# PROPOSAL FOR

# OCEANOGRAPHIC STUDY OF SEWAGE DISCHARGE IN KUGMALLIT BAY NEAR TUKTOYAKTUK, NORTHWEST TERRITORIES

Prepared for

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## 1.0 PROJECT PROPONENTS

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Role: Project manager and advisor (See Appendix A).

Hamlet of Tuktoyaktuk, NWT
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Role: Funding body and local resource provider.

Environmental Protection Branch, Environment Canada, Yellowknife
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Role: Funding in kind agency and advisor (See Appendix A).

EBA Engineering Consultants Ltd., Edmonton, AB
Ken Johnson, M.A.Sc., P.Eng., Environmental Engineer
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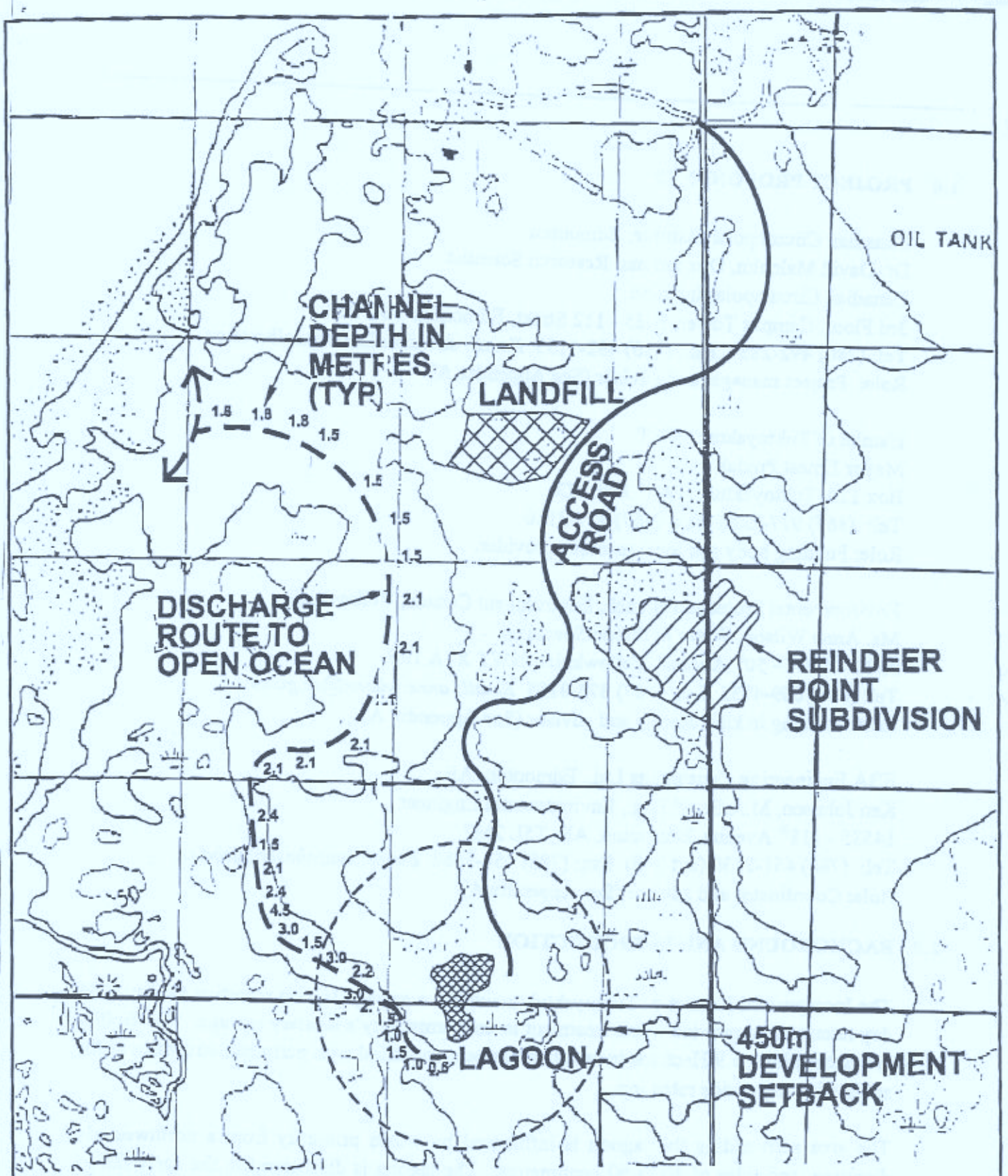
Role: Coordinator and advisor (See Appendix A).

## 2.0 BACKGROUND AND INTRODUCTION

The Incorporated Hamlet of Tuktoyaktuk maintains a sewage lagoon retention facility (365 day retention) to provide waste treatment to the community's sanitary sewage. The facility is a natural lake, 5.9 Hectares in area that has been modified with perimeter structures at the south edge to provide retention.

The area surrounding the lagoon is influenced by winds primarily from a northwesterly direction, and tides of 30 to 60 centimetres. The lagoon is discharged in the early fall of each year to a saltwater inlet. The lagoon is 3.0 kilometres southeast from the open ocean, and approximately 6.5 kilometres from the ocean by way of the inlet, which varies in depth from 1 metre to 4 metres.




**EBA Engineering Consultants Ltd.**

# TUKTOYAKTUK, NWT
## SEWAGE LAGOON LOCATION

FILE: 5512-003-00-02 DATE: AUG 21, 2000
DWG: LAGN-MAP.DWG BY: GH FCR: KRJ

N

0 250 500 750m
250 SCALE 1:25,000

The lagoon operates under the following water licence parameters:

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|---|---|
| Effluent BOD5 | 120 mg/L |
| Effluent Suspended Solids | 180 mg/L |
| Effluent pH | 6 to 9 |

The sewage lagoon is estimated to have a capacity to serve a population of 1900, depending upon the level of commercial and industrial activity that occurs in the future.

The sewage lagoon seasonal discharge point is located at a constructed berm area at the south edge of the lagoon. The lagoon is discharged into the adjacent ocean inlet in the fall of each year using a temporary pumping system set up on top of the berm.

## 3.0 PROJECT OBJECTIVES

Although the lagoon technology is appropriate for the Hamlet of Tuktoyaktuk, and the lagoon performance is good, some concern remains about the environmental impacts and potential public health impact of the seasonal effluent discharge. This concern is expressed in the Water Licence with the requirement to complete an assessment of Kugmallit Bay, and specifically those waters immediately adjacent to the seasonal discharge point.

A limited study was completed in 1994 looking at habitat relating to fish and benthic organisms. Although this available information on this study did not present any conclusions, the information suggests that in spite of the sewage discharge, a substantial fish population lives within the area potentially influenced by the seasonal sewage discharge.

The Canadian Circumpolar Institute, with the assistance of EBA Engineering Consultants Ltd., and the support of the Hamlet of Tuktoyaktuk, and Environment Canada is proposing a research program to build upon this limited body of site specific knowledge. The organization of the program will provide an interaction with DFO staff in the north, an advancement to fisheries knowledge, and training to a graduate student. The program will also take advantage of the existing site specific knowledge base of EBA (Ken Johnson, M.A.Sc., P.Eng.) to provide an efficient and effective field program, and a relevant report at the conclusion of the program. The proposed program is to include components of water quality assessment, and habitat assessment.

## 4.0 LITERATURE REVIEW

A report by Stanley Associates Engineering (Sewage Waste Disposal to the Arctic Marine Environment. Stanley Associates Engineering Ltd., 1987) suggests a number of potential impacts of an sewage discharge to the ocean, including a decrease of dissolved oxygen; an accumulation of particulate organic matter in the sediments; an increase in the nutrient level of the waters; a toxicity of sewage effluent to marine organisms; and a presence of micro-organisms that may pose a human health concern.

The decrease in dissolved oxygen from the breakdown of sewage effluent organics may affect the benthic species, cause changes in fish behaviour, or in some cases fish kills. The accumulation of particulate organic matter on benthic communities may alter benthic communities, and affect benthic-pelagic trophic relationships. A sewage effluent discharges may increase the nutrient level of the nearby waters thereby stimulating plant growth. The ammonia in sewage effluent may be toxic to fish depending upon the effluent concentration and the effluent dispersion; sewage wastes may also contain trace metals, PCBs, pesticides and other contaminants. The very low temperatures of the Arctic increase the survival of micro-organisms, including potential pathogenic species. Areas that may be used for traditional fishing and shell fish harvesting may be impacted by the survival of pathogenic organizations.

For the most part, the environmental impacts of sewage effluents on the Arctic marine environment must rely primarily on results extrapolated from other marine in located in temperate zones. There is a need to better evaluate the impacts imposed by the Arctic's unique characteristics, particularly in the Beaufort regions relatively shallow waters, low ambient water temperatures, low velocity currents, and seasonal solid ice.

Johnson suggested (Tuktoyaktuk Sewage Lagoon – Condition Assessment Report prepared by Ken Johnson, M.A.Sc., P.Eng., UMA Engineering Ltd. September 30, 2000.) that the effluent quality of the seasonal discharge from the Tuktoyaktuk sewage lagoon would be expected to fall within the range of secondary treatment. Suspended Solids and Biochemical Oxygen Demand (5 day) reduction would be in the range of 100 mg/L for Suspended Solids and 50 mg/L for Biochemical Oxygen Demand. This performance was confirmed in the effluent data collected upon discharge in 1999. The average Suspended Solids was 87 mg/L (4 samples), and the average Biochemical Oxygen Demand (5 day) was 39 mg/L (2 samples). These effluent measures are well below the water licence requirements.

Johnson also reported that the average ammonia nitrogen for these same samples was 1.2 mg/L (4 samples), and the fecal coliforms were in the range of less than 4 to 400

Coliform Forming Units (CFU) per 100 mL. Both of these average values represent significant reductions from the values which may be expected in raw sewage.

A study by Seaconsult (Dye Dispersion Study of the Marine Wastewater Discharge Near the Town of Iqaluit, NWT. Seaconsult Marine Research Ltd., 1992 - Report prepared for Ken Johnson, M.A.Sc., P.Eng., UMA Engineering Ltd.) found the dispersion of a dyed effluent discharge into Koojesse Inlet to be relatively slow under the wind condition encountered during the survey. The dye was confined to the head of Koojesse Inlet by the up inlet wind, and it was not flushed out of the inlet at low tide, but rather moved up and down the foreshore flats with the tide. The net circulation was weak and the residence time was of the order of several days.

A simple model was used to extrapolate the results from the batch dye injection to continuous discharge situation. The predicted dilution at the mouth of Koojesse Inlet (3 km distant) is approximately 1:500. These dilutions factors were applied to the fecal coliform concentrations and BOD value measured in samples of the lagoon effluent. The fecal coliform concentration in the surface waters of Koojesse Inlet was estimated to be less than 1000 CFU/dL at a distance of 620 m from the point of entry .BOD appeared to be a less critical parameter than fecal coliforms.

Stanley et al (Site Investigation of the Rankin Inlet, NWT, Wastewater Marine Outfall. S.J. Stanley, D.W. Smith, and G D. Milne, 1991) undertook a study of the Rankin Inlet sewage discharge involving the slug injection of a conservative dye-tracer followed by measurements of dye concentrations in the Johnston Cove sewage discharge. The test found that detectable levels of dye were still present in the cove for 4 days after the injection. Using the results of the dye-tracer test, an algorithm showed that the vast majority of the dilution of the wastewater results from tidal fluctuations in the water level.

Bacteriological sampling found that the average fecal coliform concentration in the Cove was over 4000 organisms/100mL. It was also found that the combination of cold temperatures and ice cover result in significant indicator organism survival.

## 5.0 METHODOLOGY

The study program will be undertaken by a student at either the Master's level or the honor's thesis level.

The study program would focus on fish habitat and influences related to this. The study program would be undertaken in the open water season, in and around the time of the yearly sewage effluent discharge from the lagoon.

Measurements will be made of the effluent quality upon discharge, and the channel quality before, during, and after discharge. Water samples would be tested for nutrients, metals, solvents, and bacteriological parameters. Sediment samples would be tested for nutrients and metals. Observations will be made for fish productivity, and some benthic and periphyton surveys will be undertaken.

Some Traditional Knowledge will be collected as well to find out local fish use.

## 6.0 PROJECT BUDGET

The proposed budget for this study is estimated to be $30,000, with allotments to the following activities.

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| Field Program by Student | $21,000 |
| Analysis | $ 7,500 |
| Report Preparation (Student,CCI;EBA) | $ 2,000 |
| Project Management and Administration (CCI) | $ 4,000 |
| Project Coordination and Consultation (EBA) | $ 3,000 |
| TOTAL | $37,500 |

The funding sources would be as follows:

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|---|---|
| DFO Subvention Research Grant | $15,000 |
| Canadian Circumpolar Institute (through funding mechanisms) | $ 5,000 |
| Hamlet of Tuktoyaktuk (direct funding and funding in kind) | $10,000 |
| Environment Canada (funding in kind) | $ 7,500 |
| TOTAL | $37,500 |

## 7.0 PROJECT SCHEDULE

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|---|---|
| Field program | Three weeks in September, 2002 |
| Analysis | October, 2002 |
| Report preparation | November, 2002 to February, 2003 |