

Environment Canada
Environmental Protection Service
Pacific Region
Yukon Branch

AN OVERVIEW OF BACTERIOLOGICAL AND
WATER CHEMISTRY CONDITIONS IN THE YUKON
RIVER NEAR THE DAWSON CITY MUNICIPAL SEWAGE
OUTFALL, 1984-1985

by

D. Davidge

December, 1985



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An overview of bacteriological
and water chemistry conditions
in the Yukon River near the
Dawson City municipal sewage
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ABSTRACT

A water quality and bacteriological survey was conducted on the Yukon River at Dawson City in July, September 1984 and March 1985. The purpose of the surveys was to measure and evaluate receiving water conditions in the vicinity of the municipal sewage outfall. The parameters measured included water chemistry and coliform bacteria levels upstream and downstream of the outfall.

The results of the water chemistry analysis show that, except for turbidity, total hardness, iron, manganese and lead levels at certain times and locations, the receiving water quality meets the criteria recommended for drinking water and aquatic life. No pattern relative to the sewage outfall location could be noted for the parameters which did not meet the recommended criteria for drinking water and aquatic life.

Fecal coliform levels indicate an increase in fecal coliforms along the right (east) bank of the Yukon River downstream of Dawson City at certain times. Background levels of fecal coliforms upstream of Dawson City averaged 17/100 ml when sampled in July 1984. Fecal coliform levels 1 km downstream of the sewage outfall ranged from 674/100 ml on July 10, 1984 to 250/100 ml on July 12, 1984 to 140/100 ml on September 13, 1984 to 0/100 ml on March 12, 1985. Elevated levels of fecal coliforms (123/100 ml) were detected at a sample station 12 km downstream of Dawson City on July 10, 1984.

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1 INTRODUCTION

During the months of July and September, 1984 and March, 1985 the Environmental Protection Service - Yukon Branch conducted field surveys on the Yukon River in the vicinity of the Dawson City municipal sewage outfall. The purpose of the investigation was to: 1) determine the coliform bacteria concentrations downstream of the sewage outfall; 2) determine the extent of lateral mixing immediately downstream of the outfall, and; 3) assess the water quality downstream of the outfall. In situ measurements and water sampling were carried out immediately upstream of the mouth of the Klondike River and up to 12 kilometres downstream of the outfall.

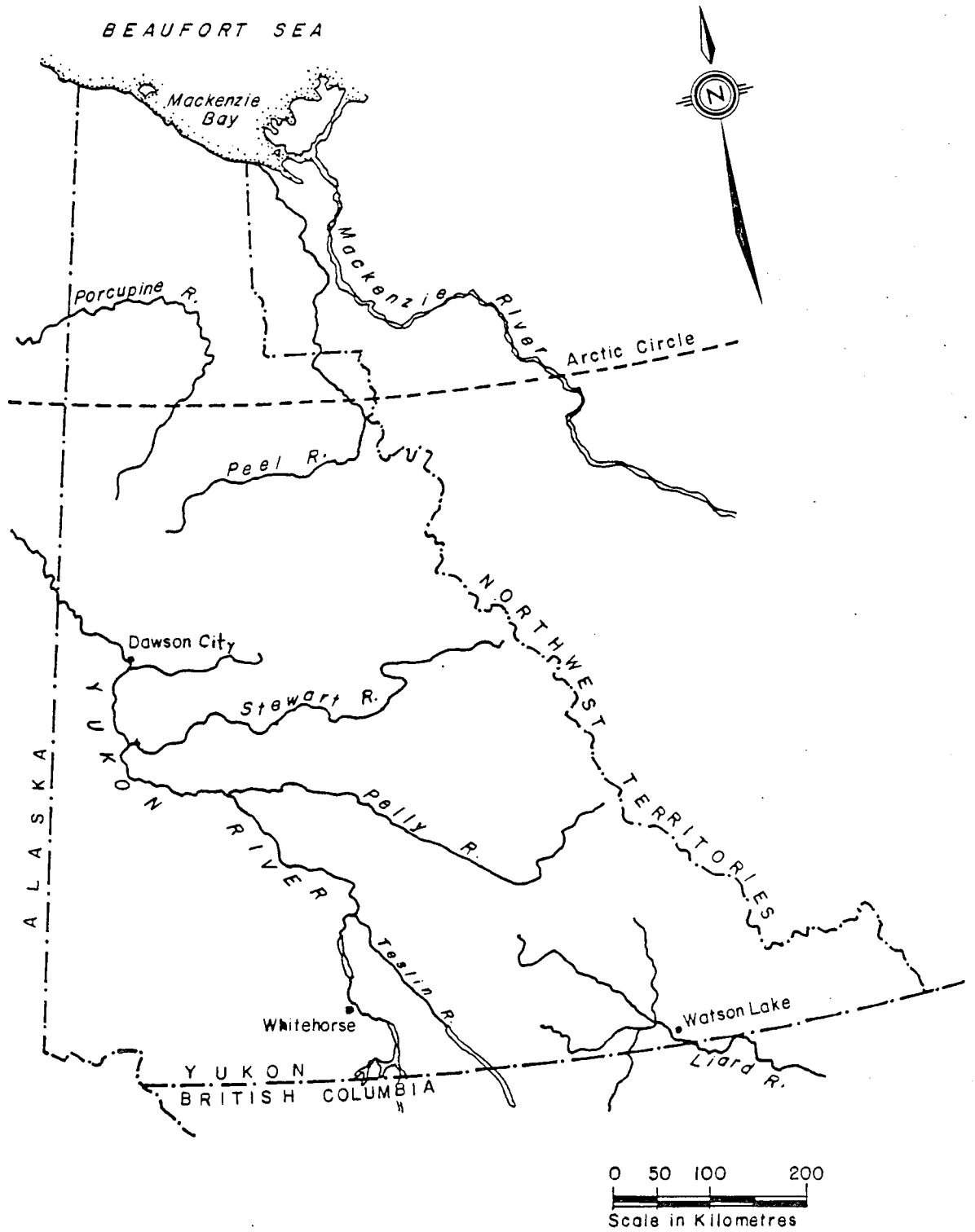


FIGURE 1 : STUDY AREA LOCATION

2 STUDY AREA

Dawson City has a population of approximately 900 and is located along the Yukon River at 64°04' Lat. and 139°26' Long. (refer to Figure 1 for study area location). The present municipal sewage disposal system was installed in the late 1970's. Raw sewage is screened at the wet well complex to remove solids and is then pumped directly to the Yukon River through an underground pipeline. The discharge pipe is about 1 meter above the river bed at the deepest part of the Yukon River in line with Church Street in Dawson City. The raw sewage is pumped to the point of discharge at a rate determined by the incoming flow. Incoming flows can vary from an average of 15 litres per second during the summer months to 40 litres per second during the winter. Discharges during the summer months occur approximately every 10 minutes while during the winter they occur every 2 to 3 minutes (Taylor, 1984 - Personal Comm.). The increased water usage during the winter months is due to the continuous use of water bleeder systems in most residential and commercial buildings to prevent water pipes from freezing. The reader should note that because the discharge was not continuous, but occurs in pulses, the bacteria and water chemistry results obtained may not reflect the true nature of the Yukon River downstream of the outfall.

3 METHODS

A total of 18 sample stations were established along the Yukon River. Of these, Stations 1, 2 and 3 are located 1 kilometer upstream of the sewage outfall and Stations 5 through 19 are located downstream at 5 cross sectional locations. The cross sections are located at 100 meters and 1, 3, 6 and 12 kilometers downstream from the outfall. Station 4 is located on the Klondike River immediately upstream of it's confluence with the Yukon River. See Figure 2 for station location and refer to Appendix II, Table 1 for station description.

Sample stations referred to in the Results and Discussion section which are succeeded by the letters a, b or c indicate "surface sample", " $\frac{1}{2}$ depth" and "near bottom (approximately 0.5 meters from bottom)", respectively.

Water sample collection and in situ measurements in July and September, 1984, were conducted from a boat. In March, 1985 the survey was conducted on the river ice using snowmobiles for transportation and a gas powered ice auger to drill the sampling holes. Temperature and conductivity were measured using a YSI Model 33 Temperature-Conductivity-Salinity Meter and dissolved oxygen was measured using a YSI Model 57 Dissolved Oxygen Meter. pH was measured using a Fisher Accumet Model 640 Field pH Meter.

Water samples for coliform bacteria, extractable metals, nutrients and total inorganic and organic carbons (T.I.C. T.O.C.) were collected from the surface, at half depth and near river bottom at selected stations. During the summer and fall months surface samples were collected by submersing the sample container below the water surface from the boat. A microbiological bulb sampler (manufactured by Research Instruments Company Limited, Guelph, Ontario) was used to collect water samples at depth for bacteria analysis and a 2.5 litre Niskin Water Sampler was used to collect water samples at depth for metals, nutrients and T.I.C. T.O.C. analysis.

Samples collected for coliform bacteria testing were analysed within 24 hours of collection using the membrane filtration technique

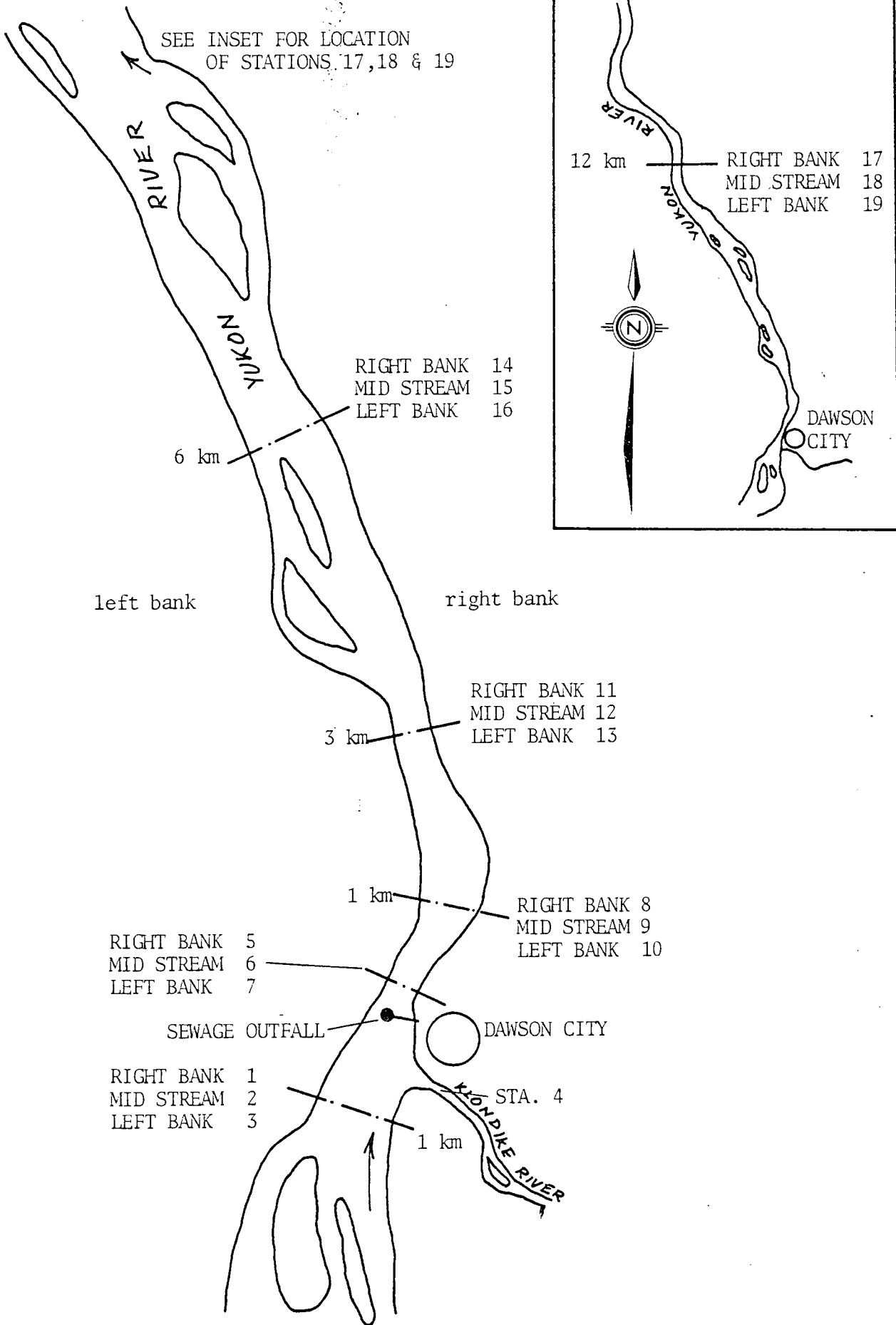


FIGURE 2 : SAMPLE STATION LOCATION

as described in Appendix I. Total and fecal coliform plate counts were conducted after the 24 hour incubation period. Appendix I provides a summary of water sample collection, preservation and analytical techniques for each parameter sampled.

In July, 1984 the sampling for coliform bacteria was carried out twice, once on July 10 and again on July 12 because of laboratory problems in obtaining consistent total coliform results. As a result, for fecal coliforms, two sets of data, July 10 and 12, are reported.

4 RESULTS AND DISCUSSION

4.1 Bacteriology

The results of coliform bacteria analysis for July and September, 1984 and March, 1985 sampling dates are presented in Appendix III, Table 1. Total coliform bacteria counts are not available for July and September, 1984 due to the presence of suspended sediments (up to 612 mg/L in July) in the samples collected. In using the membrane filtration technique suspended material present in the sample becomes trapped on the filter and disrupts individual bacteria colony growth during the incubation period. The bacteria colonies tend to join together making it difficult or impossible to count them.

Fecal coliform colony development did not appear to be inhibited by the sediments trapped on the filter as colonies were discernible therefore the counts obtained were considered valid. Suspended sediment loading in the Yukon River in March, 1985 (less than 5 mg/L) did not disrupt total or fecal coliform colony development during incubation and therefore accurate results were obtained for both coliforms.

Guidelines for drinking water prepared by Health and Welfare Canada (1978) recommend that: "no sample should contain more than 10 total coliform organisms per 100 ml" and "none of the coliform organisms detected should be fecal coliforms". Water quality guidelines for bathing and swimming published by Yukon and Northwest Territory Water Boards (1977) suggest that "if fecal coliform levels are in excess of 200 organisms/100 ml.....further investigations of the health risks associated with the water should be conducted". Although bathing and swimming do not often occur in the Yukon River, these recommendations were used as guidelines for assessing results obtained during the surveys.

Background fecal coliform numbers in July which are reflected by Stations 1, 2a, 2b and 3 on the Yukon River and Station 4 on the Klondike River averaged 17/100 ml, ranging from 0 to 86/100 ml from the

12 samples collected. There were no fecal coliforms found at Station 2a in March, 1985. The background levels for fecal coliform bacteria are noted and have to be considered when looking at levels observed downstream of the municipal outfall. Samples collected at Stations 5, 6 and 7 on July 10 and 12, 1984 show fecal coliform levels similar to those background levels found upstream.

The first indication of municipal sewage, based on fecal coliform levels, was found approximately 1.0 kilometre downstream of the outfall along the right bank at Station 8. The fecal coliform counts in surface waters at this station were elevated above or were near the recommended levels for recreational waters. The levels ranged from 674/100 ml on July 10, 250/100 ml on July 12 to 140/100 ml on September 13, 1984. Samples collected at Station 8 on September 13 at 2 and 4 meters depth showed a fecal coliform count of 290 and 520/100 ml, respectively. Samples collected from the surface and near bottom on March 12, 1985 revealed no fecal coliforms. This could be due to the high dilution factor characteristic of winter discharges or the sample may have been collected during the interval between discharges. Total coliforms ranged from 50/100 ml at the surface to 20/100 ml near bottom at Station 8 on March 12, 1985.

At Station 9 (midstream) and Station 10 (left bank) fecal coliform counts ranged from 0 to 34 over the three sample periods. On September 13, 1984 no fecal coliforms were found at Station 9 at surface or at 3.0 and 6.0 meters depth. On the same day fecal coliform counts at Station 10 were 20/100 ml at the surface, 0/100 ml at 2.0 meters depth and 30/100 ml at 4.5 meters depths. In March of 1985 fecal coliforms were detected only at near bottom of Station 9 (8/100 ml). Total coliform counts ranged from 0 to 14/100 ml on the same day.

Samples collected at Station 11, approximately 3 kilometres downstream of the outfall along the right bank, show elevated numbers of fecal coliforms on September 13, 1984 ranging from 410/100 ml at the surface to 110/100 ml at near bottom. Samples collected the same day at Station 12 (midstream) and Station 13 (left bank) showed no fecal coliforms. Surface samples collected on July 10 and 12, 1984 at

Station 12 show fecal coliform levels similar to those found upstream of the outfall. On March 13, 1985 the fecal coliform count at Station 12, surface, was 92/100 ml while the total coliform count was 172/100 ml.

Samples collected at 6 and 12 kilometres downstream from the outfall on July 10/12 and September 13, 1984 show low levels of fecal coliforms except at Station 15 (midstream) where the count was 123/100 ml.

The coliform bacteria results suggest that there is lateral mixing from the outfall pipe toward the right bank and downstream of the community but very little mixing toward the left bank downstream of the outfall.

4.2 Water Quality

Water quality data for the three sample periods are presented in Appendix III, Table 2. Appendix IV, Table 1 shows water quality criteria recommended for drinking water and aquatic life.

In situ temperatures during the three sample periods varied seasonally with July averaging 14.0°C, September averaging 7.5°C and March averaging 1.9°C. The pH of the Yukon River averaged 8.17 in July, 7.76 in September and 7.70 in March. In situ pH of the Klondike River on July 10, 1984 was 7.97 .

All parameters were found to be below the accepted levels shown in Appendix IV, Table 1, except for turbidity, total hardness, iron, manganese and lead.

Water hardness exceeded the recommended 100 mg/L level for drinking water in July, 1984 at all stations except Station 4, the Klondike River, and Station 5 which is immediately downstream of the Klondike River confluence. Similarly water hardness was near or exceeded the recommended level in September, 1984 and in March, 1985.

Iron exceeded the recommended level for drinking water of 0.3 mg/L at all Stations in July, 1984. The levels ranged from 1.26 mg/L in the Klondike River to as much as 11 mg/L at Station 3 in the Yukon

River. These levels also exceed those recommended for aquatic life (1.0 mg/L). During the sample period in September, 1984 iron exceeded the recommended levels for drinking water at all stations except at Station 4, the Klondike River, but were considerably lower than levels found in July. Those samples collected at Stations 2a, 9a, 10a, 15, 16 and 19 exceeded the 1.0 mg/L recommended for aquatic life. All other stations except Station 4 were slightly less than the 1.0 mg/L level. In March, 1985 iron was below the recommended level for drinking water at all stations.

Manganese exceeded the recommended level for drinking water (0.05 mg/L) at all stations in July, 1984 but was below the recommended level in September, 1984 and March, 1985.

Lead concentrations at Station 9c, 10c and 16 on September 13, 1984 and at Station 12a on March 12, 1985 exceeded levels recommended for drinking water (0.05 mg/L) and aquatic life (0.01 mg/L for hard water). The maximum value observed was 0.11 mg/L at Station 10c.

5 CONCLUSIONS

Background levels of fecal coliform bacteria in excess of the drinking water guidelines were observed at upstream stations in the Yukon and Klondike Rivers during sampling in July 1984. Fecal coliform numbers exceeded the recommended drinking water standard and the recommended recreational (swimming) use guideline of 200/100 ml between 1 and 3 kilometers downstream of the sewage outfall, primarily along the right bank and during the summer and fall periods. The bacteria results suggest there is lateral mixing occurring toward the right bank between 1 and 3 kilometers downstream of the outfall however little lateral mixing toward the left bank.

Results from samples collected further downstream are not conclusive but suggest there is lateral mixing toward the right bank up to 6 and 12 kilometers downstream of the outfall. Fecal coliform bacteria were detected up to 12 km downstream of Dawson City during the sampling periods. Samples collected along the right bank (Stations 14 and 17) generally had higher numbers of fecal coliforms than those found at midstream or along the left bank.

No specific changes or patterns in water chemistry parameters were observed in the present study which could be attributed to the discharge of municipal sewage. Turbidity, iron, manganese and hardness exceeded drinking water standards during July, 1984 and partially in September, 1984 but are characteristic of the Yukon River water upstream of Dawson City and therefore these high levels do not originate at the sewage outfall. Levels of lead exceeding those recommended for drinking water and aquatic life are found at some of the stations downstream of the outfall during September, 1984 and March, 1985 but there is insufficient information available to suggest they originate at Dawson City.

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APPENDICES

APPENDIX I

COLLECTION, PREPERATION AND ANALYSIS
METHODS FOR WATER SAMPLES AND
WATER QUALITY CRITERIA FOR DRINKING
WATER AND AQUATIC LIFE

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

| PARAMETER | DETECTION LIMIT | COLLECTION AND PREPARATION PROCEDURE ¹ | ANALYTICAL PROCEDURE | METHOD SECTION ² |
|------------------------------|-----------------|---|---|-----------------------------|
| Temperature | 0.1°C | <u>In situ</u> measurement. | <u>YSI Model 33 Conductivity Meter</u> | |
| Conductivity | 0.2 umhos/cm | <u>In situ</u> measurement. Lab measurement was taken from the same sample as NH ₃ below. | <u>YSI Model 33 Conductivity Meter</u> <u>Radiometer Conductivity Meter (CDMC)</u> | 044 |
| Dissolved Oxygen | 1.0 mg/l | <u>In situ</u> measurement. The instrument was calibrated in the field under water saturated air conditions. | <u>YSI Model 57 Dissolved Oxygen Meter</u> | |
| pH | | Small aliquots of sample were measured soon after collection. Instrument was calibrated using 7.0 buffering solution. | <u>Potentiometric</u> | 080 |
| Non-Filterable Residue (NFR) | 5.0 mg/l | Sample was filtered through a pre-weighed glass fibre filter with a 1.5 um pore size. | <u>Filtration, Drying And Weighing Of Residue On Filter</u> | 104 |
| Filterable Residue (FR) | 10.0 mg/l | Same sample as NH ₃ . | <u>Filtration, Drying And Weighing Of Filtrate</u> | 100 |

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

| PARAMETER | DETECTION LIMIT | COLLECTION AND PRESERVATION PROCEDURE ¹ | ANALYTICAL PROCEDURE | METHOD SECTION ² |
|---|-------------------------------|--|--|-----------------------------|
| Ammonia NH ₃ -N | 0.005 mg/l | Single samples collected in 2 litre linear polyethylene containers. Each container was rinsed 3 times with sample before it was filled. No preservatives. Stores at 4°C. | <u>Phenol Hypochlorite-Colorimetric-Automated</u> | 058 |
| Colour | 5 (colour units) | Same sample as NH ₃ . | <u>Platinum-Cobalt Visual Comparison</u> | 040 |
| Turbidity | 0.1 (FTU) | Same sample as NH ₃ . | <u>Nephelometric Turbidity</u> | 130 |
| Total Alkalinity | 1.0 mg/l as CaCO ₃ | Same sample as NH ₃ . | <u>Potentiometric Titration</u> | 006 |
| Total Phosphate T PO ₄ -P | 0.005 mg/l | Same sample as NH ₃ . | <u>Acid-persulphate, Autoclave Digestion</u> | 086 |
| Nitrite NO ₂ -N | 0.005 mg/l | Same sample as NH ₃ . | <u>Diazotization-Colorimetric-Automated</u> | 070 |
| Nitrate NO ₃ -N | 0.01 mg/l | Same sample as NH ₃ . | <u>Cadmium Copper Reduction Colorimetric Automated</u> | 072 |
| Sulphate SO ₄ | 1.0 mg/l | Same sample as NH ₃ . | <u>Barium Chloranilate -UV Spectrophotometric</u> | 122 |
| Chloride Cl | 0.5 mg/l | Same sample as NH ₃ . | <u>Thiocyanate-Combined Reagent-Colorimetric</u> | 024 |
| Total and Fecal Coliform | | Surface samples collected in 125 ml wide mouth sterilized glass jars, samples at depth collected with a Microbiological Sampler utilizing sterilized rubber bulbs. | <u>Membrane Filtration Technique</u> | 902 |

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

| PARAMETER | DETECTION LIMIT | COLLECTION AND PRESERVATION PROCEDURE ¹ | ANALYTICAL PROCEDURE | METHOD SECTION ² |
|--------------------|-----------------|--|--|-----------------------------|
| Extractable Metals | mg/l | Single samples collected in 200 ml linear polyethylene bottles. Each bottle was rinsed 3 times with sample before filling. | <u>Inductively Coupled Argon Plasma (ICAP) combined with Optical Emission Spectrometer (OES)</u> | 300 |
| Al | 0.05 | Preserved to a pH <1.5 using 2.0 ml concentrated HNO ₃ . | | |
| As | 0.05 | | | |
| B | 0.001 | | | |
| Ba | 0.001 | | | |
| Be | 0.001 | | | |
| Ca | 0.1 | | | |
| Cd | 0.002 | | | |
| Co | 0.005 | | | |
| Cr | 0.005 | | | |
| Cu | 0.005 | | | |
| Fe | 0.005 | | | |
| Mg | 0.10 | | | |
| Mn | 0.001 | | | |
| Mo | 0.005 | | | |
| Na | 0.5 | | | |
| Ni | 0.02 | | | |
| P | 0.05 | | | |
| Pb | 0.02 | | | |
| Sb | 0.05 | | | |
| Se | 0.05 | | | |
| Si | 0.1 | | | |
| Sn | 0.01 | | | |
| Sr | 0.001 | | | |
| Ti | 0.002 | | | |
| V | 0.01 | | | |
| Zn | 0.002 | | | |

APPENDIX II

SAMPLE STATION LOCATION

APPENDIX II TABLE 1 - STATION LOCATION

| STATION | DESCRIPTION OF SAMPLE COLLECTION |
|---------|---|
| 1 | R. bank; surface; 1.3 km upstream of outfall |
| 2a | Mid-stream; surface; 1.3 km upstream of outfall |
| 2b | Mid-stream; bottom; 1.3 km upstream of outfall |
| 3 | L. bank; surface; 1.3 km upstream of outfall |
| 4 | Klondike River |
| 5a | R. bank; surface; 100 m downstream of outfall |
| 5b | R. bank; 1/2 depth; 100 m downstream of outfall |
| 5c | R. bank; bottom; 100 m downstream of outfall |
| 6a | Mid-stream; surface; 100 m downstream of outfall |
| 6b | Mid-stream; 1/2 depth; 100 m downstream of outfall |
| 6c | Mid-stream; bottom; 100 m downstream of outfall |
| 7a | L. bank; surface; 100 m downstream of outfall |
| 7b | L. bank; 1/2 depth; 100 m downstream of outfall |
| 7c | L. bank; bottom; 100 m downstream of outfall |
| 8a | R. bank; surface; 1.0 km downstream of outfall |
| 8b | R. bank; 1/2 depth; 1.0 km downstream of outfall |
| 8c | R. bank; bottom; 1.0 km downstream of outfall |
| 9a | Mid-stream; surface; 1.0 km downstream of outfall |
| 9b | Mid-stream; 1/2 depth; 1.0 km downstream of outfall |
| 9c | Mid-stream; bottom; 1.0 km downstream of outfall |
| 10a | L. bank; surface; 1.0 km downstream of outfall |
| 10b | L. bank; 1/2 depth; 1.0 km downstream of outfall |
| 10c | L. bank; bottom; 1.0 km downstream of outfall |
| 11a | R. bank; surface; 3.0 km downstream of outfall |
| 11c | R. bank; bottom; 3.0 km downstream of outfall |
| 12a | Mid-stream; surface; 3.0 km downstream of outfall |
| 12c | Mid-stream; bottom; 3.0 km downstream of outfall |
| 13a | L. bank; surface; 3.0 km downstream of outfall |
| 13c | L. bank; bottom; 3.0 km downstream of outfall |
| 14 | R. bank; surface; 6.0 km downstream of outfall |
| 15 | Mid-stream; surface; 6.0 km downstream of outfall |
| 16 | L. bank; surface; 6.0 km downstream of outfall |
| 17 | R. bank; surface; 12.0 km downstream of outfall |
| 18 | Mid-stream; surface; 12.0 km downstream of outfall |
| 19 | L. bank; surface; 12.0 km downstream of outfall |

APPENDIX III

BACTERIOLOGICAL AND
WATER QUALITY RESULTS

APPENDIX III TABLE 1 - FECAL AND TOTAL COLIFORM COUNTS IN THE YUKON RIVER AT DAWSON CITY, YUKON - COUNT/100 ml

| STATION | FECAL COLIFORM COUNT 100/ml | | | | TOTAL COLIFORM COUNT 100/ml |
|---------|-----------------------------|-----------------|------------------|---------------------|-----------------------------|
| | July 10 1984 | July 12 1984 | Sept. 13 1984 | March 12-13 1985 | March 12-13 1985 |
| 1 | 18 | 24 | 0 | 0 | 2 |
| 2a | 4 | 86 | NS | NS | NS |
| 2b | 10 | NS | NS | NS | NS |
| 3 | 24 | 24 | NS | NS | NS |
| 4 | 10 | 4 | 0 | NS | NS |
| 5a | 8 | 6 | NS | NS | NS |
| 6a | 18 | 58 | NS | NS | NS |
| 7a | 28 | 58 | NS | NS | NS |
| 8a | 674 | 250 | 140 | 0 | 50 |
| 8b | NS | NS | 290 | NS | NS |
| 8c | NS | NS | 520 | 0 | 20 |
| 9a | 20 | 34 | 0 | 0 | 2 |
| 9b | NS | NS | 0 | NS | NS |
| 9c | NS | NS | 0 | 8 | 14 |
| 10a | 16 | 34 | 20 | 0 | 6 |
| 10b | NS | NS | 0 | NS | NS |
| 10c | NS | NS | 30 | 0 | 0 |
| 11a | NS | NS | 410 | 92 | 172 |
| 11c | NS | NS | 110 | NS | NS |
| 12a | 26 | 14 | 0 | 0 | 0 |
| 12c | NS | NS | 0 | NS | NS |
| 13a | NS | NS | 0 | 2 | 4 |
| 13c | NS | NS | 0 | NS | NS |
| 14 | NS | NS | 30 | NS | NS |
| 15 | 6 | 123 | 10 | NS | NS |
| 16 | NS | NS | 0 | NS | NS |
| 17 | NS | NS | 30 | NS | NS |
| 18 | NS | NS | 10 | NS | NS |
| 19 | NS | NS | 0 | NS | NS |

NS - No sample collected.

APPENDIX III TABLE 2 WATER QUALITY OF YUKON RIVER AT DAWSON CITY, YUKON FOR JULY 10, 1984

| STATION NUMBER | DEPTH (m) | TEMP (°C) | IN SITU pH | LAB pH | IN SITU COND. (umhos/cm) | LAB COND. (umhos/cm) | DISSOLVED OXYGEN | COLOUR (colour units) | TURBIDITY (FTU) | T. ALK. (as CaCO ₃) (mg/L) | T. HARD. (as CaCO ₃) (mg/L) |
|----------------|-----------|-----------|------------|--------|--------------------------|----------------------|------------------|-----------------------|-----------------|--|---|
| 1 | 3.5 | N/A | 8.20 | 8.0 | N/A | 187 | 9.6 | 80 | 300 | 79.0 | 181.0 |
| 2a | 5.5 | N/A | 8.15 | 8.0 | N/A | 186 | 9.6 | 55 | 370 | 79.0 | 201.0 |
| 2b | N/A | N/A | N/A | 8.0 | N/A | 190 | N/A | 60 | 400 | 79.0 | 215.0 |
| 3 | 5.0 | 13.5 | 8.18 | 8.0 | N/A | 192 | 9.2 | 70 | 420 | 81.0 | 271.0 |
| 4 | 1.0 | 10.5 | 7.97 | 7.7 | N/A | 202 | 10.4 | 10 | 20 | 63.0 | 98.2 |
| 5a | 5.0 | 10.5 | 8.05 | 7.7 | N/A | 202 | 10.2 | 5 | 24 | 65.0 | 97.3 |
| 6a | 12.5 | 14.0 | 8.18 | 8.0 | N/A | 185 | 9.5 | 65 | 360 | 76.0 | 213.0 |
| 7a | 10.0 | 14.0 | 8.15 | 8.0 | N/A | 188 | 9.5 | 80 | 550 | 85.0 | 240.0 |
| 8a | 7.3 | 14.0 | 8.15 | 8.0 | N/A | 187 | 9.2 | 60 | 280 | 75.0 | 181.0 |
| 9a | 6.7 | 14.0 | 8.19 | 8.0 | N/A | 187 | 9.6 | 55 | 410 | 81.0 | 256.0 |
| 10a | 7.0 | 14.0 | 8.20 | 8.0 | N/A | 187 | 9.4 | 70 | 450 | 82.0 | 262.0 |
| 11a | 11.2 | 14.0 | 8.20 | 8.0 | N/A | 187 | 9.5 | 70 | 300 | 77.0 | 234.0 |
| 12a | 4.0 | 14.0 | 8.20 | 8.0 | N/A | 188 | 9.6 | 60 | 440 | 80.0 | 279.0 |
| 12b | N/A | 14.0 | N/A | 8.0 | N/A | 186 | N/A | 65 | 270 | 77.0 | 258.0 |

N/A - Not measured.

APPENDIX III TABLE 2 WATER QUALITY OF YUKON RIVER AT DAWSON CITY, YUKON FOR JULY 10, 1985 (continued)

| STATION NUMBER | TOTAL PHOSPHATE (mg/L) | NITRITE (mg/L) | NITRATE (mg/L) | AMMONIA (mg/L) | NFR (mg/L) | FR (mg/L) | T.O.C. (mg/L) | T.I.C. (mg/L) |
|----------------|------------------------|----------------|----------------|----------------|------------|-----------|---------------|---------------|
| 1 | 0.45 | 0.005 | 0.04 | 0.013 | 221 | 121 | 8.0 | 18.0 |
| 2a | 0.62 | 0.008 | 0.02 | 0.013 | 419 | 114 | 9.0 | 18.0 |
| 2b | 0.62 | 0.008 | 0.03 | 0.012 | 507 | 111 | 9.0 | 18.0 |
| 3 | 0.64 | 0.018 | 0.02 | 0.017 | 612 | 118 | 10.0 | 18.0 |
| 4 | 0.11 | 0.006 | 0.03 | 0.037 | 140 | 117 | 7.0 | 14.0 |
| 5a | 0.11 | <0.005 | 0.03 | 0.038 | 126 | 135 | 7.0 | 14.0 |
| 6a | 0.65 | 0.015 | 0.04 | 0.016 | 473 | 138 | 9.0 | 18.0 |
| 7a | 0.64 | 0.108 | 0.03 | 0.015 | 601 | 133 | 12.0 | 20.0 |
| 8a | 0.36 | 0.008 | 0.03 | 0.009 | 358 | 129 | 6.0 | 18.0 |
| 9a | 0.75 | 0.009 | 0.04 | 0.016 | 517 | 136 | 8.0 | 18.0 |
| 10a | 0.60 | 0.009 | 0.03 | 0.015 | 558 | 141 | 8.7 | 19.0 |
| 11a | 0.52 | 0.007 | 0.04 | 0.014 | 475 | 126 | 7.0 | 18.0 |
| 12a | 0.60 | 0.010 | 0.02 | 0.017 | 542 | 145 | 12.0 | 18.0 |
| 12b | 0.44 | 0.010 | 0.02 | 0.021 | 462 | 123 | 7.0 | 18.0 |

APPENDIX III TABLE 2 WATER QUALITY OF YUKON RIVER AT DAWSON CITY, YUKON FOR JULY 10, 1984
 - EXTRACTABLE METALS (continued)

| STATION NUMBER | Al (mg/L) | As (mg/L) | Ba (mg/L) | Be (mg/L) | Ca (mg/L) | Cd (mg/L) | Co (mg/L) | Cr (mg/L) | Cu (mg/L) | Fe (mg/L) | Mg (mg/L) | Mn (mg/L) | Mo (mg/L) | Na (mg/L) |
|----------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| 1 | 3.69 | <0.05 | 0.114 | <0.001 | 44.2 | <0.002 | 0.023 | 0.006 | 0.011 | 5.87 | 9.5 | 0.217 | <0.005 | 2.2 |
| 2a | 3.68 | <0.05 | 0.117 | <0.001 | 50.3 | <0.002 | 0.028 | 0.006 | 0.013 | 6.53 | 10.3 | 0.257 | <0.005 | 2.4 |
| 2b | 4.82 | <0.05 | 0.128 | <0.001 | 51.7 | <0.002 | 0.035 | 0.007 | 0.017 | 7.94 | 10.6 | 0.288 | <0.005 | 2.7 |
| 3 | 6.50 | <0.05 | 0.156 | <0.001 | 65.1 | <0.002 | 0.048 | 0.014 | 0.025 | 10.80 | 12.7 | 0.398 | <0.005 | 3.2 |
| 4 | 0.51 | <0.05 | 0.098 | <0.001 | 26.4 | <0.002 | 0.005 | <0.005 | 0.006 | 1.26 | 6.5 | 0.058 | <0.005 | 1.7 |
| 5a | 0.67 | <0.05 | 0.099 | <0.001 | 25.9 | <0.002 | <0.005 | <0.005 | <0.005 | 1.42 | 6.4 | 0.056 | <0.005 | 1.6 |
| 6a | 5.04 | <0.05 | 0.130 | <0.001 | 50.8 | <0.002 | 0.034 | 0.010 | 0.015 | 7.92 | 10.6 | 0.279 | <0.005 | 2.7 |
| 7a | 4.32 | <0.05 | 0.131 | <0.001 | 60.9 | <0.002 | 0.037 | 0.009 | 0.018 | 8.39 | 11.5 | 0.345 | <0.005 | 2.5 |
| 8a | 3.67 | <0.05 | 0.113 | <0.001 | 44.3 | <0.002 | 0.023 | 0.006 | 0.011 | 5.84 | 9.5 | 0.212 | <0.005 | 2.2 |
| 9a | 5.79 | <0.05 | 0.144 | <0.001 | 62.1 | <0.002 | 0.041 | 0.011 | 0.018 | 9.86 | 12.2 | 0.363 | <0.005 | 2.7 |
| 10a | 6.00 | <0.05 | 0.148 | <0.001 | 63.3 | <0.002 | 0.042 | 0.010 | 0.019 | 10.30 | 12.4 | 0.377 | <0.005 | 2.9 |
| 11a | 5.52 | <0.05 | 0.140 | <0.001 | 55.8 | <0.002 | 0.036 | 0.010 | 0.016 | 8.78 | 11.4 | 0.313 | <0.005 | 2.7 |
| 12a | 6.65 | <0.05 | 0.167 | <0.001 | 66.2 | <0.002 | 0.042 | 0.011 | 0.019 | 10.70 | 13.6 | 0.395 | <0.005 | 3.3 |
| 12b | 10.10 | <0.05 | 0.153 | <0.001 | 61.4 | <0.002 | <0.005 | 0.012 | 0.020 | 10.10 | 12.4 | 0.361 | <0.005 | 3.0 |

APPENDIX III TABLE 2 WATER QUALITY OF YUKON RIVER AT DAWSON CITY, YUKON FOR JULY 10, 1984
 - EXTRACTABLE METALS (Continued)

| STATION NUMBER | Ni (mg/L) | P (mg/L) | Pb (mg/L) | Sb (mg/L) | Se (mg/L) | SI (mg/L) | Sn (mg/L) | Sr (mg/L) | TI (mg/L) | V (mg/L) | Zn (mg/L) |
|----------------|-----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------|-----------|
| 1 | <0.02 | 0.46 | <0.02 | <0.05 | <0.05 | 10.8 | <0.01 | 0.145 | 0.167 | 0.01 | 0.023 |
| 2a | <0.02 | 0.58 | <0.02 | <0.05 | <0.05 | 9.7 | <0.01 | 0.156 | 0.135 | 0.01 | 0.026 |
| 2b | <0.02 | 0.59 | <0.02 | <0.05 | <0.05 | 12.4 | <0.01 | 0.159 | 0.202 | 0.02 | 0.035 |
| 3 | <0.02 | 0.80 | <0.02 | <0.05 | <0.05 | 16.3 | 0.02 | 0.185 | 0.269 | 0.02 | 0.039 |
| 4 | <0.02 | 0.12 | <0.02 | <0.05 | <0.05 | 3.2 | <0.01 | 0.146 | 0.011 | <0.01 | 0.156 |
| 5a | <0.02 | 0.14 | <0.02 | <0.05 | <0.05 | 3.5 | <0.01 | 0.144 | 0.022 | <0.01 | 0.011 |
| 6a | <0.02 | 0.59 | <0.02 | <0.05 | <0.05 | 13.8 | <0.01 | 0.157 | 0.245 | 0.02 | 0.032 |
| 7a | <0.02 | 0.76 | <0.02 | <0.05 | <0.05 | 9.5 | 0.02 | 0.172 | 0.125 | 0.02 | 0.032 |
| 8a | <0.02 | 0.45 | <0.02 | <0.05 | <0.05 | 10.5 | <0.01 | 0.151 | 0.161 | 0.01 | 0.024 |
| 9a | <0.02 | 0.79 | <0.02 | <0.05 | <0.05 | 14.3 | <0.01 | 0.178 | 0.232 | 0.02 | 0.036 |
| 10a | <0.02 | 0.81 | <0.02 | <0.05 | <0.05 | 14.6 | 0.03 | 0.180 | 0.246 | 0.02 | 0.037 |
| 11a | <0.02 | 0.68 | <0.02 | <0.05 | <0.05 | 14.4 | <0.01 | 0.168 | 0.262 | 0.02 | 0.037 |
| 12a | <0.02 | 0.84 | <0.02 | <0.05 | <0.05 | 16.8 | <0.01 | 0.200 | 0.293 | 0.02 | 0.039 |
| 12b | <0.02 | 0.76 | <0.02 | <0.05 | <0.05 | 15.9 | <0.01 | 0.181 | 0.297 | 0.02 | 0.038 |

APPENDIX III TABLE 3 WATER QUALITY OF YUKON RIVER AT DAWSON CITY, YUKON FOR SEPTEMBER 13, 1984

| STATION NUMBER | DEPTH (m) | TEMP (°C) | IN SITU pH | LAB pH | IN SITU COND. (umhos/cm) | LAB COND. (umhos/cm) | DISSOLVED OXYGEN | COLOUR (colour units) | TURBIDITY (FTU) | T. ALK. (as CaCO ₃) (mg/L) | T. HARD. (as CaCO ₃) (mg/L) |
|----------------|-----------|-----------|------------|--------|--------------------------|----------------------|------------------|-----------------------|-----------------|--|---|
| 2a | 5.0 | 7.2 | 7.83 | 7.9 | 121 | 194 | 10.4 | 20 | 14.0 | 75.0 | 102.0 |
| 4 | N/S | N/S | N/S | 7.9 | N/S | 236 | N/S | 5 | 2.1 | 76.0 | 105.0 |
| 8a | 4.5 | 9.0 | 7.80 | 7.9 | 122 | 205 | 10.5 | 10 | 10.7 | 73.0 | 98.1 |
| 8c | 4.5 | 7.2 | 7.87 | 7.9 | 122 | 206 | 10.6 | 10 | 13.0 | 73.0 | 97.5 |
| 9a | 6.5 | 8.0 | 7.50 | 7.9 | 121 | 196 | 10.6 | 20 | 16.5 | 72.0 | 98.3 |
| 9c | 6.5 | 8.1 | 7.75 | 7.9 | 122 | 198 | 10.5 | 20 | 13.0 | 72.0 | 92.9 |
| 10a | 5.0 | 7.5 | 7.66 | 7.9 | 120 | 196 | 10.4 | 20 | 11.5 | 72.0 | 98.1 |
| 10c | 5.0 | 7.3 | 7.71 | 7.9 | 120 | 198 | 10.5 | 20 | 11.5 | 71.0 | 92.7 |
| 11a | 7.5 | 7.0 | 7.90 | N/S | 120 | N/S | 10.7 | N/S | N/S | N/S | N/S |
| 12a | 9.0 | 7.8 | 7.90 | N/S | 120 | N/S | 10.7 | N/S | N/S | N/S | N/S |
| 13a | 9.0 | 7.8 | 7.70 | N/S | 118 | N/S | 10.8 | N/S | N/S | N/S | N/S |
| 14 | 3.5 | 7.2 | 7.80 | 7.9 | 119 | 200 | 11.0 | 10 | 11.0 | 73.0 | 98.6 |
| 15 | 2.5 | 7.6 | 7.80 | 8.0 | 118 | 199 | 11.0 | 20 | 11.0 | 72.0 | 101.0 |
| 16 | 2.5 | 7.2 | 7.70 | 7.9 | 117 | 198 | 10.8 | 20 | 11.5 | 73.0 | 101.0 |
| 17 | 2.5 | 8.0 | 7.80 | 7.9 | 121 | 200 | 11.1 | 20 | 11.5 | 72.0 | 98.2 |
| 18 | 7.5 | 7.8 | 7.70 | 7.9 | 119 | 198 | 11.1 | 20 | 12.0 | 72.0 | 99.5 |
| 19 | 4.5 | 7.5 | 7.80 | 8.0 | 118 | 195 | 11.1 | 20 | 16.0 | 72.0 | 99.7 |

N/A - Not sampled.

APPENDIX III TABLE 3 WATER QUALITY OF YUKON RIVER AT DAWSON CITY, YUKON FOR SEPTEMBER 13, 1984 (continued)

| STATION NUMBER | SULPHATE (mg/L) | TOTAL PHOSPHATE (mg/L) | NITRITE (mg/L) | NITRATE (mg/L) | AMMONIA (mg/L) | NFR (mg/L) | FR (mg/L) | T.O.C. (mg/L) | T.I.C. (mg/L) |
|----------------|-----------------|------------------------|----------------|----------------|----------------|------------|-----------|---------------|---------------|
| 2a | 21 | 0.067 | <0.005 | 0.13 | 0.014 | 63 | 137 | 7.0 | 17.0 |
| 4 | 37 | 0.008 | <0.005 | 0.03 | 0.005 | <5 | 153 | 4.0 | 18.0 |
| 8a | 25 | 0.053 | <0.005 | 0.02 | 0.014 | 42 | 140 | 7.0 | 17.0 |
| 8c | 25 | 0.045 | <0.005 | 0.02 | 0.027 | 34 | 143 | 6.0 | 17.0 |
| 9a | 22 | 0.070 | <0.005 | 0.02 | 0.010 | 50 | 134 | 8.0 | 16.0 |
| 9c | 22 | 0.067 | <0.005 | 0.02 | 0.034 | 51 | 132 | 7.0 | 17.0 |
| 10a | 23 | 0.071 | <0.005 | 0.02 | 0.012 | 52 | 138 | 7.0 | 17.0 |
| 10c | 20 | 0.071 | <0.005 | 0.03 | 0.040 | 50 | 134 | 7.0 | 17.0 |
| 11a | N/S | N/S | N/S | N/S | N/S | N/S | N/S | N/S | N/S |
| 12a | N/S | N/S | N/S | N/S | N/S | N/S | N/S | N/S | N/S |
| 13a | N/S | N/S | N/S | N/S | N/S | N/S | N/S | N/S | N/S |
| 14 | 23 | 0.062 | <0.005 | 0.02 | 0.010 | 44 | 139 | 6.0 | 17.0 |
| 15 | 22 | 0.068 | <0.005 | 0.02 | 0.027 | 55 | 137 | 8.0 | 16.0 |
| 16 | 21 | 0.070 | <0.005 | 0.03 | 0.031 | 63 | 139 | 8.0 | 16.0 |
| 17 | 23 | 0.058 | <0.005 | 0.02 | 0.012 | 38 | 136 | N/S | N/S |
| 18 | 22 | 0.069 | <0.005 | 0.02 | 0.012 | 47 | 140 | N/S | N/S |
| 19 | 22 | 0.074 | <0.005 | 0.03 | 0.011 | 58 | 139 | N/S | N/S |

N/S - Not sampled.

APPENDIX III TABLE 3 WATER QUALITY OF YUKON RIVER AT DAWSON CITY, YUKON FOR SEPTEMBER 13, 1984
 - EXTRACTABLE METALS (Continued)

| STATION NUMBER | Al (mg/L) | As (mg/L) | B (mg/L) | Ba (mg/L) | Be (mg/L) | Ca (mg/L) | Cd (mg/L) | Co (mg/L) | Cr (mg/L) | Cu (mg/L) | Fe (mg/L) | Mg (mg/L) |
|----------------|-----------|-----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| 2a | 0.73 | <0.05 | 0.025 | 0.052 | <0.001 | 26.8 | <0.002 | <0.005 | <0.005 | <0.005 | 1.230 | 7.0 |
| 4 | 0.07 | <0.05 | 0.105 | 0.054 | <0.001 | 28.5 | <0.002 | <0.005 | <0.005 | <0.005 | 0.191 | 7.9 |
| 8a | 0.50 | <0.05 | 0.155 | 0.049 | <0.001 | 26.0 | <0.002 | <0.005 | <0.005 | <0.005 | 0.866 | 7.0 |
| 8c | 0.45 | <0.05 | 0.145 | 0.048 | <0.001 | 25.9 | <0.002 | <0.005 | <0.005 | <0.005 | 0.752 | 7.0 |
| 9a | 0.66 | <0.05 | 0.115 | 0.046 | <0.001 | 25.8 | <0.002 | <0.005 | <0.005 | <0.005 | 1.110 | 6.8 |
| 9c | 0.47 | <0.05 | 0.035 | 0.048 | <0.001 | 24.7 | <0.002 | <0.005 | <0.005 | <0.005 | 0.789 | 6.6 |
| 10a | 0.65 | <0.05 | <0.001 | 0.047 | <0.001 | 25.8 | <0.002 | <0.005 | <0.005 | <0.005 | 1.080 | 6.8 |
| 10c | 0.51 | <0.05 | 0.015 | 0.044 | <0.001 | 24.5 | <0.002 | <0.005 | <0.005 | <0.005 | 0.826 | 6.5 |
| 11a | N/S | N/S | N/S | N/S | N/S | N/S | N/S | N/S | N/S | N/S | N/S | N/S |
| 12a | N/S | N/S | N/S | N/S | N/S | N/S | N/S | N/S | N/S | N/S | N/S | N/S |
| 13a | N/S | N/S | N/S | N/S | N/S | N/S | N/S | N/S | N/S | N/S | N/S | N/S |
| 14 | 0.54 | <0.05 | <0.001 | 0.048 | <0.001 | 26.1 | <0.002 | <0.005 | <0.005 | <0.005 | 0.899 | 7.0 |
| 15 | 0.68 | <0.05 | <0.001 | 0.048 | <0.001 | 26.5 | <0.002 | <0.005 | <0.005 | <0.005 | 1.150 | 6.9 |
| 16 | 0.72 | <0.05 | <0.001 | 0.048 | <0.001 | 26.4 | <0.002 | <0.005 | <0.005 | <0.005 | 1.200 | 6.9 |
| 17 | 0.55 | <0.05 | 0.025 | 0.050 | <0.001 | 25.9 | <0.002 | <0.005 | <0.005 | <0.005 | 0.948 | 7.0 |
| 18 | 0.59 | <0.05 | 0.035 | 0.048 | <0.001 | 26.3 | <0.002 | <0.005 | <0.005 | <0.005 | 0.995 | 7.0 |
| 19 | 0.62 | <0.05 | 0.025 | 0.048 | <0.001 | 26.3 | <0.002 | <0.005 | <0.005 | <0.005 | 1.090 | 6.9 |

N/S - Not sampled.

APPENDIX III TABLE 3 WATER QUALITY OF YUKON RIVER AT DAWSON CITY, YUKON FOR SEPTEMBER 13, 1984
 - EXTRACTABLE METALS (Continued)

| STATION NUMBER | Mn (mg/L) | Mo (mg/L) | Na (mg/L) | NI (mg/L) | P (mg/L) | Pb (mg/L) | Sb (mg/L) | Se (mg/L) | SI (mg/L) | Sn (mg/L) | Sr (mg/L) | Ti (mg/L) | V (mg/L) | Zn (mg/L) |
|----------------|-----------|-----------|-----------|-----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------|-----------|
| 2a | 0.044 | <0.005 | 2.1 | <0.02 | 0.09 | <0.02 | <0.05 | <0.05 | 4.3 | 0.09 | 0.118 | 0.021 | <0.01 | 0.008 |
| 4 | 0.012 | <0.005 | 1.7 | <0.02 | <0.05 | <0.02 | <0.05 | <0.05 | 2.9 | 0.16 | 0.160 | <0.002 | <0.01 | 0.004 |
| 8b | 0.032 | <0.005 | 1.9 | <0.02 | 0.07 | <0.02 | <0.05 | <0.05 | 3.8 | 0.24 | 0.119 | 0.015 | <0.01 | 0.007 |
| 8 | 0.029 | <0.005 | 2.0 | <0.02 | 0.08 | <0.02 | <0.05 | <0.05 | 3.7 | 0.13 | 0.120 | 0.012 | <0.01 | 0.011 |
| 9 | 0.040 | <0.005 | 2.1 | <0.02 | 0.09 | <0.02 | <0.05 | <0.05 | 4.0 | 0.11 | 0.113 | 0.019 | <0.01 | 0.007 |
| 9 | 0.030 | <0.005 | 2.1 | <0.02 | 0.05 | 0.05 | <0.05 | <0.05 | 3.8 | 0.11 | 0.111 | 0.013 | <0.01 | 0.011 |
| 10 | 0.039 | <0.005 | 2.1 | <0.02 | 0.06 | <0.02 | <0.05 | <0.05 | 4.1 | 0.05 | 0.114 | 0.017 | <0.01 | 0.008 |
| 10 | 0.031 | <0.005 | 2.2 | <0.02 | 0.06 | 0.11 | <0.05 | <0.05 | 3.9 | 0.16 | 0.111 | 0.014 | <0.01 | 0.010 |
| 11 | N/S | N/S | N/S | N/S | N/S | N/S | N/S | N/S | N/S | N/S | N/S | N/S | N/S | N/S |
| 12 | N/S | N/S | N/S | N/S | N/S | N/S | N/S | N/S | N/S | N/S | N/S | N/S | N/S | N/S |
| 13 | N/S | N/S | N/S | N/S | N/S | N/S | N/S | N/S | N/S | N/S | N/S | N/S | N/S | N/S |
| 14 | 0.034 | <0.005 | 2.0 | <0.02 | 0.06 | <0.02 | <0.05 | <0.05 | 3.9 | 0.20 | 0.119 | 0.015 | <0.01 | 0.006 |
| 15 | 0.043 | <0.005 | 2.1 | <0.02 | 0.10 | <0.02 | <0.05 | <0.05 | 4.2 | 0.23 | 0.116 | 0.020 | <0.01 | 0.008 |
| 16 | 0.045 | <0.005 | 2.2 | <0.02 | 0.08 | 0.06 | <0.05 | <0.05 | 4.4 | 0.22 | 0.116 | 0.023 | <0.01 | 0.007 |
| 17 | 0.035 | <0.005 | 2.1 | <0.02 | 0.06 | <0.02 | <0.05 | <0.05 | 3.9 | 0.11 | 0.118 | 0.015 | <0.01 | 0.007 |
| 18 | 0.036 | <0.005 | 2.1 | <0.02 | 0.06 | <0.02 | <0.05 | <0.05 | 4.1 | 0.12 | 0.118 | 0.018 | <0.01 | 0.006 |
| 19 | 0.039 | <0.005 | 2.2 | <0.02 | 0.07 | <0.02 | <0.05 | <0.05 | 4.3 | 0.17 | 0.117 | 0.020 | <0.01 | 0.006 |

N/S - Not sampled.

APPENDIX III TABLE 4 WATER QUALITY OF YUKON RIVER AT DAWSON CITY, YUKON FOR MARCH 13, 1985

| STATION NUMBER | TEMP (°C) | IN SITU pH | LAB pH | IN SITU COND. (umhos/cm) | LAB COND. (umhos/cm) | DISSOLVED OXYGEN | COLOUR (colour units) | TURBIDITY (FTU) | T. HARD. (as CaCO ₃) (mg/L) | SULPHATE (mg/L) | CHLORIDE (mg/L) |
|----------------|-----------|------------|--------|--------------------------|----------------------|------------------|-----------------------|-----------------|---|-----------------|-----------------|
| 2a | 1 | 7.69 | 7.6 | 90 | 228 | 10 | <5 | 0.7 | 108 | 21 | 0.8 |
| 8a | 1 | 7.67 | 7.6 | 110 | 240 | 10 | <5 | 0.5 | 111 | 22 | 0.6 |
| 8b | N/A | N/A | N/A | N/A | 240 | N/A | <5 | 0.5 | 110 | 22 | 0.5 |
| 9c | 1 | 7.74 | 7.8 | 100 | 235 | 10 | <5 | 0.6 | 108 | 22 | 0.6 |
| 9a | N/A | N/A | N/A | N/A | 230 | N/A | <5 | 0.6 | 109 | 21 | 0.7 |
| 10a | 1 | 7.72 | 7.7 | 130 | 232 | 10 | <5 | 0.6 | 107 | 21 | 0.7 |
| 10b | N/A | N/A | N/A | N/A | 232 | N/A | <5 | 0.6 | 109 | 21 | 0.6 |
| 11a | 1 | 7.60 | 7.6 | 119 | 238 | N/A | <5 | 0.6 | 110 | 24 | 0.7 |
| 12a | 1 | 7.76 | 7.6 | 90 | 240 | N/A | <5 | 0.6 | 112 | 23 | 0.7 |
| 13a | 1 | 7.70 | 7.6 | 115 | 235 | N/A | <5 | 0.7 | 109 | 22 | 0.8 |

N/A - Not measured.

APPENDIX III TABLE 4 WATER QUALITY OF YUKON RIVER AT DAWSON CITY, YUKON FOR MARCH 13, 1985 (continued)

| STATION NUMBER | TOTAL PHOSPHATE (mg/L) | NITRITE (mg/L) | NITRATE (mg/L) | AMMONIA (mg/L) | NFR (mg/L) | FR (mg/L) | T.O.C. (mg/L) | T.I.C. (mg/L) |
|----------------|------------------------|----------------|----------------|----------------|------------|-----------|---------------|---------------|
| 2a | 0.021 | <0.005 | 0.09 | <0.005 | <5 | 144 | 6.0 | 21.0 |
| 8a | 0.034 | <0.005 | 0.10 | <0.005 | <5 | 150 | 8.0 | 18.0 |
| 8b | 0.004 | <0.005 | 0.10 | <0.005 | <5 | 145 | 6.0 | 20.0 |
| 9a | 0.002 | <0.005 | 0.10 | <0.005 | <5 | 151 | 7.0 | 18.0 |
| 9b | 0.004 | <0.005 | 0.09 | <0.005 | <5 | 143 | 6.0 | 19.0 |
| 10a | 0.004 | <0.005 | 0.09 | <0.005 | <5 | 145 | 5.0 | 20.0 |
| 10b | 0.003 | <0.005 | 0.10 | <0.005 | <5 | 141 | 8.0 | 18.0 |
| 11a | 0.005 | <0.005 | 0.12 | <0.005 | <5 | 148 | 6.0 | 16.0 |
| 12a | 0.007 | <0.005 | 0.11 | <0.005 | <5 | 146 | 7.0 | 17.0 |
| 13a | 0.004 | <0.005 | 0.10 | <0.005 | <5 | 146 | 7.0 | 17.0 |

APPENDIX III TABLE 4 WATER QUALITY OF YUKON RIVER AT DAWSON CITY, YUKON FOR MARCH 13, 1985
 - EXTRACTABLE METALS (Continued)

| STATION NUMBER | Al (mg/L) | As (mg/L) | B (mg/L) | Ba (mg/L) | Be (mg/L) | Ca (mg/L) | Cd (mg/L) | Co (mg/L) | Cr (mg/L) | Cu (mg/L) | Fe (mg/L) | Mg (mg/L) |
|----------------|-----------|-----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| 2a | <0.05 | <0.05 | <0.001 | 0.050 | <0.001 | 30.1 | <0.002 | <0.005 | <0.005 | <0.005 | 0.049 | 8.0 |
| 8a | <0.05 | <0.05 | <0.001 | 0.053 | <0.001 | 30.8 | <0.002 | <0.005 | <0.005 | <0.005 | 0.045 | 8.2 |
| 8b | <0.05 | <0.05 | <0.001 | 0.052 | <0.001 | 30.4 | <0.002 | <0.005 | <0.005 | <0.005 | 0.047 | 8.2 |
| 9a | <0.05 | <0.05 | <0.001 | 0.050 | <0.001 | 29.8 | <0.002 | <0.005 | <0.005 | <0.005 | 0.041 | 8.0 |
| 9b | <0.05 | <0.05 | <0.001 | 0.050 | <0.001 | 30.1 | <0.002 | <0.005 | <0.005 | <0.005 | 0.040 | 8.1 |
| 10a | <0.05 | <0.05 | <0.001 | 0.050 | <0.001 | 29.6 | <0.002 | <0.005 | <0.005 | <0.005 | 0.033 | 8.1 |
| 10b | <0.05 | <0.05 | <0.001 | 0.050 | <0.001 | 30.1 | <0.002 | <0.005 | <0.005 | <0.005 | 0.038 | 8.2 |
| 11a | <0.05 | <0.05 | <0.001 | 0.055 | <0.001 | 30.2 | <0.002 | <0.005 | <0.005 | <0.005 | 0.044 | 8.4 |
| 12a | <0.05 | <0.05 | <0.001 | 0.053 | <0.001 | 30.8 | <0.002 | <0.005 | <0.005 | <0.005 | 0.089 | 8.4 |
| 13a | <0.05 | <0.05 | <0.001 | 0.050 | <0.001 | 30.3 | <0.002 | <0.005 | <0.005 | <0.005 | 0.041 | 8.1 |

APPENDIX III TABLE 4 WATER QUALITY OF YUKON RIVER AT DAWSON CITY, YUKON FOR MARCH 13, 1985
 - EXTRACTABLE METALS (Continued)

| STATION NUMBER | Mn (mg/L) | Mo (mg/L) | Na (mg/L) | Ni (mg/L) | P (mg/L) | Pb (mg/L) | Sb (mg/L) | Se (mg/L) | Si (mg/L) | Sn (mg/L) | Sr (mg/L) | Tl (mg/L) | V (mg/L) | Zn (mg/L) |
|-------------------|--------------|--------------|--------------|--------------|-------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|-------------|--------------|
| 2a | 0.005 | <0.005 | 2.8 | <0.02 | <0.05 | <0.02 | <0.05 | <0.05 | 3.3 | <0.01 | 0.141 | <0.002 | <0.005 | 0.011 |
| 8a | 0.005 | <0.005 | 2.5 | <0.02 | <0.05 | 0.03 | <0.05 | <0.05 | 3.2 | <0.01 | 0.144 | <0.002 | <0.005 | 0.008 |
| 8b | 0.005 | <0.005 | 2.5 | <0.02 | <0.05 | <0.02 | <0.05 | <0.05 | 3.2 | <0.01 | 0.144 | <0.002 | <0.005 | 0.006 |
| 9a | 0.004 | <0.005 | 2.7 | <0.02 | <0.05 | <0.02 | <0.05 | <0.05 | 3.3 | <0.01 | 0.141 | <0.002 | <0.005 | 0.008 |
| 9b | 0.005 | <0.005 | 2.7 | <0.02 | <0.05 | 0.03 | <0.05 | <0.05 | 3.3 | <0.01 | 0.142 | <0.002 | <0.005 | 0.007 |
| 10a | 0.004 | <0.005 | 2.8 | <0.02 | <0.05 | <0.02 | <0.05 | <0.05 | 3.3 | <0.01 | 0.143 | <0.002 | <0.005 | 0.006 |
| 10b | 0.004 | <0.005 | 2.8 | <0.02 | <0.05 | <0.02 | <0.05 | <0.05 | 3.3 | <0.01 | 0.143 | <0.002 | <0.005 | 0.006 |
| 11a | 0.005 | <0.005 | 2.6 | <0.02 | <0.05 | <0.02 | <0.05 | <0.05 | 3.2 | <0.01 | 0.149 | <0.002 | <0.005 | 0.006 |
| 12a | 0.008 | <0.005 | 2.7 | <0.02 | <0.05 | 0.09 | <0.05 | <0.05 | 3.3 | <0.01 | 0.145 | <0.002 | <0.005 | 0.008 |
| 13a | 0.004 | <0.005 | 2.7 | <0.02 | <0.05 | <0.02 | <0.05 | <0.05 | 3.3 | <0.01 | 0.141 | <0.002 | <0.005 | 0.008 |

APPENDIX IV

WATER QUALITY CRITERIA FOR
DRINKING WATER AND AQUATIC LIFE

APPENDIX IV TABLE 1 WATER QUALITY CRITERIA FOR DRINKING WATER AND AQUATIC LIFE

| SUBSTANCE | RECOMMENDED LEVEL(S) FOR DRINKING WATER | REFERENCE(S) | RECOMMENDED LEVEL(S) FOR AQUATIC LIFE | REFERENCE(S) |
|---|--|--------------|---|--------------|
| Alkalinity mg/l (Total) | Not considered a public health problem | 4 | >20 | 3 |
| Aluminum (Al) mg/l | Not considered a public health problem | 7 | 0.1 | 5 |
| Ammonia (NH ₃ -N) mg/l | 0.5 | 4 | 0.02 | 3 |
| Arsenic (As) mg/l | 0.05 | 1 | 0.05 | 2 |
| Barium (Ba) mg/l | 1.0 | 1 | 5.0 | 7 |
| Cadmium (Cd) mg/l | 0.005 | 1 | 0.0002 | 2 |
| Calcium (Ca) mg/l | 75-200 | 7 | | |
| Chloride (Cl) mg/l | 250 | 1 | | |
| Chromium (Cr) mg/l | 0.05 | 1 | 0.04 | 2 |
| Colour Pt. Counts | 15 | 1 | | |
| Conductivity @ 25°C (umhos/cm) | Depends on dissolved salts | 7 | 150-500 | 6 |
| Copper (Cu) mg/l | 1.0 | 1 | 0.005 | 5 |
| Dissolved oxygen (% saturation) | Near 100% | 4 | <u>>5.0 mg/l</u> | 3 |
| Hardness (Total) as mg/l CaCO ₃ | 80-100 | 1 | | |
| Iron (Fe) mg/l | 0.3 | 1 | 1.0 | 3 |
| Lead (Pb) mg/l | 0.05 | 1 | 0.005 (soft H ₂ O*) 0.01 (hard H ₂ O*) | 2 2 |
| Magnesium (Mg) mg/l | 50 | 4 | | |
| Manganese (Mn) mg/l | 0.05 | 1 | 1.0 | 7 |
| Nickel (Ni) mg/l | 0.25 | 2 | 0.025 (soft H ₂ O*) 0.25 (hard H ₂ O*) | 2 2 |
| Nitrate (NO ₃ -N) mg/l | 10 | 1 | | |
| Nitrite (NO ₂ -N) mg/l | 0.001 | 1 | | |
| pH units | 6.5 - 8.5 | 1 | 6.5 - 9.0 | 3 |
| Phosphorus (P) mg/l (Total) | | | 0.020 to prevent algae | 5 |

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

| SUBSTANCE | RECOMMENDED LEVEL(S) FOR DRINKING WATER | REFERENCE(S) | RECOMMENDED LEVEL(S) FOR AQUATIC LIFE | REFERENCE(S) |
|--|--|--------------|--|--------------|
| Residue: Filterable mg/l (Total dissolved solids) | 1000 | 4 | 70 - 400 with a maximum of 2000 | 6 |
| Selenium (Se) mg/l | 0.01 | 1 | 0.01 | 2 |
| Silver (Ag) mg/l | 0.05 | 1 | 0.0001 | 2 |
| Sodium (Na) mg/l | 20 | 1 | | |
| Strontium (Sr) mg/l | 10 | 1 | | |
| Sulphate (SO ₄) mg/l | 500 | 1 | | |
| Tin (Sn) mg/l | Not present in natural waters | 7 | | |
| Turbidity J.T.U. | 5 | 1 | | |
| Zinc (Zn) mg/l | 5.0 | 1 | 0.030 | 5 |
| * Soft water has a total hardness less than 95 mg/l as CaCO ₃ . Hard water has a total hardness of more than 95 mg/l as CaCO ₃ (Reference 6). | | | | |
| REFERENCES: | | | | |
| 1. Health & Welfare Canada, <u>Guidelines for Canadian Drinking Water Quality 1978</u> , Supply and Services, Canada (1979). | | | | |
| 2. Inland Waters Directorate, <u>Guidelines for Surface Water Quality</u> , Vol. 1, Inorganic Chemical Substances. Environment Canada, Ottawa (1979, 1980). | | | | |
| 3. Thurston, R.V., R.C. Russo, C.M. Fetteroff Jr., T.A. Edsall, and Y.M. Barber Jr. (Eds.), <u>A Review of the EPA Red Book: Quality Criteria for Water</u> . Water Quality Section, American Fisheries Society, Bethesda, MD, 313p. (1979). | | | | |

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

| SUBSTANCE | RECOMMENDED LEVEL(S) FOR DRINKING WATER | REFERENCE(S) | RECOMMENDED LEVEL(S) FOR AQUATIC LIFE | REFERENCE(S) |
|-----------|---|--------------|--|--------------|
| 4. | Anonymous, <u>Guidelines for Establishing Water Quality Objectives for the Territorial Waters of the Yukon and Northwest Territories</u> . Report of the Working Group on Water Quality Objectives to the Chairmen, Water Boards, Yukon and Northwest Territories, July (1977). | | | |
| 5. | Ontario Ministry of the Environment, <u>Water Management - Goals, Policies, Objectives and Implementation Procedures of the Ministry of the Environment</u> . (1978). | | | |
| 6. | Environment Canada, <u>Pollution Sampling Handbook</u> . Pacific Region Laboratory Services, Fisheries Operations and Environmental Protection Service, West Vancouver, B.C. (1976). | | | |
| 7. | California State Water Resources Control Board, <u>Water Quality Criteria</u> . Publication No. 3-A Second Edition by McKee and Wolf. (1963) | | | |