.23	3.18	529	1185	7	8	-	8	0.80	-
3/7/93	GSL-4	289	0.13	0.0014	0.39	0.26	< 0.02	< 0.03	0.25	4.21	520	1227	3	6	-	6	0.87	-
3/7/93	GSL-4	290	0.12	0.001	0.47	0.12	< 0.02	< 0.03	0.21	3.67	518	1065	7	4	-	4	0.77	-
3/7/93	GSL-4	291	0.19	0.0002	0.37	0.212	< 0.02	< 0.03	0.22	3.15	672	2568	3	11	-	11	0.85	-
3/7/93	GSL-4	292	0.1	0.0006	0.41	0.113	< 0.02	< 0.03	0.23	3.63	500	972	7	5	-	5	0.78	-
3/10/93	GSL-4	346	0.25	0.001	0.22	0.224	< 0.02	< 0.03	0.19	4.03	736	3484	3	12	-	12	0.87	-
3/11/93	GSL-4	348	0.14	0.001	0.22	0.365	< 0.02	< 0.03	0.23	3.04	620	1945	3	12	-	12	0.82	-
6/17/93	GSL-4	395	0.12	0.001	0.29	0.114	< 0.02	< 0.03	0.21	2.37	540	1185	7	6	-	6	0.75	-
6/17/93	GSL-4	396	0.15	0.003	0.24	0.185	< 0.02	< 0.03	0.2	3.69	618	1459	7	14	-	14	0.62	-
6/17/93	GSL-4	397	0.24	0.001	0.23	0.379	< 0.02	< 0.03	0.24	3.13	875	4090	5	15	-	15	0.61	-
12/1/92	GSL-5	143	0.2	0.0005	0.85	0.138	< 0.02	< 0.03	0.11	3.47	645	2154	2-3	5	-	5	0.80	70.3
12/1/92	GSL-5	144	0.57	-	-	-	< 0.02	-	0.18	-	529	1079	3	3	-	3	0.73	35.2
12/2/92	GSL-5	175	0.14	0.0021	0.36	0.33	< 0.02	< 0.03	0.29	3.71	553	1358	7	8	-	8	0.80	41.3
12/2/92	GSL-5	176	0.26	0.0017	0.28	0.139	< 0.02	< 0.03	0.26	3.63	710	3035	7	9	-	9	0.85	86.1
10/3/92	GSL-6	177	0.5	0.0018	0.19	0.213	< 0.02	< 0.03	0.27	2.63	592	1746	5-2	8	-	8	0.84	42
10/3/92	GSL-6	178	0.32	0.0023	0.31	0.448	< 0.02	< 0.03	0.24	2.06	940	7210	5-2	14	-	14	0.87	148.7
10/3/92	GSL-6	179	0.24	0.0021	0.27	0.191	< 0.02	< 0.03	0.15	3.38	654	2200	5-2	10	-	10	0.79	39.7
10/3/92	GSL-6	180	0.24	0.0026	0.26	0.145	< 0.02	< 0.03	0.18	3.35	667	2554	5-2	8	-	8	0.86	57.2
10/3/92	GSL-6	181	0.15	0.0027	0.24	0.114	< 0.02	< 0.03	0.13	4	630	2442	5-2	8	-	8	0.98	45.9
10/3/92	GSL-6	182	0.12	0.0008	0.19	0.147	< 0.02	< 0.03	0.21	3.54	690	2841	7	8	-	8	0.86	75
10/3/92	GSL-6	183	0.22	0.0001	0.24	0.134	< 0.02	< 0.03	0.27	3.55	700	2436	2	7	-	7	0.71	41.7
10/3/92	GSL-6	184	0.16	0.003	0.28	0.123	< 0.02	< 0.03	0.21	4.66	674	2396	5-2	7	-	7	0.78	43.6
10/3/92	GSL-6	185	0.18	0.0034	0.3	0.281	< 0.02	< 0.03	0.25	3.67	658	2385	5-2	9	-	9	0.84	71.1
10/3/92	GSL-6	186	0.07	0.0013	0.23	0.134	< 0.02	< 0.03	0.19	3.19	650	2242	2	7	-	7	0.82	49.1
10/3/92	GSL-6	187	0.21	0.0023	0.31	0.192	< 0.02	< 0.03	0.21	4.31	692	2905	2	7	-	7	0.88	86.3
10/3/92	GSL-6	188	0.15	0.0032	0.23	0.211	< 0.02	< 0.03	0.15	3.95	662	2577	2	11	-	11	0.89	82.2
10/3/92	GSL-6	189	0.12	0.0038	0.28	0.276	< 0.02	< 0.03	0.21	3.6	751	3568	2	10	-	10	0.84	75.7
10/3/92	GSL-6	190	0.11	0.0012	0.24	0.15	< 0.02	< 0.03	0.27	3.01	666	2345	2	8	-	8	0.79	49.4
10/3/92	GSL-6	191	0.19	0.0008	0.21	0.131	< 0.02	< 0.03	0.22	3.29	666	2833	1-2	10	-	10	0.96	56.1
10/3/92	GSL-6	192	0.18	0.0026	0.24	0.19	< 0.02	< 0.03	0.24	3.77	673	2683	2	9	-	9	0.88	49
10/3/92	GSL-6	193	0.2	0.0021	0.28	0.184	< 0.02	< 0.03	0.27	3.25	649	2498	7	7	-	7	0.91	70
10/3/92	GSL-6	194	0.33	0.0025	0.23	0.176	< 0.02	< 0.03	0.26	3.54	787	4034	2	12	-	12	0.83	89.4
10/3/92	GSL-6	195	0.3	0.0023	0.28	0.18	< 0.02	< 0.03	0.2	3.59	597	2028	7	6	-	6	0.95	44.3
10/3/92	GSL-6	196	0.09	0.0019	0.27	0.179	< 0.02	< 0.03	0.18	3.18	626	1996	7	12	-	12	0.81	55.1
10/3/92	GSL-6	197	0.16	0.0005	0.44	0.178	< 0.02	< 0.03	0.23	3.49	635	2519	2	10	-	10	0.98	39.9
10/3/92	GSL-6	198	0.17	0.0004	0.28	0.332	< 0.02	< 0.03	0.23	4.86	673	2415	2	10	-	10	0.79	63.5
10/3/92	GSL-6	199	0.16	0.0024	0.33	0.171	< 0.02	< 0.03	0.27	4.98	730	3004	2	11	-	11	0.77	66
10/3/92	GSL-6	200	0.19	0.0018	0.32	0.164	< 0.02	< 0.03	0.23	4.09	655	2298	2	8	-	8	0.82	46.8
10/3/92	GSL-6	201	0.22	0.0025	0.21	0.194	< 0.02	< 0.03	0.16	3.28	650	2479	2	7	-	7	0.90	68.3
10/3/92	GSL-6	202	0.26	0.0002	0.31	0.257	< 0.02	< 0.03	0.19	3.5	696	3188	2	12	-	12	0.95	59.7

Appendix 17b. Metal concentrations in the liver of lake whitefish caught in Yellowknife Bay 1992-93.

Northern Pike
Esox lucius (Linnaeus)

Date Sampled	Location	Sample No.	As (0.05)	Cd (0.0001)	Cu (0.10)	Hg (0.05)		Ni (0.02)		Pb (0.03)	Se (0.05)	Zn (0.05)	liver wt.
			Metals (Detection limit ppm)										
8/26/92	GSL-1	95	0.34	0.053	11.1	0.081		0.04	<	0.05	0.93	47.12	-
8/26/92	GSL-1	96	0.46	0.034	8.67	0.047		0.07	<	0.05	1.48	25.9	-
8/26/92	GSL-1	97	0.69	0.092	12.3	0.07		0.08	<	0.05	0.96	40.95	-
8/26/92	GSL-1	98	0.15	0.126	3.71	0.112		0.05	<	0.05	1.66	34.57	-
8/26/92	GSL-1	99	0.45	0.09	30.8	0.091		0.05	<	0.05	1.2	51.99	-
8/26/92	GSL-1	100	0.42	0.488	6.31	0.079		0.13	<	0.05	1.18	26.83	-
8/26/92	GSL-1	101	0.85	0.105	7.49	0.085		0.16	<	0.05	1.37	34.88	-
8/26/92	GSL-1	102	0.38	0.099	7.68	0.099	<	0.04	<	0.05	1.28	39.06	-
8/26/92	GSL-1	103	0.55	0.129	4.83	0.114	<	0.04	<	0.05	1.06	61.1	-
6/11/93	GSL-1	376	0.17	0.145	2.54	0.177	<	0.04	<	0.05	0.84	19.87	-
6/12/93	GSL-1	393	0.1	0.158	5.28	0.168		0.06	<	0.05	1.15	31.57	-
6/12/93	GSL-1	394	0.08	0.04	2.52	0.066	<	0.04	<	0.05	1.06	27.9	-
7/5/93	GSL-1	417	0.07	0.083	11.82	0.087	<	0.04	<	0.05	1.52	35.17	-
7/5/93	GSL-1	418	0.13	0.085	3.68	0.184	<	0.04	<	0.05	1.36	20.35	-
7/5/93	GSL-1	419	0.09	0.074	4.35	0.095	<	0.04	<	0.05	1.12	20.78	-
8/31/93	GSL-1	440	0.08	0.109	7.4	0.131		0.06	<	0.05	1.59	37.05	-
8/26/92	GSL-2	126	0.1	0.097	7.18	0.089	<	0.04	<	0.05	-	32.76	-
8/25/92	GSL-3	55	0.18	0.068	6.26	0.047	<	0.04	<	0.05	1.91	31.79	-
8/25/92	GSL-3	56	0.34	0.04	10.7	0.106	<	0.04	<	0.05	2.08	21.31	-
8/25/92	GSL-3	67	0.07	0.093	3.97	0.051	<	0.04	<	0.05	1.49	27.56	-
8/25/92	GSL-3	68	0.07	0.151	4.73	0.078		0.06	<	0.05	2.1	25.27	-
5/5/93	GSL-3	226	0.31	0.093	3.74	0.091		0.09	<	0.05	1.48	17.73	-
3/7/93	GSL-3	300	0.36	0.076	2.94	0.051		0.12		0.07	0.62	23.87	-
3/7/93	GSL-3	301	0.19	0.018	0.72	0.026		0.17	<	0.05	0.71	14.92	-
3/7/93	GSL-3	302	0.45	0.039	3.53	0.037		0.08	<	0.05	1.01	35.78	-
3/8/93	GSL-3	321	0.18	0.037	3.21	0.04	<	0.04	<	0.05	0.78	22.99	-
3/8/93	GSL-3	322	0.2	0.043	1.64	0.044	<	0.04	<	0.05	0.91	24.21	-
3/8/93	GSL-3	323	0.07	0.047	1.92	0.033	<	0.04	<	0.05	0.82	9.65	-
6/18/93	GSL-3	408	0.14	0.126	2.96	0.103	<	0.04	<	0.05	1.44	18.03	-
6/18/93	GSL-3	409	0.07	0.085	5.14	0.096	<	0.04	<	0.05	1.13	23.1	-
6/18/93	GSL-3	410	0.09	0.024	6.14	0.07	<	0.04	<	0.05	0.9	17.53	-
6/18/93	GSL-3	411	0.15	0.089	1.46	0.079		0.06	<	0.05	1.34	23.51	-
6/18/93	GSL-3	412	0.15	0.17	10.19	0.144		0.06	<	0.05	2.24	41	-
6/18/93	GSL-3	413	0.05	0.035	2.4	0.08		0.04	<	0.05	1.01	22.6	-
6/18/93	GSL-3	414	0.08	0.024	1.24	0.064	<	0.04	<	0.05	1.04	14.68	-
6/18/93	GSL-3	415	0.11	0.101	14.28	0.136		0.06	<	0.05	2.21	28.71	-
6/18/93	GSL-3	416	0.15	0.174	9.93	0.104	<	0.04	<	0.05	1.64	54.51	-
8/30/93	GSL-3	420	0.27	0.084	8.18	0.092	<	0.04	<	0.05	1.1	42.1	-
8/30/93	GSL-3	421	0.12	0.026	3.92	0.082	<	0.04	<	0.05	1.3	17.22	-
8/30/93	GSL-3	422	0.18	0.285	4.42	0.197	<	0.04	<	0.05	1.29	19.08	-
8/30/93	GSL-3	423	0.13	0.042	2.11	0.066	<	0.04	<	0.05	1.31	28.33	-
8/30/93	GSL-3	424	0.05	0.052	3.66	0.059	<	0.04	<	0.05	1.15	39.57	-
8/31/93	GSL-3	425	0.1	0.245	4.01	0.128	<	0.04	<	0.05	1.54	72.37	-
8/31/93	GSL-3	426	0.13	0.091	3.52	0.083	<	0.04	<	0.05	1.34	17.79	-
8/31/93	GSL-3	427	0.18	0.125	10.03	0.11	<	0.04	<	0.05	1.59	25.79	-
8/31/93	GSL-3	428	0.09	0.077	3.07	0.068	<	0.04	<	0.05	1.74	60.01	-
8/31/93	GSL-3	429	0.13	0.087	6.01	0.073	<	0.04	<	0.05	1.19	27.91	-
8/31/93	GSL-3	430	0.16	0.152	4.99	0.106	<	0.04	<	0.05	1.75	27.71	-
8/31/93	GSL-3	431	0.08	0.096	5.62	0.162	<	0.04	<	0.05	1.33	42.96	-
5/5/93	GSL-4	252	0.05	0.025	2.07	0.069		0.28	<	0.05	0.07	34.09	-
5/5/93	GSL-4	253	0.11	0.028	1.64	0.021		0.05	<	0.05	0.9	21.82	-
5/5/93	GSL-4	254	0.08	0.034	1.42	0.054		0.16	<	0.05	0.99	22.94	-
3/6/93	GSL-4	255	0.35	0.029	1.09	0.024		0.06	<	0.05	0.36	16.26	-
3/6/93	GSL-4	256	0.19	0.095	4.26	0.07	<	0.04	<	0.05	0.5	33.42	-
3/6/93	GSL-4	257	0.13	0.011	0.82	0.017	<	0.04	<	0.05	0.56	11.65	-

Appendix 17b. continued

Northern Pike
Esox lucius (Linnaeus)

Date Sampled	Location Location	Sample No.	As (0.05)	Cd (0.0001)	Cu (0.10)	Hg (0.05)	Ni (0.02)	Pb (0.03)	Se (0.05)	Zn (0.05)	liver wt.
			Metals (Detection limit ppm)								
3/6/93	GSL-4	258	0.2	0.046	1.1	0.158	< 0.04	< 0.05	1.35	15.92	-
3/6/93	GSL-4	259	0.05	0.028	1.1	0.025	0.05	< 0.05	1.01	10.95	-
3/6/93	GSL-4	260	0.16	0.014	0.8	0.023	0.04	< 0.05	0.99	11.82	-
3/7/93	GSL-4	277	0.27	0.033	1.08	0.04	0.07	< 0.05	0.85	24.76	-
3/7/93	GSL-4	278	0.19	0.049	1.44	0.027	0.11	< 0.05	0.78	23.94	-
3/7/93	GSL-4	279	0.15	0.02	2.7	0.028	0.1	< 0.05	0.87	29.53	-
3/7/93	GSL-4	280	0.14	0.026	1	0.03	0.17	< 0.05	0.98	19.64	-
3/7/93	GSL-4	281	0.15	0.021	1.25	0.022	0.09	< 0.05	0.75	15.98	-
3/7/93	GSL-4	282	0.1	0.028	1.07	0.035	0.2	< 0.05	0.82	21.48	-
3/7/93	GSL-4	283	0.07	0.038	1.18	0.036	0.12	< 0.05	0.93	22.25	-
3/7/93	GSL-4	284	0.26	0.014	1.96	0.043	0.1	< 0.05	2.03	18.24	-
3/7/93	GSL-4	285	0.22	0.028	1.13	0.022	0.34	< 0.05	0.73	10.45	-
3/7/93	GSL-4	286	0.23	0.069	1.19	0.041	0.23	< 0.05	0.84	16.03	-
3/7/93	GSL-4	287	0.23	0.027	1.13	0.04	0.15	< 0.05	1.1	22.22	-
3/7/93	GSL-4	288	0.19	0.058	1.17	0.053	0.05	< 0.05	1.1	19.5	-
3/7/93	GSL-4	289	0.22	0.016	1.46	0.021	0.12	< 0.05	0.9	19.05	-
3/7/93	GSL-4	290	0.2	0.019	0.99	0.029	< 0.04	0.06	0.85	13.7	-
3/7/93	GSL-4	291	0.26	0.026	2.19	0.038	0.06	0.08	0.81	20.11	-
3/7/93	GSL-4	292	0.13	0.023	0.87	0.029	< 0.04	< 0.05	0.9	14.81	-
3/10/93	GSL-4	346	0.29	0.028	1.64	0.063	< 0.04	< 0.05	0.77	25.19	-
3/11/93	GSL-4	348	0.2	0.087	1.91	0.086	< 0.04	< 0.05	0.95	32.7	-
6/17/93	GSL-4	395	0.08	0.101	2.23	0.066	0.1	< 0.05	1.19	45.98	-
6/17/93	GSL-4	396	0.25	0.1	2.77	0.118	0.04	< 0.05	1.05	26.96	-
6/17/93	GSL-4	397	0.05	0.112	5.92	0.155	< 0.04	< 0.05	1.68	25.28	-
12/1/92	GSL-5	143	1.08	0.014	2.16	0.046	< 0.04	< 0.05	0.78	19.74	70.3
12/1/92	GSL-5	144	0.58	0.013	0.74	0.06	< 0.04	< 0.05	0.9	15.93	35.2
12/2/92	GSL-5	175	0.64	0.032	1.58	0.04	0.12	< 0.05	1.32	21.95	41.3
12/2/92	GSL-5	176	0.58	0.032	3.18	0.048	< 0.04	< 0.05	1.31	14.38	86.1
10/3/92	GSL-6	177	0.7	0.046	1.75	0.169	0.07	< 0.05	1.12	62.17	42
10/3/92	GSL-6	178	0.83	0.042	3.16	0.055	0.19	< 0.05	1.27	22.81	148.7
10/3/92	GSL-6	179	0.85	0.065	3.7	0.024	0.08	< 0.05	1.14	35.83	39.7
10/3/92	GSL-6	180	0.64	0.03	3.51	0.02	0.19	< 0.05	1.44	31.99	57.2
10/3/92	GSL-6	181	0.73	0.031	2.5	0.021	< 0.04	< 0.05	1.62	31.78	45.9
10/3/92	GSL-6	182	0.64	0.021	1.48	0.047	< 0.04	< 0.05	1.7	27.09	75
10/3/92	GSL-6	183	0.63	0.046	4.67	0.106	0.07	< 0.05	1.6	47.47	41.7
10/3/92	GSL-6	184	0.47	0.038	3.53	0.079	0.09	< 0.05	1.41	44.36	43.6
10/3/92	GSL-6	185	0.54	0.06	2.07	0.118	< 0.04	< 0.05	1.13	26.86	71.1
10/3/92	GSL-6	186	0.27	0.041	3.54	0.068	< 0.04	< 0.05	0.94	40.09	49.1
10/3/92	GSL-6	187	0.24	0.045	2.71	0.064	0.09	< 0.05	0.81	40.83	86.3
10/3/92	GSL-6	188	0.23	0.054	2.82	0.049	0.48	< 0.05	0.81	29.21	82.2
10/3/92	GSL-6	189	0.16	0.06	4.58	0.066	0.2	< 0.05	0.85	27.7	75.7
10/3/92	GSL-6	190	0.12	0.024	1.89	0.035	< 0.04	< 0.05	0.74	50.38	49.4
10/3/92	GSL-6	191	0.14	0.021	4.16	0.041	< 0.04	< 0.05	0.69	23.07	56.1
10/3/92	GSL-6	192	0.13	0.025	5.47	0.06	0.21	< 0.05	0.87	61.23	49
10/3/92	GSL-6	193	0.09	0.01	2.24	0.049	0.08	< 0.05	1.05	31.33	70
10/3/92	GSL-6	194	0.08	0.021	2.31	0.051	0.07	< 0.05	1.05	20.33	89.4
10/3/92	GSL-6	195	0.12	0.013	1.22	0.078	0.04	< 0.05	1.11	15.83	44.3
10/3/92	GSL-6	196	0.1	0.045	1.01	0.026	0.13	< 0.05	0.14	55.38	55.1
10/3/92	GSL-6	197	0.13	0.065	3.3	0.055	0.15	< 0.05	0.9	30.87	39.9
10/3/92	GSL-6	198	0.16	0.062	6.38	0.082	< 0.04	< 0.05	0.85	45.81	63.5
10/3/92	GSL-6	199	0.09	0.047	4.24	0.037	0.11	< 0.05	1.04	39.7	66
10/3/92	GSL-6	200	0.24	0.061	3.69	0.077	0.38	< 0.05	0.93	40.14	46.8
10/3/92	GSL-6	201	0.11	0.03	5.21	0.041	< 0.04	< 0.05	0.72	25.35	68.3
10/3/92	GSL-6	202	0.12	0.06	8.57	0.072	0.33	< 0.05	1.15	44.52	59.7

(-) = Information not available

Appendix 17c. Metal concentrations in the kidney of northern pike caught in Yellowknife Bay 1992-93.

Northern pike Esox lucius (Linnaeus)			Metals (Detection limit ppm)							
Date Sampled	Location	Sample No.	As (0.05)	Cd (0.0001)	Cu (0.10)	Hg (0.05)	Ni (0.02)	Pb (0.03)	Se (0.05)	Zn (0.05)
8/26/92	GSL-1	95	0.6	0.317	1.27	0.094	0.06	-	1.04	147.02
8/26/92	GSL-1	96	0.4	0.083	0.86	0.036	0.05	-	0.8	84.66
8/26/92	GSL-1	97	0.71	0.37	1.2	0.065	0.06	-	1.27	158.27
8/26/92	GSL-1	98	0.27	0.088	0.73	0.054	0.04	-	1.04	228.6
8/26/92	GSL-1	99	0.73	0.127	1.21	0.173	0.04	-	1.28	71.14
8/26/92	GSL-1	100	0.41	0.467	0.97	0.284	0.26	-	1.49	159.52
8/26/92	GSL-1	101	0.48	0.14	1.21	0.046	0.1	-	1.23	146.93
8/26/92	GSL-1	102	0.37	0.173	1.1	0.093	0.05	-	0.88	118.72
8/26/92	GSL-1	103	0.26	0.15	0.82	0.141	0.06	-	0.99	171.31
6/11/93	GSL-1	376	-	-	-	-	-	N.S.	-	-
6/12/93	GSL-1	393	-	-	-	-	-	N.S.	-	-
6/12/93	GSL-1	394	-	-	-	-	-	N.S.	-	-
7/5/93	GSL-1	417	0.13	0.199	0.9	0.079	0.05	-	0.9	5.39
7/5/93	GSL-1	418	0.76	0.356	0.95	0.236	0.18	-	1.9	8.07
7/5/93	GSL-1	419	0.18	0.294	0.71	0.077	0.1	-	1.15	12.06
8/31/93	GSL-1	440	0.67	0.19	1.02	0.065	0.32	-	1.55	16.17
8/26/92	GSL-2	126	0.6	0.19	1.01	0.125	0.07	?	0.27	183.3
8/25/92	GSL-3	55	0.21	0.399	1.22	0.085	0.11	?	1.01	99.71
8/25/92	GSL-3	56	0.22	0.189	0.96	0.139	0.16	?	0.98	156.77
8/25/92	GSL-3	67	0.14	0.172	0.85	0.119	0.07	?	1.61	162.32
8/25/92	GSL-3	68	0.24	0.436	0.95	0.066	0.14	?	1.81	140.46
5/5/93	GSL-3	226	-	-	-	-	-	?	-	-
3/7/93	GSL-3	300	-	-	-	-	-	?	-	-
3/7/93	GSL-3	301	-	-	-	-	-	?	-	-
3/7/93	GSL-3	302	-	-	-	-	-	?	-	-
3/8/93	GSL-3	321	0.21	0.305	0.94	0.13	0.12	N.S.	1.46	125.71
3/8/93	GSL-3	322	0.18	0.3	0.93	0.068	0.08	-	1.1	160.02
3/8/93	GSL-3	323	0.22	0.323	0.71	0.064	0.1	-	1.55	114.43
6/18/93	GSL-3	408	0.33	0.55	0.6	0.105	0.17	-	1.5	8.17
6/18/93	GSL-3	409	0.09	0.255	1.08	0.062	0.09	-	1.51	12.2
6/18/93	GSL-3	410	0.05	0.233	1.09	0.119	0.06	-	1.46	7.75
6/18/93	GSL-3	411	0.35	0.23	1.1	0.083	0.14	-	1.52	10.19
6/18/93	GSL-3	412	0.14	0.412	1.23	0.125	0.12	-	1.6	8.37
6/18/93	GSL-3	413	0.06	0.235	1.14	0.139	0.07	-	1.6	31.28
6/18/93	GSL-3	414	0.27	0.196	0.87	0.136	0.12	-	1.4	12.42
6/18/93	GSL-3	415	0.15	0.27	0.96	0.126	0.16	-	1.23	9.4
6/18/93	GSL-3	416	0.19	0.446	1.26	0.031	0.09	-	1.61	4.34
8/30/93	GSL-3	420	0.18	0.123	0.57	0.109	0.14	-	1.07	19.73
8/30/93	GSL-3	421	0.26	0.34	1.07	0.095	0.14	-	1.6	12.74
8/30/93	GSL-3	422	0.4	0.698	1.21	0.212	0.28	-	2	12.84
8/30/93	GSL-3	423	0.19	0.257	1	0.039	0.06	-	0.97	12.59
8/30/93	GSL-3	424	0.15	0.334	1.01	0.067	0.06	-	1.15	14.12

(-) = Information not available

Appendix 17c. continued

Northern pike Esox lucius (Linnaeus)			Metals (Detection limit ppm)							
Date Sampled	Location	Sample No.	As (0.05)	Cd (0.0001)	Cu (0.10)	Hg (0.05)	Ni (0.02)	Pb (0.03)	Se (0.05)	Zn (0.05)
8/31/93	GSL-3	425	0.69	0.484	1.14	0.159	0.17	-	1.35	25.55
8/31/93	GSL-3	426	0.29	0.511	1.01	0.074	0.12	-	1.44	7.04
8/31/93	GSL-3	427	0.26	0.501	0.83	0.128	0.22	-	1.72	18.84
8/31/93	GSL-3	428	0.15	0.14	0.97	0.057	0.06	-	1.26	15.55
8/31/93	GSL-3	429	0.21	0.221	0.78	0.046	0.09	-	0.98	14.19
8/31/93	GSL-3	430	0.3	0.33	0.86	0.086	0.13	-	1.24	14.61
8/31/93	GSL-3	431	0.11	0.145	0.58	0.174	0.12	-	0.9	10.38
3/10/93	GSL-4	346	0.26	0.149	0.89	0.124	0.08	-	1.49	94.77
3/11/93	GSL-4	348	0.18	0.471	1.27	0.287	0.12	-	1.33	122.55
6/17/93	GSL-4	395	0.18	0.346	1.07	0.075	0.09	-	0.98	7.8
6/17/93	GSL-4	396	0.26	0.264	0.62	0.148	0.17	-	1.2	7.48
6/17/93	GSL-4	397	0.19	0.232	0.98	0.133	0.09	-	1.33	7.78
12/1/92	GSL-5	143	0.8	0.111	0.89	0.084	0.1	-	0.56	116.07
12/1/92	GSL-5	144	0.2	0.127	0.91	-	0.08	-	0.56	104.85
12/2/92	GSL-5	175	0.69	0.225	1.2	0.148	0.16	-	0.68	105.83
12/2/92	GSL-5	176	0.29	0.26	0.99	0.072	0.16	-	0.67	117.55
10/3/92	GSL-6	177	0.4	0.178	0.96	0.086	0.12	-	0.4	133.1
10/3/92	GSL-6	178	0.16	0.114	0.83	0.351	0.13	-	0.42	70.93
10/3/92	GSL-6	179	0.3	0.214	0.97	0.084	0.12	-	0.76	92.22
10/3/92	GSL-6	180	0.21	0.122	0.86	0.044	0.07	-	0.67	95.14
10/3/92	GSL-6	181	0.14	0.169	0.95	0.028	0.09	-	0.65	79.53
10/3/92	GSL-6	182	0.09	0.068	0.82	0.05	0.13	-	0.68	109.77
10/3/92	GSL-6	183	0.13	0.085	0.94	0.059	0.11	-	0.72	109
10/3/92	GSL-6	184	0.14	0.207	1	0.059	0.09	-	0.71	104.41
10/3/92	GSL-6	185	0.25	0.458	1.11	0.119	0.17	-	0.01	112.83
10/3/92	GSL-6	186	0.14	0.154	1.06	0.056	0.15	-	0.01	108.71
10/3/92	GSL-6	187	0.1	0.136	0.68	0.054	0.1	-	0.55	97.75
10/3/92	GSL-6	188	0.15	0.194	0.89	0.082	0.5	-	0.63	74.83
10/3/92	GSL-6	189	0.2	0.172	1.05	0.148	0.2	-	0.84	78.61
10/3/92	GSL-6	190	0.13	0.152	0.89	0.063	0.07	-	0.57	109.5
10/3/92	GSL-6	191	0.11	0.196	1.2	0.034	0.13	-	0.02	83.93
10/3/92	GSL-6	192	0.12	0.076	0.38	0.049	0.11	-	0.33	53.33
10/3/92	GSL-6	193	0.09	0.097	1.13	0.056	0.18	-	0.01	91.08
10/3/92	GSL-6	194	0.13	0.099	0.98	0.072	0.3	-	0.02	84.82
10/3/92	GSL-6	195	0.17	0.196	0.84	0.057	0.58	-	0.4	96.29
10/3/92	GSL-6	196	0.09	0.239	0.86	0.057	0.08	-	0.66	123.16
10/3/92	GSL-6	197	0.22	0.334	1.41	0.16	0.11	-	0.29	87.86
10/3/92	GSL-6	198	0.09	0.164	0.99	0.087	0.6	-	0.02	111.46
10/3/92	GSL-6	199	0.09	0.195	0.75	0.048	0.09	-	0.01	104.76
10/3/92	GSL-6	200	0.1	0.231	1.31	0.101	1.5	-	0.02	86.5
10/3/92	GSL-6	201	0.14	0.125	1.02	0.156	0.05	-	0.01	125.89
10/3/92	GSL-6	202	0.24	0.2	1.17	0.09	0.77	-	0.62	105.84

(-) = Information not available

Appendix 18a. Biological descriptors and metal concentrations in the muscle of walleye caught in Yellowknife Bay 1992-93.

Walleye Stizostedion vitreum (Mitchill)			Metals (Detection limit ppm)								Biological parameters					
Date Sampled	Location	Sample No.	As (0.05)	Cd (0.0001)	Cu (0.10)	Hg (0.05)	Ni (0.02)	Pb (0.03)	Se (0.05)	Zn (0.05)	Length	Weight	Maturity	Scale method	Accepted age	k-factor
8/25/92	GSL-1	7	< 0.05	0.0007	0.34	0.111	< 0.02	< 0.03	0.13	3.89	416	780	7	10	10	1.08
8/25/92	GSL-1	8	< 0.05	0.0008	0.39	0.115	< 0.02	< 0.03	0.15	3.06	385	625	7	9	9	1.10
8/25/92	GSL-1	9	< 0.05	0.0011	0.3	0.201	< 0.02	< 0.03	0.16	2.43	415	865	7	12	12	1.21
8/25/92	GSL-1	10	< 0.05	0.0008	0.32	0.15	< 0.02	< 0.03	0.15	2.58	364	572	7	9	9	1.19
8/25/92	GSL-1	11	0.07	0.0013	0.23	0.116	< 0.02	< 0.03	0.16	2.79	378	657	7	8	8	1.22
8/25/92	GSL-1	12	< 0.05	0.0005	0.27	0.137	< 0.02	< 0.03	0.16	3.01	371	591	7	9	9	1.16
8/25/92	GSL-1	13	< 0.05	0.0006	0.26	0.141	< 0.02	< 0.03	0.17	4.56	411	862	7	14	14	1.24
8/25/92	GSL-1	14	< 0.05	0.0007	0.26	0.112	< 0.02	< 0.03	0.15	3.42	410	821	7	10	10	1.19
8/25/92	GSL-1	15	0.09	0.0004	0.21	0.173	< 0.02	< 0.03	0.11	2.97	459	1147	2	13	13	1.19
8/25/92	GSL-1	16	0.13	0.0007	0.84	0.132	< 0.02	< 0.03	0.16	3.22	425	935	7	10	10	1.22
8/25/92	GSL-1	17	< 0.05	0.0005	0.16	0.141	< 0.02	< 0.03	0.17	2.87	382	634	1	8	8	1.14
8/25/92	GSL-1	18	< 0.05	0.0004	0.24	0.122	< 0.02	< 0.03	0.21	2.92	380	593	1	7	7	1.08
8/25/92	GSL-1	19	0.06	0.0011	0.21	0.119	< 0.02	< 0.03	0.2	3.6	346	494	0	7	7	1.19
8/26/92	GSL-1	104	0.05	0.0012	0.35	0.163	< 0.02	< 0.03	0.17	2.97	365	573	1	9	9	1.18
8/26/92	GSL-1	105	0.05	0.0009	0.28	0.169	< 0.02	< 0.03	0.19	2.84	348	466	2	9	9	1.10
8/31/93	GSL-1	433	0.06	0.002	0.27	0.182	< 0.02	< 0.03	0.3	3.32	420	953	7	8	8	1.29
8/31/93	GSL-1	434	0.04	0.001	0.3	0.157	< 0.02	< 0.03	0.28	5.12	380	635	1	7	7	1.16
8/31/93	GSL-1	435	0.01	0.001	0.24	0.128	< 0.02	< 0.03	0.26	3.64	422	988	1	10	10	1.31
8/31/93	GSL-1	436	0.01	0.002	0.25	0.073	< 0.02	< 0.03	0.24	2.79	425	923	7-8	10	10	1.20
8/31/93	GSL-1	437	0.03	0.002	0.28	0.092	< 0.02	< 0.03	0.26	3.8	476	1398	7	9	9	1.30
8/31/93	GSL-1	438	0.03	0.002	0.24	0.096	< 0.02	< 0.03	0.15	4.01	416	960	1	9	9	1.33
8/31/93	GSL-1	439	0.03	0.006	0.28	0.144	< 0.02	< 0.03	0.09	2.78	364	596	1	9	9	1.24
8/25/92	GSL-2	36	0.09	0.0007	0.22	0.227	< 0.02	< 0.03	0.2	2.73	422	388	7	9	9	0.52
8/25/92	GSL-2	37	0.1	0.0005	0.31	0.146	< 0.02	< 0.03	0.25	3.84	408	806	7	12	12	1.19
8/25/92	GSL-2	38	0.13	0.0007	0.32	0.191	< 0.02	< 0.03	0.12	2.87	411	890	7	10	10	1.28
8/25/92	GSL-2	39	0.08	0.0009	0.19	0.204	< 0.02	< 0.03	0.08	2.92	415	820	7	13	13	1.15
8/26/92	GSL-2	123	0.07	0.001	0.25	0.152	< 0.02	< 0.03	0.11	3.46	467	1185	2	12	12	1.16
8/26/92	GSL-2	124	0.2	0.0016	0.39	0.194	< 0.02	< 0.03	0.07	2.91	462	1159	7	15	15	1.18
8/26/92	GSL-2	125	0.08	0.0015	0.27	0.239	< 0.02	< 0.03	0.05	2.79	439	1121	2	12	12	1.32
8/31/93	GSL-3	432	0.01	0.001	0.31	0.152	< 0.02	< 0.03	0.24	2.7	397	748	8	8	8	1.20

Appendix 18b. Metal concentrations in the liver of walleye caught in Yellowknife Bay 1992-93.

Walleye Stizostedion vitreum (Mitchill)										
			Metals (Detection limit ppm)							
Date Sampled	Location	Sample No.	As (0.05)	Cd (0.0001)	Cu (0.10)	Hg (0.05)	Ni (0.02)	Pb (0.03)	Se (0.05)	Zn (0.05)
8/25/92	GSL-1	7	0.33	0.255	1.93	0.064 <	0.04 <	0.05	1.18	19.93
8/25/92	GSL-1	8	0.63	0.328	3.11	0.09	0.43 <	0.05	1.29	22.5
8/25/92	GSL-1	9	0.2	0.295	1.72	0.066	0.08 <	0.05	0.98	14.23
8/25/92	GSL-1	10	0.38	0.311	2.4	0.083 <	0.04 <	0.05	1.13	23.46
8/25/92	GSL-1	11	0.44	0.314	2.11	0.071	0.05 <	0.05	1.27	22.42
8/25/92	GSL-1	12	0.34	0.188	1.42	0.059 <	0.04 <	0.05	1	16.13
8/25/92	GSL-1	13	0.25	0.186	1.56	0.061 <	0.04 <	0.05	1.25	16.38
8/25/92	GSL-1	14	0.31	0.24	1.71	0.064 <	0.04 <	0.05	0.75	17.74
8/25/92	GSL-1	15	0.29	0.096	1.53	0.067 <	0.04 <	0.05	0.82	17.35
8/25/92	GSL-1	16	0.49	0.173	1.79	0.046	0.08 <	0.05	0.91	16.06
8/25/92	GSL-1	17	0.43	0.275	2.33	0.06	0.04 <	0.05	1.16	22.38
8/25/92	GSL-1	18	0.25	0.306	1.63	0.063 <	0.04 <	0.05	0.94	21.79
8/25/92	GSL-1	19	0.5	0.198	2.56	0.062	0.04 <	0.05	1.46	16.51
8/26/92	GSL-1	104	1.03	0.328	2.23	0.057 <	0.04 <	0.05	1.25	20.72
8/26/92	GSL-1	105	0.75	0.267	2.13	0.048	0.05 <	0.05	0.77	15.28
8/31/93	GSL-1	433	0.48	0.268	1.94	0.071 <	0.04 <	0.05	1.46	21.47
8/31/93	GSL-1	434	0.22	0.289	1.82	0.055 <	0.04	0.12	0.98	19.54
8/31/93	GSL-1	435	0.21	0.163	1.69	0.062 <	0.04 <	0.05	0.79	18.48
8/31/93	GSL-1	436	0.25	0.162	2.2	0.057 <	0.04 <	0.05	1	15.8
8/31/93	GSL-1	437	0.21	0.093	1.13	0.07 <	0.04 <	0.05	0.48	16.93
8/31/93	GSL-1	438	0.28	0.096	1.99	0.064 <	0.04 <	0.05	0.69	20.54
8/31/93	GSL-1	439	0.52	0.279	1.97	0.062 <	0.04 <	0.05	1.15	19.6
8/25/92	GSL-2	36	0.13	0.192	2.15	0.09	0.04 <	0.05	-	18.75
8/25/92	GSL-2	37	0.65	0.096	1.54	0.022 <	0.04 <	0.05	-	19.5
8/25/92	GSL-2	38	0.4	0.132	1.62	0.081	0.06 <	0.05	-	16.23
8/25/92	GSL-2	39	0.57	0.122	1.59	0.09 <	0.04 <	0.05	-	17.07
8/26/92	GSL-2	123	0.19	0.195	1.11	0.071 <	0.04 <	0.05	-	18.76
8/26/92	GSL-2	124	0.37	0.2	1.61	0.062	0.05 <	0.05	-	16.11
8/26/92	GSL-2	125	0.28	0.121	1.18	0.083 <	0.04 <	0.05	-	17.38
8/31/93	GSL-3	432	0.74	0.193	1.93	0.072 <	0.04 <	0.05	1.21	18.63

(-) = Information not available

Appendix 18c. Metal concentrations in the kidney of walleye caught in Yellowknife Bay 1992-93

Walleye Stizostedion vitreum (Mitchill)									
			Metals (Detection limit ppm)						
Date Sampled	Location	Sample No.	As (0.05)	Cd (0.0001)	Cu (0.10)	Hg (0.05)	Ni (0.02)	Se (0.05)	Zn (0.05)
8/25/92	GSL-1	7	0.12	0.004	1.64	0.031	< 0.04	1.96	30.51
8/25/92	GSL-1	8	0.05	0.01	2.09	0.034	< 0.04	1.46	30.33
8/25/92	GSL-1	9	0.05	-	-	0.049	-	1.48	-
8/25/92	GSL-1	10	0.64	0.008	1.5	0.049	< 0.04	0.83	15.68
8/25/92	GSL-1	11	0.05	0.015	1.43	0.051	0.06	1.27	22.28
8/25/92	GSL-1	12	0.05	0.008	1.32	0.043	0.26	1.3	25.8
8/25/92	GSL-1	13	0.05	0.011	1.28	0.038	0.06	0.81	18.99
8/25/92	GSL-1	14	0.05	0.028	1.26	0.044	0.04	0.91	29.16
8/25/92	GSL-1	15	0.15	0.009	1.21	0.051	0.05	0.58	19.29
8/25/92	GSL-1	16	0.05	-	-	0.04	-	1.37	-
8/25/92	GSL-1	17	0.23	-	-	0.041	-	0.78	-
8/25/92	GSL-1	18	0.05	0.156	1.12	0.031	< 0.04	1.39	22.06
8/25/92	GSL-1	19	-	-	-	0.04	-		-
8/26/92	GSL-1	104	0.25	-	-	0.039	-	0.85	-
8/26/92	GSL-1	105	0.43	-	-	0.043	-	0.79	-
8/31/93	GSL-1	433	0.1	0.039	0.69	0.042	< 0.04	1.12	16.92
8/31/93	GSL-1	434	0.07	0.044	0.61	0.033	< 0.04	1	16.81
8/31/93	GSL-1	435	0.19	-	-	0.031	-	0.92	-
8/31/93	GSL-1	436	0.08	0.071	0.65	0.033	0.05	1.01	17.63
8/31/93	GSL-1	437	0.18	0.007	0.82	0.021	0.04	0.83	19.31
8/31/93	GSL-1	438	0.19	0.017	0.76	0.026	0.05	0.72	18.06
8/31/93	GSL-1	439	0.11	0.068	0.62	0.026	0.04	1.1	17.97
8/25/92	GSL-2	36	0.08	0.217	1.1	0.051	0.04	0.47	17.61
8/25/92	GSL-2	37	0.26	0.051	0.88	0.057	< 0.04	0.6	18.19
8/25/92	GSL-2	38	-	0.068	0.91	0.077	< 0.04	-	18.43
8/25/92	GSL-2	39	-	0.087	0.71	0.071	< 0.04	-	16.79
8/26/92	GSL-2	123	0.45	0.047	0.79	0.087	< 0.04	0.34	18.49
8/26/92	GSL-2	124	0.34	0.095	0.99	0.077	0.04	0.32	21.68
8/26/92	GSL-2	125	0.55	0.032	1.04	0.077	0.04	0.32	14.36
8/31/93	GSL-3	432	0.15	0.048	0.53	0.044	< 0.04	1.14	14.92

(-) = Information not available

Appendix 19a. Biological descriptors and metal concentrations in the muscle of longnose suckers caught in Yellowknife Bay 1992-93.

Longnose sucker *Catostomus catostomus* (Forster)			Metals (Detection limits ppm)								Biological parameters					
Date Sampled	Location	Sample No.	As (0.05)	Cd (0.0001)	Cu (0.10)	Hg (0.05)	Ni (0.02)	Pb (0.03)	Se (0.05)	Zn (0.05)	Length	Weight	Maturity	Scale method	Accepted age	k-factor
8/25/92	GSL-1	6	0.08	0.0005	0.55	0.023	< 0.02	< 0.03	0.1	2.9	364	786	7	7	7	1.63
8/25/92	GSL-2	35	0.18	0.0002	0.16	0.049	< 0.02	< 0.03	0.1	2.19	428	1127	2	11	11	1.44
8/26/92	GSL-2	106	0.11	0.0012	0.64	0.042	< 0.02	< 0.03	0.12	3.85	352	609	n/a	6	6	1.40
8/26/92	GSL-2	107	0.09	0.0007	0.94	0.045	< 0.02	< 0.03	0.17	2.53	386	868	1	7	7	1.51
8/26/92	GSL-2	108	0.1	0.0003	0.73	0.031	< 0.02	< 0.03	0.1	2.6	398	1054	1	7	7	1.67
8/26/92	GSL-2	109	0.08	0.0005	0.38	0.037	< 0.02	< 0.03	0.18	2.28	429	1215	2	7	7	1.54
8/26/92	GSL-2	110	0.09	0.0008	0.48	0.034	< 0.02	< 0.03	0.17	3.24	348	621	1	5	5	1.47
8/26/92	GSL-2	111	0.09	0.0006	0.41	0.038	< 0.02	< 0.03	0.14	3.3	348	615	1	5	5	1.46
8/26/92	GSL-2	112	0.08	0.0008	0.24	0.045	< 0.02	< 0.03	0.31	2.65	428	1359	2	-	-	1.73
8/26/92	GSL-2	127	0.11	0.0005	0.24	0.05	< 0.02	< 0.03	0.07	2.71	456	995	7	12	12	1.05
6/11/93	GSL-2	377	0.1	0.002	0.34	0.1	< 0.02	< 0.03	0.23	2.36	493	1276	3	15	15	1.06
6/11/93	GSL-2	378	0.39	0.001	0.28	0.032	< 0.02	< 0.03	0.23	3.32	410	987	7	11	11	1.43
6/11/93	GSL-2	379	0.28	0.001	0.36	0.057	< 0.02	< 0.03	0.24	3.46	372	667	2	10	10	1.30
6/11/93	GSL-2	380	0.15	0.001	0.37	0.072	< 0.02	< 0.03	0.22	2.46	482	1510	4	12	12	1.35
6/11/93	GSL-2	381	0.25	0.001	0.23	0.026	< 0.02	< 0.03	0.26	2.81	411	891	2	11	11	1.28
6/11/93	GSL-2	382	0.39	0.0001	0.22	0.026	< 0.02	< 0.03	0.19	3.05	396	813	n/a	11	11	1.31
6/11/93	GSL-2	383	0.27	0.001	0.26	0.026	< 0.02	< 0.03	0.22	3.12	412	824	2	12	12	1.18
6/11/93	GSL-2	384	0.19	0.002	0.31	0.049	< 0.02	< 0.03	0.24	3.06	426	1054	7	10	10	1.36
6/11/93	GSL-2	385	0.3	0.001	0.28	0.021	< 0.02	< 0.03	0.25	2.56	395	854	2	9	9	1.39
6/11/93	GSL-2	386	0.28	0.002	0.35	0.045	< 0.02	< 0.03	0.24	2.88	376	680	6	10	10	1.28
6/11/93	GSL-2	387	0.32	0.002	0.32	0.024	< 0.02	< 0.03	0.21	2.98	390	871	6	12	12	1.47
6/11/93	GSL-2	388	0.23	0.001	0.23	0.027	< 0.02	< 0.03	0.22	2.86	349	566	0	10	10	1.33
6/11/93	GSL-2	389	0.28	0.001	0.26	0.045	< 0.02	< 0.03	0.21	2.84	391	824	7	8	8	1.38
6/11/93	GSL-2	390	0.14	0.001	0.26	0.027	< 0.02	< 0.03	0.27	2.97	414	1044	1-2	13	13	1.47
6/11/93	GSL-2	391	0.34	0.001	0.25	0.072	< 0.02	< 0.03	0.24	2.59	368	750	7	11	11	1.50
6/11/93	GSL-2	392	0.23	0.002	0.27	0.062	< 0.02	< 0.03	0.24	2.63	415	916	8	11	11	1.28
8/25/92	GSL-3	52	0.22	0.0006	0.23	0.04	< 0.02	< 0.03	0.79	2.89	425	1144	7	8	8	1.49
8/25/92	GSL-3	53	0.2	0.0009	0.29	0.04	< 0.02	< 0.03	0.6	2.41	440	1255	2	9	9	1.47
8/25/92	GSL-3	54	0.19	0.0013	0.26	0.03	< 0.02	< 0.03	0.64	3.11	405	1034	7	9	9	1.56
3/7/93	GSL-4	268	0.11	0.0038	1.41	0.03	< 0.02	< 0.03	0.22	3.06	358	660	7	6	6	1.44

Appendix 19b. Metal concentrations in the liver of longnose suckers caught in Yellowknife Bay 1992-93.

Longnose sucker Catostomus catostomus (Forster)										
			Metals (Detection limits ppm)							
Date Sampled	Location	Sample No.	As (0.05)	Cd (0.0001)	Cu (0.10)	Hg (0.05)	Ni (0.02)	Pb (0.03)	Se (0.05)	Zn (0.05)
8/25/92	GSL-1	6	0.12	0.057	11.62	0.026	0.06	< 0.05	1.03	23.89
8/25/92	GSL-2	35	0.27	0.059	9.46	0.038	0.07	< 0.05	-	23.55
8/26/92	GSL-2	106	0.47	0.045	13.34	0.031	0.06	< 0.05	0.9	21.39
8/26/92	GSL-2	107	0.73	0.073	31.55	0.035	< 0.04	< 0.05	0.88	36.16
8/26/92	GSL-2	108	0.81	0.076	20.98	0.038	0.05	< 0.05	0.87	29.73
8/26/92	GSL-2	109	0.91	0.055	11.5	0.009	0.05	< 0.05	0.88	20.45
8/26/92	GSL-2	110	0.61	0.058	24.72	0.025	< 0.04	< 0.05	0.66	31.11
8/26/92	GSL-2	111	0.05	0.047	13.37	0.023	< 0.04	< 0.05	1.1	24.7
8/26/92	GSL-2	112	0.52	0.067	18.23	0.028	< 0.04	< 0.05	0.88	29.48
8/26/92	GSL-2	127	< 0.05	0.092	6.81	0.027	< 0.04	< 0.05	-	25.55
6/11/93	GSL-2	377	0.09	0.169	13.13	0.038	< 0.04	< 0.05	0.68	22.13
6/11/93	GSL-2	378	0.15	0.093	26.93	0.022	< 0.04	< 0.05	0.85	24.01
6/11/93	GSL-2	379	0.48	0.117	19.99	0.022	0.15	0.09	0.83	23.22
6/11/93	GSL-2	380	0.11	0.174	4.16	0.037	< 0.04	< 0.05	0.79	20.17
6/11/93	GSL-2	381	0.27	0.026	4.66	0.041	< 0.04	< 0.05	0.92	17.78
6/11/93	GSL-2	382	0.95	0.122	14.27	0.03	0.16	< 0.05	0.63	20.32
6/11/93	GSL-2	383	0.35	0.13	10.25	0.027	< 0.04	< 0.05	0.97	21.76
6/11/93	GSL-2	384	0.08	0.111	8.01	0.026	< 0.04	< 0.05	0.75	19.4
6/11/93	GSL-2	385	0.16	0.243	13.76	0.03	< 0.04	< 0.05	0.89	34.09
6/11/93	GSL-2	386	0.21	0.113	27.18	0.034	< 0.04	< 0.05	0.93	23.5
6/11/93	GSL-2	387	0.16	0.09	10.95	0.029	< 0.04	< 0.05	0.87	19.32
6/11/93	GSL-2	388	0.27	0.11	15.39	0.034	0.04	< 0.05	0.89	24.77
6/11/93	GSL-2	389	0.38	0.041	4.86	0.034	0.11	< 0.05	0.9	15.04
6/11/93	GSL-2	390	0.11	0.104	27.17	0.038	< 0.04	< 0.05	0.97	24.61
6/11/93	GSL-2	391	0.19	0.127	20.48	0.044	0.08	< 0.05	1.25	30.28
6/11/93	GSL-2	392	0.27	0.09	14.75	0.034	0.04	< 0.05	1.12	23.98
8/25/92	GSL-3	52	0.11	0.036	20.29	0.024	0.05	< 0.05	1.2	26.89
8/25/92	GSL-3	53	0.29	0.199	8.03	0.02	0.09	< 0.05	1.17	19.18
8/25/92	GSL-3	54	0.56	0.153	16.85	0.021	0.09	< 0.05	1.47	20.7
3/7/93	GSL-4	268	< 0.05	0.036	13.1	0.027	< 0.04	< 0.05	0.52	18.92

(-) = Information not available

Appendix 19c. Metal concentrations in the kidney of longnose suckers caught in Yellowknife Bay 1992-93.

Longnose sucker *Catostomus catostomus* (Forster)										
			Metals (Detection limits ppm)							
Date Sampled	Location	Sample No.	As (0.05)	Cd (0.0001)	Cu (0.10)	Hg (0.05)	Ni (0.02)	Pb (0.03)	Se (0.05)	Zn (0.05)
8/25/92	GSL-1	6	< 0.05	0.004	1.79	0.017	0.06	?	1.67	33.74
8/25/92	GSL-2	35	0.32	0.304	0.87	0.042	0.13	?	0.42	19.9
8/26/92	GSL-2	106	0.34	0.081	1.77	0.017	0.05	?	0.72	17.95
8/26/92	GSL-2	107	0.22	0.141	1.4	0.018	0.11	?	0.94	17.6
8/26/92	GSL-2	108	0.39	0.182	1.02	0.019	0.08	?	0.69	18.27
8/26/92	GSL-2	109	0.16	0.183	1.29	0.021	0.11	?	1.07	19.44
8/26/92	GSL-2	110	0.29	0.166	1.51	0.018	0.1	?	0.79	19.97
8/26/92	GSL-2	111	0.36	0.214	1.53	0.017	0.1	?	0.78	27.9
8/26/92	GSL-2	112	0.25	0.155	1.19	0.02	0.11	?	1.25	17.3
8/26/92	GSL-2	127	0.4	0.177	1.11	0.043	0.12	?	0.35	26.47
6/11/93	GSL-2	377	0.12	0.608	1.37	0.046	0.18	N.S.	0.76	18.45
6/11/93	GSL-2	378	0.21	0.428	0.94	0.032	0.17	-	0.96	18.09
6/11/93	GSL-2	379	0.49	-	-	0.038	-	N.S.	1.09	-
6/11/93	GSL-2	380	0.1	0.679	1.04	0.036	0.22	N.S.	0.83	15.05
6/11/93	GSL-2	381	0.27	0.514	1.62	0.046	0.29	N.S.	1.12	20.05
6/11/93	GSL-2	382	0.58	0.472	0.84	0.037	0.22	-	0.68	16.96
6/11/93	GSL-2	383	0.52	-	-	0.026	-	N.S.	0.77	-
6/11/93	GSL-2	384	0.39	0.399	1.01	0.02	0.15	-	0.73	20.88
6/11/93	GSL-2	385	0.27	-		0.029	-	N.S.	0.96	-
6/11/93	GSL-2	386	0.43	1.005	1.42	0.025	0.16	N.S.	1.08	18.78
6/11/93	GSL-2	387	0.37	0.42	1.6	0.026	0.33	N.S.	1.14	17.29
6/11/93	GSL-2	388	0.3	0.512	1.11	0.035	0.23	N.S.	0.81	20.15
6/11/93	GSL-2	389	1.02	-	-	0.035	-	N.S.	0.83	-
6/11/93	GSL-2	390	0.3	-	-	0.052	-	N.S.	0.95	-
6/11/93	GSL-2	391	0.32	0.812	1.54	0.037	0.4	N.S.	1	21.44
6/11/93	GSL-2	392	0.16	-	-	0.03	-	N.S.	1.15	-
8/25/92	GSL-3	52	0.42	0.202	1.18	0.011	0.07	?	0.83	17.48
8/25/92	GSL-3	53	0.19	1.567	1.07	0.024	0.08	?	0.71	27.85
8/25/92	GSL-3	54	0.14	0.422	1.23	0.024	0.11	?	0.86	23.16
3/7/93	GSL-4	268	-	-	-	-	-	?	-	-

Appendix 20a. Biological descriptors and metal concentrations in the muscle of burbot caught in Yellowknife Bay 1992-93.

Burbot
Lota lota (Linnaeus)

			Metals (Detection limit ppm)								Biological parameters						
Date Sampled	Location	Sample No.	As (0.05)	Cd (0.0001	Cu (0.10)	Hg (0.05)	Ni (0.02)	Pb (0.03)	Se (0.05)	Zn (0.05)	Length	Weight	Maturity	Scale method	Otolith method	Accepted age	k-factor
3/12/93	GSL-1	357	0.35	0.001	0.31	0.228	< 0.02	< 0.03	0.19	5.86	563	1083	5	11	13	13	0.61
3/12/93	GSL-1	358	0.26	0.001	0.33	0.179	< 0.02	< 0.03	0.2	5.21	605	1561	5	13	13	13	0.70
3/12/93	GSL-1	359	0.31	0.001	0.23	0.185	< 0.02	< 0.03	0.21	3.71	559	934	5	11	14	14	0.53
3/12/93	GSL-1	360	0.26	< 0.000	0.28	0.131	< 0.02	< 0.03	0.19	4.22	499	1006	6	7	7	7	0.81
3/12/93	GSL-1	361	0.41	0.001	0.31	0.102	< 0.02	< 0.03	0.22	5.12	360	308	0	6	3	3	0.66
3/17/93	GSL-1	369	0.14	< 0.000	0.25	0.183	< 0.02	< 0.03	0.18	2.98	685	2697	5	14	14	14	0.84
3/17/93	GSL-1	370	0.20	< 0.000	0.25	0.124	< 0.02	< 0.03	0.22	4.21	609	1661	7	14	13	13	0.74
3/18/93	GSL-1	372	0.21	0.001	0.31	0.098	< 0.02	< 0.03	0.27	4.66	517	971	5-2	7	8	8	0.70
3/18/93	GSL-1	373	0.21	0.001	0.39	0.122	< 0.02	< 0.03	0.18	5.6	634	980	10	10	10	10	0.38
3/18/93	GSL-1	374	0.38	0.001	0.24	0.202	< 0.02	< 0.03	0.2	3.79	658	2143	10	-	18	18	0.75
3/18/93	GSL-2	371	0.42	< 0.000	0.29	0.155	< 0.02	< 0.03	0.18	5.16	525	939	5	7	10	10	0.65
8/25/92	GSL-3	69	0.25	0.001	0.22	0.117	< 0.02	< 0.03	0.48	3.5	554	1013	7	12	13	13	0.60
5/5/93	GSL-3	222	0.08	0.000	0.16	0.155	< 0.02	< 0.03	0.16	3.1	554	1464	6-7	13	-	13	0.86
5/5/93	GSL-3	223	0.23	0.000	0.43	0.086	< 0.02	< 0.03	0.16	3.08	605	1634	3-4	12	-	12	0.74
5/5/93	GSL-3	224	0.13	0.000	0.96	0.145	< 0.02	< 0.03	0.13	3.38	609	1364	2	14	-	14	0.60
5/5/93	GSL-3	225	0.16	0.001	0.35	0.173	< 0.02	< 0.03	0.16	3.65	595	1257	3-4	12	-	12	0.60
3/7/93	GSL-3	294	0.16	0.001	0.84	0.097	< 0.02	< 0.03	0.34	3.72	484	704	1-2	7	8	8	0.62
3/7/93	GSL-3	295	0.22	0.001	0.43	0.102	< 0.02	< 0.03	0.16	6.29	498	872	1-2	9	10	10	0.71
3/7/93	GSL-3	296	0.17	0.001	0.53	0.177	< 0.02	< 0.03	0.14	5.46	568	1291	5	16	16	16	0.70
3/7/93	GSL-3	297	0.33	0.001	0.45	0.119	< 0.02	< 0.03	0.11	4.33	604	1328	5	11	14	14	0.60
3/7/93	GSL-3	298	0.22	0.000	0.37	0.117	< 0.02	< 0.03	0.15	4.48	505	1045	6	8	8	8	0.81
3/7/93	GSL-3	299	0.64	0.000	0.42	0.15	< 0.02	< 0.03	0.14	4.92	459	618	5	7	7	7	0.64
3/8/93	GSL-3	312	0.20	< 0.000	0.2	0.114	< 0.02	< 0.03	0.19	3.42	712	2369	3	13	14	14	0.66
3/8/93	GSL-3	313	0.16	0.001	0.41	0.199	< 0.02	< 0.03	0.18	7.35	585	1566	5	15	18	18	0.78
3/8/93	GSL-3	314	0.24	0.001	0.32	0.157	< 0.02	< 0.03	0.16	6.12	587	1436	5	12	14	14	0.71
3/8/93	GSL-3	315	0.26	< 0.000	0.57	0.087	< 0.02	< 0.03	0.2	4.46	384	418	1	7	7	7	0.74
3/8/93	GSL-3	316	0.19	< 0.000	0.22	0.166	< 0.02	< 0.03	0.21	4.51	565	1012	5	13	16	16	0.56
3/8/93	GSL-3	317	0.40	< 0.000	0.21	0.271	< 0.02	< 0.03	0.14	4.1	538	1000	5	13	12	12	0.64
3/8/93	GSL-3	318	0.15	< 0.000	0.25	0.143	< 0.02	< 0.03	0.15	4.51	643	2022	5	14	14	14	0.76
3/9/93	GSL-3	324	0.15	< 0.000	0.33	0.122	< 0.02	< 0.03	0.19	4.47	641	1756	5	13	14	14	0.67
3/9/93	GSL-3	325	0.11	< 0.000	0.24	0.155	< 0.02	< 0.03	0.15	4.41	632	1853	5	12	14	14	0.73
3/9/93	GSL-3	326	0.14	0.002	0.27	0.191	< 0.02	< 0.03	0.15	5.3	622	1597	5	15	15	15	0.66
3/9/93	GSL-3	327	0.16	0.005	0.16	0.177	< 0.02	< 0.03	0.16	2.97	651	1492	9	15	17	17	0.54
3/9/93	GSL-3	328	0.21	0.011	0.17	0.258	< 0.02	< 0.03	0.19	2.94	590	1149	3-4	14	19	19	0.56
3/9/93	GSL-3	329	0.41	0.003	0.18	0.152	< 0.02	< 0.03	0.16	3.48	587	1477	10	12	13	13	0.73
3/10/93	GSL-3	338	0.14	0.001	0.32	0.091	< 0.02	< 0.03	0.21	5.48	488	849	10	11	11	11	0.73
3/10/93	GSL-3	339	0.22	0.001	0.25	0.166	< 0.02	< 0.03	0.17	3.22	585	1264	5	12	14	14	0.63

(-) = Information not available

Appendix 20a. continued

Burbot Lota lota (Linnaeus)																		
			Metals (Detection limit ppm)								Biological parameters							
Date Sampled	Location	Sample No.	As (0.05)	Cd (0.0001	Cu (0.10)	Hg (0.05)	Ni (0.02)	Pb (0.03)	Se (0.05)	Zn (0.05)	Length	Weight	Maturity	Scale method	Otolith method	Accepted age	k-factor
3/10/93	GSL-3	340	0.29	0.001	0.26	0.132	< 0.02	< 0.03	0.21	4.53	681	1932	9	13	15	15	0.61
3/10/93	GSL-3	341	0.22	0.003	0.27	0.111	< 0.02	< 0.03	0.16	5.36	643	1350	5	13	14	14	0.51
3/10/93	GSL-3	342	0.13	0.001	0.35	0.132	< 0.02	< 0.03	0.21	4.59	608	1627	5	14	14	14	0.72
3/10/93	GSL-3	343	0.36	0.001	0.22	0.108	< 0.02	< 0.03	0.22	3.13	526	884	-	10	9	9	0.61
6/17/93	GSL-4	398	0.35	0.002	0.24	0.15	< 0.02	< 0.03	0.19	3.6	618	977	2	-	15	15	0.41
5/5/93	GSL-4	234	0.14	0.000	0.2	0.278	< 0.02	< 0.03	0.2	3.27	765	2923	5	11	12	12	0.65
5/5/93	GSL-4	235	0.20	0.001	0.26	0.14	< 0.02	< 0.03	0.12	3.05	635	2027	4	9	10	10	0.79
5/5/93	GSL-4	236	0.33	0.001	0.26	0.121	< 0.02	< 0.03	0.19	3.58	606	1172	5	12	14	14	0.53
5/5/93	GSL-4	237	0.15	< 0.000	0.4	0.109	< 0.02	< 0.03	0.19	5.15	553	1199	5	12	14	14	0.71
5/5/93	GSL-4	238	0.25	0.000	0.31	0.145	< 0.02	< 0.03	0.19	3.28	580	1305	5	12	14	14	0.67
3/7/93	GSL-4	261	0.18	0.001	0.47	0.172	< 0.02	< 0.03	0.19	3.4	608	1677	9	12	14	14	0.75
3/7/93	GSL-4	262	0.15	-	0.67	0.095	< 0.02	< 0.03	0.22	5.66	588	1602	9	9	10	10	0.79
3/7/93	GSL-4	263	0.12	0.001	0.63	0.074	< 0.02	< 0.03	0.27	4.72	531	972	5	7	8	8	0.65
3/7/93	GSL-4	264	0.14	0.000	0.5	0.15	< 0.02	< 0.03	0.18	3.35	598	1523	5	12	14	14	0.71
3/7/93	GSL-4	265	0.25	0.001	0.57	0.101	< 0.02	< 0.03	0.25	3.77	530	1084	5	10	10	10	0.73
3/7/93	GSL-4	266	0.16	0.001	0.65	0.119	< 0.02	< 0.03	0.2	5.95	678	2217	5	14	17	17	0.71
3/7/93	GSL-4	267	0.19	0.002	0.59	0.202	< 0.02	< 0.03	0.2	2.94	684	2446	5	18	18	18	0.76
3/7/93	GSL-4	293	0.19	0.001	0.47	0.118	< 0.02	< 0.03	0.21	3.56	595	1626	2	14	14	14	0.77
3/8/93	GSL-4	306	0.24	< 0.000	0.27	0.119	< 0.02	< 0.03	0.21	4.94	589	1368	5	14	16	16	0.67
3/8/93	GSL-4	307	0.17	< 0.000	0.2	0.112	< 0.02	< 0.03	0.22	3.72	565	1185	9	10	10	10	0.66
3/8/93	GSL-4	308	0.30	0.002	0.34	0.079	< 0.02	< 0.03	0.2	6.08	536	1263	5	11	10	10	0.82
3/8/93	GSL-4	309	0.20	< 0.000	0.23	0.127	< 0.02	< 0.03	0.22	3.67	604	1539	5	12	15	15	0.70
3/8/93	GSL-4	310	0.26	< 0.000	0.36	0.059	< 0.02	< 0.03	0.21	6.38	407	425	0	5	7	7	0.63
3/8/93	GSL-4	311	0.66	< 0.000	0.3	0.169	< 0.02	< 0.03	0.2	4.01	659	1868	5	18	14	14	0.65
3/9/93	GSL-4	330	0.27	0.001	0.23	0.136	< 0.02	< 0.03	0.26	3.29	654	1991	5	13	14	14	0.71
3/9/93	GSL-4	331	0.15	< 0.000	0.37	0.058	< 0.02	< 0.03	0.16	5	545	1144	2	6	7	7	0.71
3/9/93	GSL-4	332	0.18	0.007	0.23	0.205	< 0.02	< 0.03	0.22	4.18	657	1529	5	14	15	15	0.54
3/9/93	GSL-4	333	0.23	0.001	0.47	0.32	< 0.02	< 0.03	0.16	6.41	597	1477	5	18	27	27	0.69
3/9/93	GSL-4	334	0.30	0.001	0.33	0.155	< 0.02	< 0.03	0.11	4.98	599	1330	9	11	14	14	0.62
3/9/93	GSL-4	335	0.12	0.001	0.22	0.285	< 0.02	< 0.03	0.22	5.26	706	1659	5	23	25	25	0.47
3/9/93	GSL-4	336	0.23	0.001	0.17	0.254	< 0.02	< 0.03	0.2	2.77	650	1839	5	16	18	18	0.67
3/9/93	GSL-4	337	0.15	0.001	0.3	0.102	< 0.02	< 0.03	0.27	4.27	527	1008	9	11	14	14	0.69
3/10/93	GSL-4	344	0.15	0.001	0.27	0.109	< 0.02	< 0.03	0.21	4.55	620	1806	5	13	14	14	0.76
3/10/93	GSL-4	345	0.12	0.001	0.43	0.133	< 0.02	< 0.03	0.19	5.23	607	1661	7	10	14	14	0.74
3/11/93	GSL-4	347	0.18	0.001	0.23	0.391	< 0.02	< 0.03	0.21	2.52	655	1248	5	16	20	20	0.44
10/3/92	GSL-6	203	0.15	0.002	0.26	0.127	< 0.02	< 0.03	0.21	4.31	640	2052	8	-	13	13	0.78

(-) = Information not available

Appendix 20b. Metal concentrations in the liver of burbot caught in Yellowknife Bay 1992-93.

Burbot Lota lota (Linnaeus)										
			Metals (Detection limit ppm)							
Date Sampled	Location	Sample No.	As (0.05)	Cd (0.0001)	Cu (0.10)	Hg (0.05)	Ni (0.02)	Se (0.03)	Pb (0.05	Zn (0.05)
3/12/93	GSL-1	357	2.76	0.053	4.52	0.087	< 0.04	0.23	< 0.05	15.39
3/12/93	GSL-1	358	0.87	0.09	5.86	0.03	< 0.04	0.45	< 0.05	13.86
3/12/93	GSL-1	359	1.41	0.186	6.68	0.055	0.05	0.67	< 0.05	16.02
3/12/93	GSL-1	360	0.95	0.018	1.25	0.037	< 0.04	0.4	< 0.05	10.47
3/12/93	GSL-1	361	1.22	0.014	2.19	0.009	< 0.04	0.53	< 0.05	11.94
3/17/93	GSL-1	369	0.60	0.038	2.6	0.034	< 0.04	0.13	< 0.05	11.29
3/17/93	GSL-1	370	0.84	0.097	3.69	0.036	< 0.04	0.25	< 0.05	11.27
3/18/93	GSL-1	372	1.06	0.047	2.49	0.033	< 0.04	0.13	< 0.05	8.47
3/18/93	GSL-1	373	1.20	0.033	4.44	0.034	< 0.04	0.23	< 0.05	17.13
3/18/93	GSL-1	374	1.05	0.069	9.4	0.037	< 0.04	0.7	< 0.05	20.89
3/18/93	GSL-2	371	2.98	0.063	4.34	0.048	< 0.04	0.2	< 0.05	14.91
5/5/93	GSL-3	222	0.43	0.07	5.27	0.081	< 0.04	0.69	< 0.05	12.16
5/5/93	GSL-3	223	0.58	0.084	4.04	0.047	0.05	0.41	< 0.05	11.94
5/5/93	GSL-3	224	1.12	0.154	16.14	0.07	0.18	0.56	< 0.05	16.59
5/5/93	GSL-3	225	1.02	0.224	13.47	0.112	0.53	0.64	< 0.05	21.17
8/25/92	GSL-3	69	0.05	0.17	10.4	0.026	< 0.04		< 0.05	21.5
3/7/93	GSL-3	294	1.09	0.071	5.44	0.016	< 0.04	0.77	0.06	12.66
3/7/93	GSL-3	295	1.11	0.073	4.28	0.019	< 0.04	0.78	< 0.05	11.62
3/7/93	GSL-3	296	1.64	0.281	19.84	0.049	< 0.04	0.83	< 0.05	19.14
3/7/93	GSL-3	297	2.30	0.097	4.26	0.026	< 0.04	0.44	0.13	12.14
3/7/93	GSL-3	298	0.86	0.026	3.59	0.013	< 0.04	0.44	0.08	9.48
3/7/93	GSL-3	299	2.04	0.152	3.15	0.037	0.2	0.43	0.04	13
3/8/93	GSL-3	312	1.14	0.133	6.18	0.056	< 0.04	0.41	< 0.05	17.18
3/8/93	GSL-3	313	1.57	0.246	6.02	0.063	< 0.04	0.54	< 0.05	15.47
3/8/93	GSL-3	314	1.89	0.064	5.09	0.056	< 0.04	0.75	< 0.05	11
3/8/93	GSL-3	315	0.96	0.047	7.51	0.01	< 0.04	0.37	< 0.05	11.46
3/8/93	GSL-3	316	1.47	0.163	5.07	0.036	< 0.04	0.6	< 0.05	15.41
3/8/93	GSL-3	317	2.42	0.258	18.18	0.108	0.04	0.71	< 0.05	21.98
3/8/93	GSL-3	318	0.59	0.067	5.28	0.027	< 0.04	0.11	< 0.05	11.45
3/9/93	GSL-3	324	0.65	0.087	7.78	0.04	< 0.04	0.42	< 0.05	15.56
3/9/93	GSL-3	325	0.54	0.043	4.09	0.027	< 0.04	0.34	< 0.05	12.39
3/9/93	GSL-3	326	0.38	0.129	11.88	0.057	< 0.04	0.15	< 0.05	14.69
3/9/93	GSL-3	327	1.78	0.235	13.14	0.049	< 0.04	0.08	< 0.05	17.83
3/9/93	GSL-3	328	1.39	0.358	24.33	0.129	< 0.04	1.22	< 0.05	26.08
3/9/93	GSL-3	329	1.39	0.256	10.12	0.033	< 0.04	0.07	< 0.05	18.31
3/10/93	GSL-3	338	0.59	0.057	4.61	0.012	< 0.04	0.37	< 0.05	11.14
3/10/93	GSL-3	339	0.97	0.141	12.56	0.048	< 0.04	0.51	< 0.05	15.74

(-) = Information not available

Appendix20b. continued

Burbot Lota lota (Linnaeus)										
			Metals (Detection limit ppm)							
Date Sampled	Location	Sample No.	As (0.05)	Cd (0.0001)	Cu (0.10)	Hg (0.05)	Ni (0.02)	Se (0.03)	Pb (0.05	Zn (0.05)
3/10/93	GSL-3	340	0.88	0.116	10.18	0.033	< 0.04	0.23	< 0.05	17.65
3/10/93	GSL-3	341	1.01	0.142	9.98	0.047	< 0.04	0.73	< 0.05	18.46
3/10/93	GSL-3	342	0.71	0.077	4.12	0.023	< 0.04	0.31	< 0.05	10.72
3/10/93	GSL-3	343	1.12	0.087	5.9	0.02	< 0.04	0.5	< 0.05	15.06
6/17/93	GSL-4	398	3.34	0.298	5.12	0.1	0.08	0.89	< 0.05	23.5
5/5/93	GSL-4	234	0.46	1.689	7.07	0.035	0.26	0.5	< 0.05	14.18
5/5/93	GSL-4	235	0.63	1.274	5.77	0.038	0.24	0.58	< 0.05	14.18
5/5/93	GSL-4	236	0.61	1.804	6.37	0.009	0.42	0.75	< 0.05	15.01
5/5/93	GSL-4	237	0.54	0.102	7.11	0.025	< 0.04	1.09	< 0.05	14.06
5/5/93	GSL-4	238	0.58	0.106	9.01	0.023	0.26	0.53	< 0.05	10.72
3/7/93	GSL-4	261	0.20	0.178	15.71	0.084	< 0.04	1.31	< 0.05	25.79
3/7/93	GSL-4	262	0.71	0.07	4.24	0.062	< 0.04	1.03	< 0.05	14.65
3/7/93	GSL-4	263	0.84	0.16	11.22	0.038	< 0.04	1.06	< 0.05	21.06
3/7/93	GSL-4	264	1.12	0.115	4.77	0.083	0.09	0.41	< 0.05	13.48
3/7/93	GSL-4	265	1.20	0.197	7.68	0.023	< 0.04	0.48	< 0.05	15.54
3/7/93	GSL-4	266	0.83	0.069	7.85	0.089	< 0.04	0.4	< 0.05	15.18
3/7/93	GSL-4	267	0.74	0.249	8.17	0.034	< 0.04	0.49	< 0.05	13.88
3/7/93	GSL-4	293	0.48	0.085	3.57	0.016	0.13	0.44	< 0.05	9.88
3/8/93	GSL-4	306	0.91	0.194	6.48	0.038	< 0.04	0.48	< 0.05	16.66
3/8/93	GSL-4	307	0.76	0.061	3.82	0.025	< 0.04	0.37	< 0.05	10.69
3/8/93	GSL-4	308	1.09	0.058	5.36	0.031	< 0.04	0.32	< 0.05	12.9
3/8/93	GSL-4	309	0.77	0.125	7.5	0.03	< 0.04	0.15	< 0.05	14.13
3/8/93	GSL-4	310	1.19	0.047	4.19	0.013	< 0.04	0.35	< 0.05	13.34
3/8/93	GSL-4	311	1.19	0.181	9.72	0.038	< 0.04	0.41	< 0.05	15.04
3/9/93	GSL-4	330	0.73	0.075	2.29	0.025	< 0.04	0.03	< 0.05	10.91
3/9/93	GSL-4	331	0.40	0.06	4.24	0.015	< 0.04	0.46	< 0.05	12.77
3/9/93	GSL-4	332	1.54	0.288	13.62	0.093	< 0.04	0.59	< 0.05	20.47
3/9/93	GSL-4	333	1.04	0.324	6.23	0.103	0.04	0.7	< 0.05	14.36
3/9/93	GSL-4	334	0.96	0.156	7.69	0.025	< 0.04	0.85	< 0.05	17.9
3/9/93	GSL-4	335	0.75	0.507	2.05	0.143	< 0.04	0.76	< 0.05	17.48
3/9/93	GSL-4	336	1.21	0.347	11.21	0.078	0.04	1.24	< 0.05	20.63
3/9/93	GSL-4	337	1.58	0.2	7.27	0.023	< 0.04	1.19	< 0.05	18.18
3/10/93	GSL-4	344	0.53	0.108	6.52	0.029	< 0.04	0.2	< 0.05	9.37
3/10/93	GSL-4	345	0.66	0.04	3.23	0.027	< 0.04	0.31	< 0.05	11.97
3/11/93	GSL-4	347	1.11	0.597	15.03	0.12	< 0.04	2.1	< 0.05	24.62
10/3/92	GSL-6	203	0.52	0.063	5.46	0.061	0.12	0.21	< 0.05	16.8

(-) = Information not available

Appendix 20c. Metal concentrations in the kidney of burbot caught in Yellowknife Bay 1992-93.

Burbot Lota lota (Linnaeus)										
			Metals (Detection limit ppm)							
Date Sampled	Location	Sample No.	As (0.05)	Cd (0.0001)	Cu (0.10)	Hg (0.05)	Ni (0.02)	Pb (0.03)	Se (0.05)	Zn (0.05)
3/12/93	GSL-1	357	7.87	0.013	0.48	0.099	0.04	N.S.	0.99	21.46
3/12/93	GSL-1	358	3.62	0.01	0.48	0.055	0.04	N.S.	0.93	16.42
3/12/93	GSL-1	359	7.00	0.001	0.45	0.058	0.07	N.S.	1.32	16.7
3/12/93	GSL-1	360	3.62	0.003	0.85	0.054	0.09	N.S.	0.94	17.85
3/12/93	GSL-1	361	-	-	-	0.036	-	N.S.	-	-
3/17/93	GSL-1	369	2.43	-	-	0.058	-	N.S.	0.71	-
3/17/93	GSL-1	370	3.27	0.029	0.65	0.053	0.04	N.S.	1.53	23.44
3/18/93	GSL-1	372	4.28	0.008	0.43	0.049	0.04	N.S.	0.66	18.43
3/18/93	GSL-1	373	4.44	0.006	0.41	0.056	0.04	N.S.	1.04	18.98
3/18/93	GSL-1	374	10.35	0.017	0.58	0.108	0.04	N.S.	1.1	26.32
3/18/93	GSL-2	371	15.13	0.008	0.33	0.048	0.04	N.S.	0.8	13.72
8/25/92	GSL-3	69	2.82	-	-	0.052	-	?	0.32	-
5/5/93	GSL-3	222	-	-	-	-	-	N.S.	-	-
5/5/93	GSL-3	223	-	-	-	-	-	N.S.	-	-
5/5/93	GSL-3	224	-	-	-	-	-	N.S.	-	-
5/5/93	GSL-3	225	-	-	-	-	-	N.S.	-	-
3/8/93	GSL-3	312	10.16	-	-	0.106	-	N.S.	0.71	-
3/8/93	GSL-3	313	2.47	0.043	0.6	0.066	0.06	N.S.	0.9	15.78
3/8/93	GSL-3	314	8.32	-	-	0.092	-	N.S.	1.24	-
3/8/93	GSL-3	315	3.03	-	-	0.042	-	N.S.	1.11	-
3/8/93	GSL-3	316	3.42	-	-	0.034	-	N.S.	1.46	-
3/8/93	GSL-3	317	12.40	-	-	0.11	-	N.S.	0.88	-
3/8/93	GSL-3	318	3.84	0.01	0.53	0.07	0.04	N.S.	0.7	16.01
3/9/93	GSL-3	324	1.99	-	-	0.061	-	N.S.	1.13	-
3/9/93	GSL-3	325	2.23	0.011	0.69	0.069	0.14	N.S.	0.96	25.27
3/9/93	GSL-3	326	1.06	0.009	0.57	0.077	0.04	N.S.	1.36	18.11
3/9/93	GSL-3	327	6.58	-	-	0.113	-	N.S.	1.86	-
3/9/93	GSL-3	328	2.99	0.026	0.43	0.105	0.05	N.S.	1.65	20.03
3/9/93	GSL-3	329	6.57	-	-	0.055	-	N.S.	1.11	-
3/10/93	GSL-3	338	1.98	-	-	0.051	-	N.S.	1.07	-
3/10/93	GSL-3	339	3.54	-	-	0.098	-	N.S.	1.27	-
3/10/93	GSL-3	340	4.24	0.023	0.7	0.084	0.05	N.S.	1.08	22.4
3/10/93	GSL-3	341	3.48	-	-	0.051	-	N.S.	0.81	-
3/10/93	GSL-3	342	3.00	0.038	0.6	0.072	0.06	N.S.	1.03	23.69
3/10/93	GSL-3	343	4.63	-	-	0.065	-	N.S.	1.37	-
6/17/93	GSL-4	398	3.21	0.029	2.85	0.127	0.35	N.S.	1.17	20.73
3/8/93	GSL-4	306	2.13	0.041	0.41	0.045	0.08	N.S.	1.02	16.97
3/8/93	GSL-4	307	2.88	-	-	0.039	-	N.S.	0.9	-
3/8/93	GSL-4	308	3.72	0.008	0.76	0.22	0.04	N.S.	0.55	13.32
3/8/93	GSL-4	309	-	-	-	0.144	-	-	-	-
3/8/93	GSL-4	310	3.86	-	-	0.029	-	N.S.	1.2	-
3/8/93	GSL-4	311	19.37	-	-	0.048	-	N.S.	0.57	-
3/9/93	GSL-4	330	4.32	0.003	0.54	0.068	0.04	N.S.	0.8	15.64
3/9/93	GSL-4	331	4.03	-	-	0.035	-	N.S.	1.81	-
3/9/93	GSL-4	332	2.75	0.051	0.41	0.054	0.04	-	1.08	18.7
3/9/93	GSL-4	333	2.86	0.022	0.39	0.083	0.1	-	1.4	18.3
3/9/93	GSL-4	334	3.55	0.025	0.55	0.047	0.08	N.S.	1.52	18.91
3/9/93	GSL-4	335	3.45	0.035	0.81	0.198	0.14	N.S.	0.85	20.59
3/9/93	GSL-4	336	3.47	0.051	0.69	0.121	0.09	N.S.	1.58	20.84
3/9/93	GSL-4	337	6.21	-	-	0.036	-	N.S.	1.43	-
3/10/93	GSL-4	344	2.08	0.02	0.57	0.045	0.07	N.S.	1.03	18.92
3/10/93	GSL-4	345	3.88	0.001	0.59	0.064	0.04	N.S.	1.01	13.5
3/11/93	GSL-4	347	1.89	0.117	0.42	0.116	0.05	N.S.	0.82	17.5
10/3/92	GSL-6	203	-	-	-	0.049	-	N.S.	-	-

(-) = Information not available

Appendix 21. Biological descriptors of lake cisco caught in Yellowknife Bay 1992-93.

Lake cisco Coregonus artedii									
			Biological parameters						
Date Sampled	Location	Sample No.	Length	Weight	Maturity	Scale method	Otolith method	Accepted age	k-factor
12/03/93	GSL-1	YKB93441	160	38	4	-	6	6	0.93
12/03/93	GSL-1	YKB93442	147	31	7	-	7	7	0.98
12/03/93	GSL-1	YKB93443	161	37	3	-	7	7	0.89
12/03/93	GSL-1	YKB93444	235	146	6	-	7	7	1.12
12/03/93	GSL-1	YKB93445	176	46	7	-	5	5	0.84
12/03/93	GSL-1	YKB93446	208	103	6	-	7	7	1.14
12/03/93	GSL-1	YKB93447	163	42	5-3	-	5	5	0.97
12/03/93	GSL-1	YKB93448	164	43	2	-	6	6	0.97
12/03/93	GSL-1	YKB93449	154	37	3-4	-	8	8	1.01
12/03/93	GSL-1	YKB93450	150	32	6-7	4	-	4	0.95
12/03/93	GSL-1	YKB93451	182	62	6-7	-	6	6	1.03
12/03/93	GSL-1	YKB93452	237	154	1	-	5	5	1.16
12/03/93	GSL-1	YKB93453	258	182	6	-	8	8	1.06

Appendix 22. Biological descriptors and metal concentrations in the muscle, liver and kidney of two lake trout caught in Yellowknife Bay 1992-93.

Lake trout Salvelinus namaycush (Walbaum)		Muscle						Liver						Kidney					
		Samples						Samples						Samples					
		362	363	Max	Min	Mean	S.D.	362	363	Max	Min	Mean	S.D.	362	363	Max	Min	Mean	S.D.
Metals (detection limits ppm)																			
As	(0.05)	0.24	0.39	0.39	0.24	0.315	0.106	0.30	0.27	0.30	0.27	0.285	0.021	0.17	0.27	0.27	0.17	0.220	0.071
Cd	(0.0001)	0.001	0.001	0.001	0.001	0.001	0.000	0.024	0.029	0.029	0.024	0.027	0.004	0.178	0.113	0.178	0.113	0.146	0.046
Cu	(0.10)	0.51	0.38	0.51	0.38	0.45	0.09	22.78	12.31	22.78	12.31	17.55	7.40	0.81	0.67	0.81	0.67	0.74	0.10
Hg	(0.05)	0.165	0.202	0.202	0.165	0.184	0.026	0.134	0.125	0.134	0.125	0.130	0.006	0.348	0.241	0.348	0.241	0.295	0.076
Ni	(0.02)	< 0.02	< 0.02	0.02	0.02	0.02	0.00	< 0.04	< 0.04	0.04	0.04	0.04	0.00	0.05	-	0.05	0.05	-	-
Pb	(0.03)	< 0.03	< 0.03	0.03	0.03	0.03	0.00	< 0.05	< 0.05	0.05	0.05	0.05	0.00	< 0.05	< 0.05	0.05	0.05	0.05	0.00
Se	(0.05)	0.20	0.17	0.20	0.17	0.19	0.02	1.17	1.78	1.78	1.17	1.48	0.43	0.88	0.78	0.88	0.78	0.83	0.07
Zn	(0.05)	3.04	2.99	3.04	2.99	3.02	0.04	28.01	25.89	28.01	25.89	26.95	1.50	19.69	17.79	19.69	17.79	18.74	1.34
Biological data																			
Length		517	557	557	517	537	28.284												
Weight		1805	2275	2275	1805	2040	332.3												
Maturity		2	6																
Age		6	-																
K-factor		1.306	1.317	1.317	1.306	1.311	0.007												

Appendix 23. Photographs and description of segments 3 and 2 of the littoral zones in the Yellowknife Back Bay Study Area.

Photo #1

Segment #3. This segment is typical of the most densely vegetated areas of Yellowknife Bay. Note the submerged macrophytes that grow throughout the littoral zone which extends 15 to 20 meters.

Photo #2

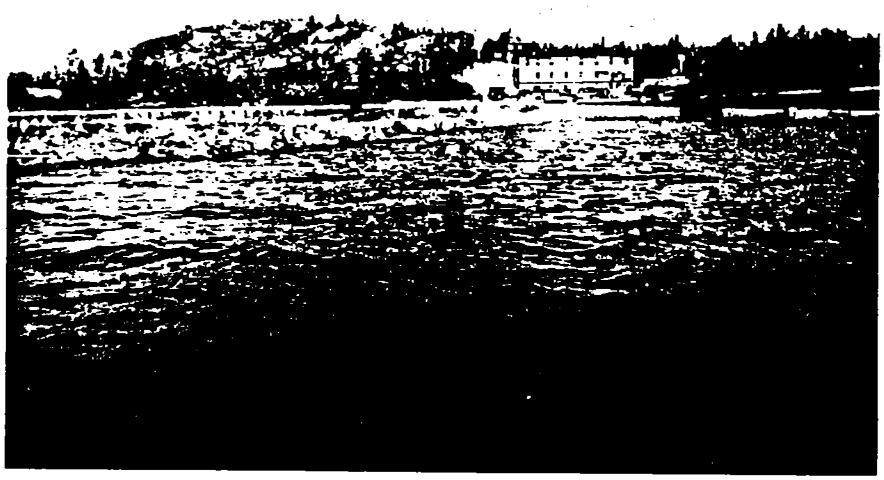
Here is a closer view of the shoreline shown in Photo 1. Cobbles and rocks lie on a clay bed along the shoreline. At various places along the investigated portion of the Yellowknife Bay, waste materials were present as seen on this illustration.

Appendix 23 continued. Photographs and description of segments 5 and 7 of the littoral zones in the Yellowknife-Back Bay Study Area.

Photo #3

Segment 5. This area is characterized by a flat shoreline associated with a bedrock point extending into the bay. This shoreline is relatively vegetated and accounts for the presence of organic matter in the sandy sediments along the shore; clay bottom covers the rest of the 15 meter littoral zone. Patches of emergent macrophytes (Equisetum spp., Sedge spp., etc.) similar to the one shown here, are commom between segments 1 to 19, and 31 to 39 of Yellowknife Bay.

Photo #4



Segment 7. This picture illustrates one of the most disturbed sections of the shoreline. The littoral zone extends to approximately 10 meters. The substrate is a mixture of hard and soft clay sediments. The shore is vegetated discontinuously. Emergent or submerged macrophytes are absent.

Appendix 23 continued. Photograph and description of segment 12 of the littoral zone in the Yellowknife-Back Bay Study Area.

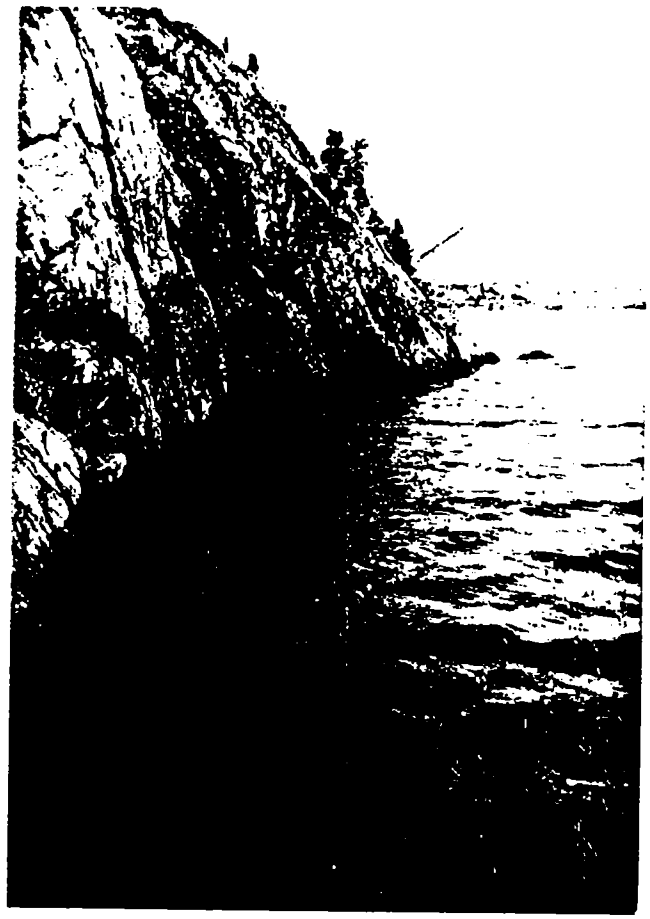


Photo #5

Segment 12. Here is an example of steep shore of bedrock associated with a short littoral zone entending to a maximum of five meters. A discontinuous cover of submerged macrophytes grow between the scattered rocks lying on a clay bottom.

Appendix 23 continued. Photograph and description of segment 27 of the littoral zone in the Yellowknife-Back Bay Study Area.

Photo #6

Segment 27. This densely vegetated shore is located at the tip of Latham Island. The littoral zone extends to approximately 60 meters. The clay sediments support dense stretches of emergent aquatic plants at the shoreline while submerged macrophytes grow in the open waters. Note the presence of anthropogenic waste material a few meters off shore.

Appendix 23 continued. Photographs and description of segments 42 and 46 of the littoral zones in the Yellowknife-Back Bay Study Area.

Photo #7

Segment 42. Here is a representation of one of the most densely vegetated and widest littoral zone. The bottom sediments gradually change from sand to clay with distance from shore. Scattered boulders are present throughout the littoral zone.

Photo #8

Segment 46. This section is characteristic of the undisturbed shoreline of Yellowknife Bay extending from the pumping station (white building) to Mosher Island: relatively unvegetated bedrock shore, litoral zone of eight meters or less with rocks standing in sandy clay sediments. Emergent and submerged macrophytes not absent.

Appendix 24. Health Risk Assessment for the consumption of fish from the Yellowknife-Back Bay areas which was conducted by Health Canada in Ottawa.

Health and Welfare Canada | Santé et Bien-être social Canada

Health Protection Branch | Direction générale de la protection de la santé

Bureau of Chemical Safety
Room 309B, Banting Building
Postal Locator 2203G2
Ottawa, Ontario
K1A 0L2

October 31, 1996

Mr. J.A. MacKinnon
A/Manager Contaminants Program
Health and Social Services
Government of the Northwest Territories
Yellowknife, NT
X1A 2L9

Dear Mr. MacKinnon:

This refers to your letter of October 22, 1996, under cover of which you forwarded, on behalf of Mr. Francis Jackson, his letter of October 16 concerning the Yellowknife Back Bay health hazard assessment (HHA).

The first request is for information similar to that released with the Iqaluit clam HHA. Indeed, the YK Back Bay HHA letter resembles the Iqaluit clam HHA letter. With regard to the latter, Environment Canada/Yellowknife and/or other northern agencies may have gathered and then presented additional related information in Iqaluit.

The next question deals with which contaminants were investigated and what dietary information was used in the YK HHA. This Bureau investigated all the data sent, which included levels of mercury, selenium, arsenic, cadmium, copper, zinc and lead in various fish tissues. Evaluators used various dietary information available at the time, which included the responses gathered in the recent Mackenzie dietary study conducted by the Mackenzie Regional Health office.

I agree that our HHA response might have mentioned and acknowledged the participation of the Dene communities of Dettah and Ndilo. At the request of the Dene Nation, all completed questionnaires have been forwarded to the Centre for Indigenous Nutrition and the Environment (CINE) for comparison with the dietary studies that they conducted in the many other Dene communities.

.../2

Canada

Appendix 24. (cont'd) Health Risk Assessment for the consumption of fish from the Yellowknife-Back Bay areas which was conducted by Health Canada in Ottawa.

The levels of trace metal contaminants in the fish did not pose a health hazard, so there was no recommendation to restrict current consumption of fish from Yellowknife Back Bay. As new dietary information becomes available, Bureau evaluators will be glad to review the situation. In the next few weeks, we expect to receive the CINE report on the dietary studies conducted by that organization in Dene/Metis communities. We also look forward to the meeting with CINE, the Dene Nation and the GNWT Department of Health and Social Services, that is being coordinated by Carole Mills. That meeting and subsequent ones will ensure that these new data will be shared by all those involved in the health hazard assessment process.

We trust that this information is satisfactory. If there are any further questions, please have Mr. Jackson contact Ms. V. Jerome at (613) 941-6224.

Yours truly,

H.B.S. Conacher, Ph.D.
A/Director
Bureau of Chemical Safety

c.c. V. Jerome