National Inuit Position Paper regarding the CCME Canada-Wide Strategy for the Management of Municipal Wastewater Effluent and Environment Canada's Proposed Regulatory Framework for Wastewater

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INUIT TAPIRIIT KANATAMI

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Prepared for the Inuit Tapiriit Kanatami by

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Introduction

The Inuit Tapiriit Kanatami (ITK) and the communities of the four Inuit regions of Canada have completed a review of the Canada-wide Strategy for Management of Municipal Wastewater Effluent and Environment Canada's Proposed Regulatory Framework for Wastewater that aim to address the harmful impacts of wastewater discharges on public health and the environment. A fundamental concern with the Strategy and the Proposed Regulatory Framework comes in the geographic and cultural bias that is inherent to the process of advancing from principles to practices in the proposed "roll out" of the Strategy as well as the Proposed Regulatory Framework.

ITK acknowledges that some consideration is being given to northern Canada in the implementation of the strategy through a series of incremental steps that may ultimately employ a timeline of up to 30 years. However, significant deficiencies exist in the fundamental research that is the basis to the criteria that are being applied to these increments, particularly in how these criteria relate to the Inuit communities of northern Canada. Advances in the basis for developing a Canada-wide Strategy for Management of Municipal Wastewater Effluent with relevance to the regions occupied by Inuit must be made on the basis of science, applied science (engineering) and social science (habits, attitudes and social patterns of the residents of the community – Reference: Hydromantis Inc., January, 2006, page 55).

Any solutions to the waste management challenges in northern communities must also be benchmarked against the "best appropriate technology", which is a term that describes the technical and operational differences encountered in the north. Those systems which are technologically simple and engineered for sufficient capacity tend to perform well. Problems appear to be linked with undersized systems, maintenance deficiencies, and poor operational practices (Reference: Johnson and Wilson, 1999).

Representatives from ITK and the regional Inuit land claims organizations were invited by Environment Canada to consultation meetings on the strategy in various locations. Participation by the Inuit regional representatives and ITK at several of the meetings may be considered adequate by Environment Canada. However, overall the consultation process was highly deficient regarding the representation, timelines, and financial support.

The regional Inuit land claims organizations and ITK have responded to the present consultation opportunity to the best of their ability given the limited funding and an extremely short time period provided by Environment Canada. However, the short timeframe prevented ITK and the regional Inuit land claims organizations from meeting internal consultation requirements, and limited direct consultation within the other regional organizations, and the Inuit communities themselves. As a result of these deficiencies ITK, the regional Inuit land claims organizations, and the Inuit communities reserve the right to change conclusions at any time, particularly after the draft regulations have been made public. From an Inuit perspective, the consultation process has been inadequate and has not fulfilled the Crown's duty to consult.

Under the various regional agreements, the Government of Canada, the Provinces, and the Territories are required to consult in a meaningful way with the Inuit of Canada when making decisions that affect them. The insufficient consultation timeframe illustrates a lack of consideration

for the constraints in the northern context, and the consultation obligations of the Government of Canada and the CCME.

Regions and Communities

There are approximately 41,000 Inuit in Canada, with the majority living in one of 53 communities in the four self-governing Inuit regions in the north (See Figure 1). The Inuit regions are the Inuvialuit Settlement Region of the Northwest Territories, the Nunavut Territory, the Nunavik region of Quebec, and the Nunatsiavut region of Newfoundland and Labrabour.

Inuvialuit Settlement Region

The Inuvialuit Settlement Region is located in the northwestern part of the Northwest Territories. The Inuit population is approximately 5,000 living in the mainland communities of Inuvik, Aklavik, Tuktoyaktuk, and Paulatuk and the two island communities of Sachs Harbour (Banks Island) and Holman (Victoria Island). Inuvik is the administrative centre for the region and has a total population of 3,400 of which 1/3 are Inuvialuit. Inuvik is the only Inuit community in Canada that has an all season connecting road to the south; the communities of Tuktoyaktuk and Aklavik have only a seasonal ice road. The communities of Sachs Harbour, Ulukhaktok, and Paulatuk continue to rely solely upon air and marine connections for transportation and supplies.

Nunavut

Nunavut has an Inuit population of approximately 23,000 people living in the regions of Qikiqtani (eastern region), Kivalliq (central region), and the Kitikmeot (western region). The territory's twenty-six communities generally have populations of around 1,000 or less. The regional administrative centres of Cambridge Bay in Kitikmeot, and Rankin Inlet in Kivalliq, have populations of 1,300 and 2,700 respectively. The territorial capital, Iqaluit, is the largest community with a population of over approximately 6,000. The primary method of transportation between the communities and the south is via air and marine vessels.

Qikiqtani Region of Nunavut

The Qikiqtani region is located at the eastern part of Nunavut and includes Baffin Island, the eastern High Arctic Islands, and the Belcher Islands. The Inuit population of the region is approximately 12,000 living in 13 coastal communities: Iqaluit, Kimmirut, Cape Dorset, Hall Beach, Igloolik, Arctic Bay, Resolute Bay, Pond Inlet, Grise Fiord, Clyde River, Qikitarjuaq, Pangnirtung, and Sanikiluaq.

Figure 1. Inuit Regions of Canada

Kivalliq Region of Nunavut
The Kivalliq region lies on the western coast of Hudson Bay and includes Southampton Island. Just over 6,000 Inuit live in seven communities: Rankin Inlet, Repulse Bay, Chesterfield Inlet, Baker Lake, Coral Harbour, Whale Cove and Arviat.

Kitikmeot Region of Nunavut
The westernmost region of Nunavut has an Inuit population of 4,000 and includes the Boothia Peninsula and Victoria Island. The communities are Cambridge Bay, Kugluktuk, Umingmaktuuq, Bathurst Inlet, Taloyoak, Gjoa Haven and Kugaaruk.

Nunavik Region
The region of Nunavik lies north of the 55th parallel in the province of Quebec. Nearly 10,000 Inuit call Nunavik home and live in 14 communities including: Kangiqsualujjuaq, Tasiujaq, Aupaluk, Kangirsuk, Quaqtaq, Kangirsujuaq, Salluit, Ivujivik, Akulivik, Puvirnituq, Inukjuak, Umiujaq, and Kuujjuarapik. Kuujjuaq is the regional administrative centre with a population of approximately 2,300 residents. With a lack of roads connecting the communities, the primary method of transportation between them and the south is via air and marine vessels.

Nunatsiavut Region
Approximately 5,200 Inuit inhabit the five northernmost coastal communities of Labrador and the more southern communities of Happy Valley-Goose Bay, Northwest River, and Mud Lake. The coastal communities are Nain, Hopedale, Postville, Makkovik and Rigolet. Nain, with a population of 1,200, is the administrative centre for the northern coastal region. The primary method of transportation between the communities and the south is via air and marine vessels.

Northern communities and Inuit communities in particular, are unique in their "built environment" (See Figure 2). The communities have no road access (with the exception of three communities of the Inuvialuit region), limited access by water (during the ice free season), and year round access by aircraft only. The proximity of the various components of infrastructure creates unique interactions.

The size of the majority of the Inuit communities is "very small" with daily wastewater flows of less than 500 m3/day (Reference: Environment Canada, October 2007, page 8). The populations vary from the largest community of Iqaluit (population of 6000) in Nunavut, to the smallest communities, of Sachs Harbour, Inuvialuit Region, Grise Fiord, Nunavut Territory, Aupaluk, Nunavik Region each with populations less than 200 people. [1]

Climate, Geography and Terrain
The climate in the communities of each of the four Inuit regions is extremely cold, with the average yearly temperatures less than zero degrees C. The warmest average yearly temperate in the four regions occurs in Nunatsiavut region with a temperature of -3 C in Nain. The mean daily temperatures in July range from 5 to 10 C in the Inuvialuit Settlement Region, 5 to 10 C in Nunavut, 5 to 10 C in Nunavik and in the range of 5 to 15 C in Nunatsiavut (See Figure 3.)

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[1] ***FOOTNOTE***: *The population of 1000 associated with a "very small" system is defined by the typical waste generation for a piped system (500 L/c/d), not a trucked system which is most commonly used in Inuit communities; based on a per capita waste generation of 90 L/c/d, a "very small" community may have a population of 5500 people.*

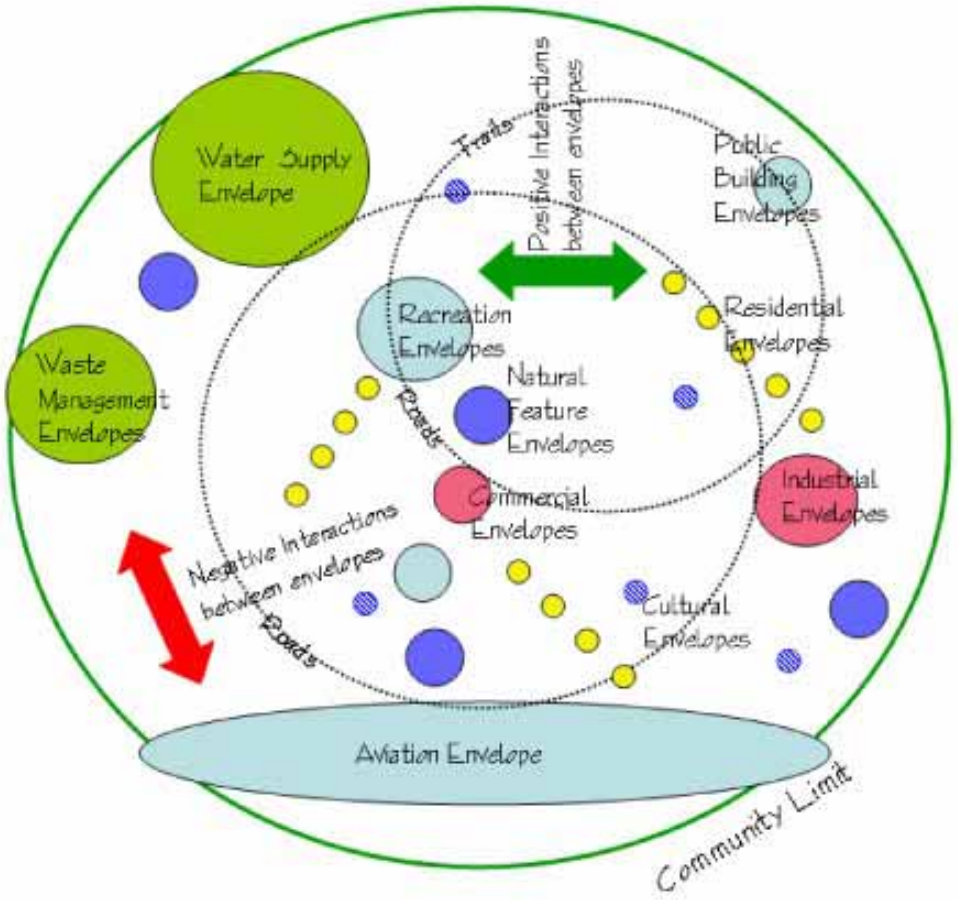

Figure 2. Physical Constraints in Inuit Communities

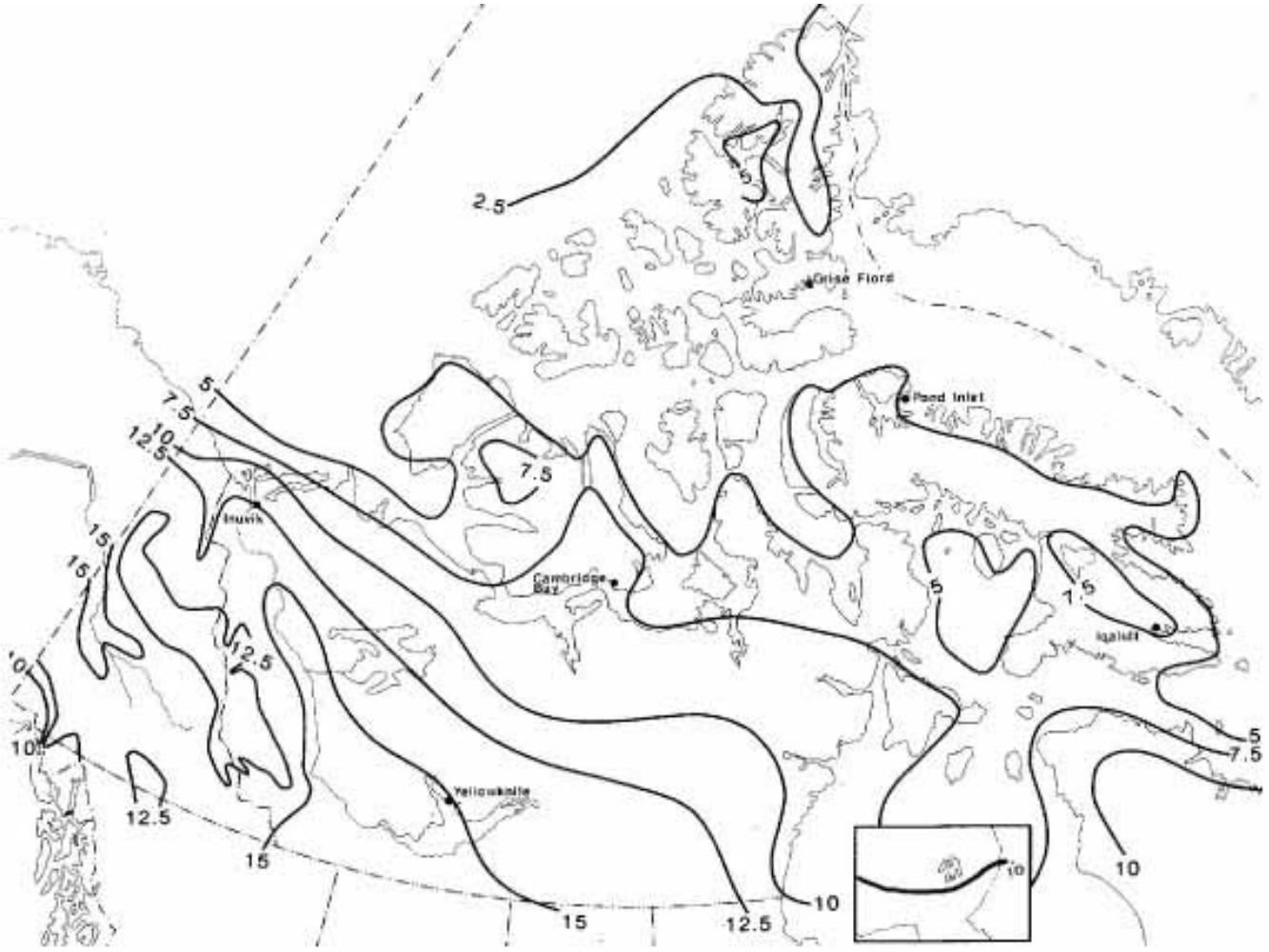

Figure 3. Mean Daily July Temperatures

The extremely cold weather may be described further by the number of frost free days in the communities (See Table 1).

Table 1. Average Yearly Frost Free Days for Select Inuit Communities

Region	Community	Average Yearly Frost Free Days
Inuvialuit	Sachs Harbour	57
Inuvialuit	Inuvik	107
Nunavut	Resolute	40
Nunavut	Rankin Inlet	102
Nunavik	Kuujjuaq	115
Nunatsiavut	Nain	126

The geography of the communities in the Inuit regions generally creates great distances between the individual communities themselves, and between the communities and major centres further south. The traditional activities of the Inuit and the development of permanent settlements have placed all but three of the communities along the mainland or arctic island coasts.

The majority of the terrain in the Inuit regions of Canada is Canadian Shield, with smaller regions of Interior Plains and Arctic Lowlands (See Figure 4). The Inuvialuit Settlement Region is primarily interior plains with a small area of Arctic coastal Plain. Nunavut consists of Canadian Shield and Interior Plains and Arctic Lowlands; the Kivalliq and Qikiqtani Regions are Canadian Shield terrain, and the Kitikmeot region is and Arctic Lowlands. Nunavik and Nunatsiavut are located in the Canadian Shield.

Socio-Economics

Inuvialuit Settlement Region

The Inuvialuit Region is a government region of the Northwest Territories; the government of the Northwest Territories (GNWT) is the senior government responsible for the delivery of services. Locally elected community councils oversee the administration and delivery of a wide variety of services to the hamlet residents in addition to the services delivered by the GNWT. The main employment in the Inuvialuit region is government related, however significant economic development has been provided by oil and gas activities.

Nunavut

The Government of Nunavut has an elected territorial legislature representing 23 electoral districts. The legislative assembly operates as a consensus government; therefore the premier is elected by the members of the legislature.

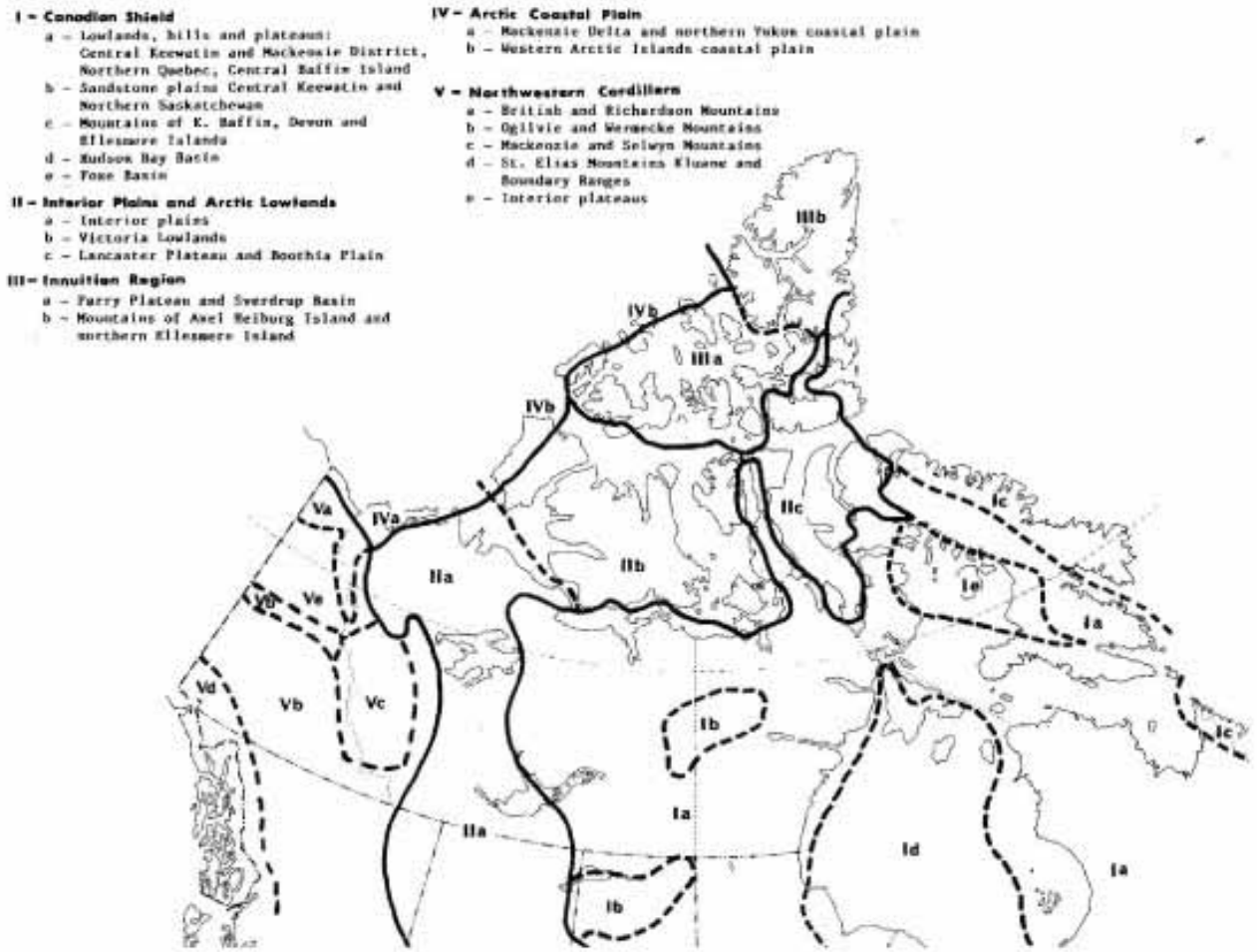

Figure 4. Terrain in Inuit Regions of Canada

Qikiqtani Region of Nunavut
The economy of the region is based upon renewable resource harvesting including a commercial inshore and offshore fishery, arts and crafts, tourism, and the public and service sectors. The public sector is a major employer in the region.

Kivalliq Region of Nunavut
Renewable resource harvesting is a primary economic activity and includes a caribou and arctic char processing plant. Tourism has grown substantially in the region and there is some growing interest in mineral exploration as well. The public sector is a major employer in the region.

Kitikmeot Region of Nunavut
As well as renewable resource harvesting such as a commercial char fishery and musk ox harvest, the region has considerable mineral wealth that is in the process of being explored and developed. The public sector is a major employer in the region.

Nunavik Region
Renewable resource harvesting, the Xtrata nickel mine, tourism, the public sector, transportation and the service industry are all important elements of the regional economy. Each community has its local administration provided by municipal councils as established by the Northern Village Corporation. Each Northern Village is part of the Kativik Regional Authority that oversees the administration of the region. The Kativik Regional Government is responsible for the delivery and coordination of municipal infrastructures and services, manpower and training, environmental issues and the coordination of economic policy.

Nunatsiavut Region
Locally elected Inuit community councils oversee functions and the provision of services to the municipalities. Harvesting of land and sea resources continues to be an economic mainstay of the region with government employment, fishing, and the service industry being primary employers. The Voisey's Bay nickel deposit has greatly increased the economic activity of the region.

Existing Wastewater Technology, Performance, Cost and Operations

Only three of the 53 Inuit communities, namely Rankin Inlet, Pangnirtung, and Iqaluit, use mechanical sewage systems. The system in Rankin Inlet is preliminary treatment to remove large solids by screening. The system in Pangnirtung is secondary treatment using a rotating biological contactor. The system in Iqaluit has preliminary and primary treatment for the removal of solids by screening. Although designs for secondary treatment systems have been completed in Rankin Inlet and Iqaluit, construction of the advanced systems has not yet been authorized. All of these mechanical systems have significant operating challenges.

Historically, all of the mechanical systems used in Inuit communities have failed at one point or another and communities have fallen back on the use of the simpler technologies of wastewater detention or retention (lagoon systems) (Reference: Johnson and Wilson, 1999).

Most of the remaining communities use lagoon systems which are either detention or retention ponds. Detention ponds provide a continuous discharge, and retention ponds provide a periodic discharge. Overall these systems tend to perform well because of the simple technology, although there are problems with undersized systems, maintenance deficiencies and poor operation practices

(Reference: Johnson and Wilson, 1999). The five communities of Nunatsiavut directly discharge sewage into the ocean without any sewage treatment.

Johnson and Wilson (1999) reported that lagoons and natural lakes perform reasonably well. The limited data suggested a Biochemical Oxygen Demand (BOD) reduction in the range of 87 to 96 percent (BOD less than 150 mg/L and as low as 11 mg/L), Total Suspended Solids (TSS) reduction in the range of 90 to 93 percent (TSS less that 80 mg/L and as low as 5 mg/L) and fecal coliform reduction in the range of 2 to 4 logs (fecal coliforms less than $2x10^6$ and as low as $3x10^1$). The influent sewage was estimated to be 600 mg/L BOD, 725 mg/L SS, and 10^7 coliforms/100 mL.

Dillon (2006) reported effluent BOD less than 150 mg/L, and as low as 6 mg/L, and TSS less than 180 mg/L and as low as 7 mg/L.

The capital cost of lagoon systems in the Inuit communities are highly variable depending upon the location, granular materials available, competitiveness, and contractor experience and confidence. A lagoon constructed in Grise Fiord (population less that 200) in 1996 cost approximately $300,000 (Reference: Johnson, 1998); the current of this same lagoon would probably be closer to one million dollars. In general terms, lagoon systems are multi-million dollar construction projects.

The operation and maintenance of a lagoon system is also highly variable. In Grise Fiord, the annual cost for water and sewer was approximately $2240 per capita (See Table 2); the sewage portion of this cost was approximately $670 per capita.

Table 2. Grise Fiord, Nunavut Operation and Maintenance costs

Year	Water $	Sewer $	Total $
2001	234,391	100,200	334,591
2002	255,959	109,696	365,655

$2,240 per capita per year in 2002 or 6.4 cents per litre for water and sewer
Water use - 5,678,500 litres per year or 95 litres per capita per day

From an operation perspective, any sewage treatment system, particularly mechanical sewage treatment systems have significant cultural and language barriers which must be addressed on a daily basis (Reference: Christou, 2005). The biological aspects of sewage treatment process are difficult to explain because Inuit have never heard words like clarifier or biomass.

Documentation Associated with Canada-Wide Strategy for Management of Municipal Wastewater Effluent

A significant number of documents and presentations have been prepared in association with the Canada-Wide Strategy for Management of Municipal Wastewater Effluent, and the proposed implementation strategy by Environment Canada. The documents reviewed in the preparation of this position paper included:

- Canada-wide Strategy for the Management of Municipal Wastewater Effluents. September 2007.

- Proposed Regulatory Framework for Wastewater. October, 2007.

- Review of the State of Knowledge of Municipal Effluent Science and Research: Review of Existing and Emerging Technologies; Review of Wastewater Treatment Best Management Practices. January, 2006.

- Affordability of Wastewater Treatment Services in Canada. June, 2006

Discussion on Documentation

The documentation associated with Canada-Wide Strategy for Management of Municipal Wastewater Effluent provides a comprehensive basis for advancing the harmonization of sewage effluent standards, but in a context that is grounded in southern Canada, and in a non-Inuit cultural context. Elements in the documentation must be challenged in order the guide the any future implementation of the effluent standards in Inuit regions of Canada.

In order to facilitate an organized discussion of the documentation, particular statements and points of discussion to Inuit regions have been made.

Canada-wide Strategy for the Management of Municipal Wastewater Effluents. September 2007.

- Page 2 – Key Element of the Strategy: sustainable funding strategy; facility size; wastewater facility monitoring. *Challenge – given the capital, and operation and maintenance costs associated with sewage treatment in Inuit regions, a realistic and sustainable funding strategy would have to be supported by senior governments; Inuit living in communities such as Grise Fiord cannot afford the current sewage cost of $670 per person per year.*
- Page 4 – "due to extreme climatic conditions and remoteness of Canada's arctic, alternative performance standards …will be proposed within 5 years" *Challenge – data collection and compilation for sewage systems in Inuit communities has been very limited in the past decades for reasons such as cost, human resources and the simple fact that samples often cannot be transported to laboratories in a timely manner; these same conditions will exist over the next years and into the foreseeable future, therefore it is not realistic to state that the necessary science to support alternative performance standards for Inuit communities may be completed within the next five years.*
- Page 5 – "all wastewater facilities are required to monitor their effluent discharge" *Challenge – Inuit communities do not have the administrative, financial, and human resources to undertake data collection and compilation for sewage systems; this fact has been demonstrated over the past several decades for reasons such as cost, as well, samples often cannot be transported to laboratories in a timely manner.*
- Page 16 – "the term arctic is still under discussion…defining arctic include number of growing degree days, mean annual near surface ground temperature and number of ice-free days" *Challenge – climatic conditions are highly variable across the arctic, particularly with the onset of climate change; rather than a climatic base for defining the arctic, a geographic base should be used for defining the arctic, which includes the Inuit regions of Canada.*

Proposed Regulatory Framework for Wastewater. October 2007.

- Page 7 – "authorize maximum effluent discharge levels of 25 (BOD and TSS)" *Challenge – Inuit communities cannot consistently meet the effluent discharge levels of 25 mg/L for BOD and TSS with the lagoon technology that is the most appropriate to the various conditions in the Inuit regions.*
- Page 10 – "timelines to achieve effluent discharge levels in regulations" C*hallenge – an extended timeline is not going to change the reality that Inuit communities cannot afford the capital, and operation and maintenance costs of any advanced sewage treatment technology without significant and sustained financial support from senior governments.*
- Page 11 – "threshold acute concentration of ammonia versus pH " *Challenge – temperature also influences the toxicity of ammonia and lower temperatures reduce the toxicity of ammonia; the low temperature environment of the arctic should be integral to the toxicity considerations for ammonia.*
- Page 14 – "certain wastewater systems have constraints …. due to the extreme climatic conditions and remoteness of Canada's arctic" *Challenge – climate and remoteness are only two of many constraints associated with the Inuit communities of Canada's arctic; the decision making must be made on the basis of science, applied science (engineering) and social science (administrative, financial and human resources).*

Review of the State of Knowledge of Municipal Effluent Science and Research: Review of Existing and Emerging Technologies; Review of Wastewater Treatment Best Management Practices. January, 2006.

- Page 55 – "the operating an maintenance costs for mechanical treatment systems in the north are substantially higher… such consideration make these treatment process less acceptable to small/remote and northern communities" *Challenge – operating and maintenance costs are more than "substantially higher"; the costs are potentially an order of magnitude higher than the south, and Inuit communities cannot afford these costs.*
- Page 55 – "considerations in treatment level required include: habits, attitudes and social patterns of the residents of the community" (USEPA documentation) *Challenge – these social science aspects of wastewater treatment are not an integral part of the considerations for the Inuit regions and should be.*
- Page 56 – case studies for small central US municipalities; recommendations include: develop in house training; form partnerships with larger regional cities; implement modest but consistent rate increases. *Challenge – these recommendations do not apply to Inuit communities.*
- Page 57 – "smaller and rural communities may have difficulty in attracting and employing dedicated wastewater treatment operators" *Challenge – Inuit communities do have difficulty in attracting and employing operators particularly resources from outside the community.*
- Page 57 – "it may be possible to retain private firms to offer operating and maintenance services" *Challenge – private firms are not an option for operating and maintenance services in Inuit communities for the reasons of cost and retaining operators.*
- Page 59 – "many technical resources are available through technical associations, government agencies and internet portals" *Challenge – Inuktitut remains the first language of many residents of the Inuit communities, therefore the technical resources are not available to the communities, and may not be available for many years.*

Affordability of Wastewater Treatment Services in Canada. June 2006

- Page 8 – "the average annual wastewater charge per household was calculated to be $185.35" *Challenge – the value of $185 does not include any consideration of the costs in the Canadian arctic ; the costs in the Canadian arctic are potentially an order of magnitude higher.*
- Page 9 – "average annual household wastewater charges in Canada appear to be 'affordable' when compared against median annual household income" *Challenge – the costs in the Canadian arctic are potentially an order of magnitude higher; Inuit cannot afford these costs without significant and sustained funding from senior governments.*

Discussion on Regional Analyses

Separate analyses on the regulatory, administrative and financial context of the four Inuit regions of Canada, and the context of infrastructure in general, and wastewater treatment in particular in the Inuit communities have been prepared. These reports are appended to this document.

- **National Performance Standards (NPS)**

The majority of Inuit sewage discharges are currently "very small" (<500m3/day), and most of communities are likely to score as "low risk" facilities, but because of the weight given to CBOD5/'TSS and ammonia levels, many communities could score anywhere from low to high risk. Not until thorough effluent characterizations of Inuit communities are done will the risk be known. Senior governments will undertake research to develop NPS within 5 years, but it is not known how this will be done and how it will adequately and thoroughly address all systems in all communities. It is questionable whether this can possibly be done in time for implementation.

- **Considerations for Arctic Conditions**

Because of extreme climate and remoteness of the Inuit regions, alternative performance standards for Arctic conditions will be proposed within five years. This will allow further investigation of the constraints associated with meeting NPS. However, the process for proposing Arctic NPS is not known, and what constraints will be considered. The definition of Arctic is under discussion, and consideration is being given to defining arctic regions by climatic factors. However, if both climate and remoteness are reasons for an arctic NPS, it is questionable as to why only climatic definitions are being considered. Political and jurisdictional boundaries should be considered. Having two performance standards would pose significant challenges and unnecessarily complicate management and compliance.

- **Site-Specific Effluent Discharge Objectives (EDOs)**

Site-specific environmental risk assessments of the receiving environment, where municipal wastewater effluent is discharged, will guide the development of site-specific EDOs for substances in wastewater effluent, including those not covered by the NPS.

Jurisdictions will use the results of these assessments to set more stringent discharge requirements for those parameters already covered by NPS. If arctic specific NPS are developed and are less stringent than 25/25 (CBOD; TSS) it is questionable how EDOs will be developed in such a way that they will not circumvent the purpose of arctic specific NPS.

- **Monitoring**

All wastewater facilities are required to monitor their effluent discharge; however, there is currently very limited monitoring data available because of a variety of factors associated with access for sample shipment, cost of sampling, and community capacity for sampling. All water and wastewater samples must be shipped south to accredited laboratory facilities.

- **Reduction at Source**

Reducing substances at source is an important aspect of the strategy. Inuit communities vary in water consumption and wastewater production. Generally speaking, households with trucked water are already conservative in use. Opportunities for reduction at source will be very limited. Communities that produce less wastewater, but of higher concentrations of NPS may be under more pressure to meet higher treatment efficacies.

- **Regulatory Reporting**

The results of monitoring activities will be reported to the jurisdiction, but the definition of jurisdictions is not stated. The feasibility of establishing regulatory reporting is questionable considering existing monitoring and reporting capacity. Clarification is needed on requirements for all Inuit communities.

- **Science and Research**

More research is needed and research must be disseminated through an independent national wastewater research coordination committee in order to facilitate the applied science (engineering) application of the research. It is not very clear how research will be done that addresses issues specific to Inuit regions. It is unclear how Environment Canada will lead a process, within two years, to engage a diversity of organizations to investigate and determine the feasibility of setting up an independent national wastewater research coordination committee.

- **Governance**

Within 3 years it is expected that jurisdictions will establish bi-lateral federal-provincial and federal-territorial agreements for governance of the regulatory framework. Limited information is provided on what agreements are needed among the various jurisdictions, taking into account the regulatory role of the provincial governments, territorial governments, and the regional water boards. No other wording on this issue is provided in the strategy so it is difficult to gauge the potential governance impacts of "harmonized" requirements and implementation.

- **Considerations for Canada's Arctic in National Performance Standards**

The Strategy recognizes that Canada's Arctic faces unique concerns due to its extreme climatic conditions and remoteness. Alternative National Performance Standards for arctic facilities are anticipated within five years, however a number of factors such as ice-free days are being explored to determine which ones may affect the achievement of any proposed NPS. The availability data is currently a limiting factor, and will continue to be a limiting factor. The basis for NPS of 25mg/L CBOD5, 25mg/L of TSS is not specified and seems arbitrary and thus raises the question of how arctic NPS will be developed or chosen.

- **Single Discharge Approach Environmental Risk Assessment**

Environmental Risk Assessments are required under the strategy. Effluent Discharge Objectives (EDOs) are expressed as concentrations and/or loads of substances. Regulation by loading does

not appear to happen in any Inuit community as judged by existing water licenses. Regulating by loads is an added burden because accurate discharge flows are needed, but it makes compliance more equitable because communities that use less water and have more concentrated effluent will be more at risk of violating regulations. Additionally, in some communities, concentrations could be very high, but actual loads would remain extremely minimal.

- **Completing an Environmental Risk Assessment**

The goal is to determine potential impact of wastewater effluent in receiving waters and to help limit substance concentrations and loads "at the end of the discharge pipe" in order to protect all uses of receiving water. "End of pipe" framework is problematic for many Inuit communities because effluent from lagoons is discharged to wetlands in many instances. Doing the risk assessment as outlined in the strategy will be difficult without directions on assessing diffuse discharges such as treatment wetlands.

- **Mixing Zone and Dilution Assessment**

Conditions in Inuit communities range from no holding cell or lagoon, to small holding cell, to small lagoon, to large lagoon, to lined lagoon, to WWTP, all of which may or may discharge through a pipe or through exfiltrating through a berm to a wetland where effluent passes diffusely through vegetation and soils before entering receiving waters. This makes identification of mixing zones and plumes extremely difficult for most Inuit facilities. Effluent that is discharged onto a wetland which allows for more treatment must be considered in this section of the strategy.

- **Determining the Need for Effluent Discharge Objectives and Objective Development**

Effluent Quality Objectives (EQOs) are desired characteristics or benchmarks that if attained will protect all water uses for a particular water body. Effluent Discharge Objectives (EDOs) are implemented in situations where it is projected or calculated that EQOs may be exceeded at the edge of the mixing zone. Arctic specific EQOs should be developed through science and research mandate. While some arctic ecosystems are fragile, the massive potential for dilution and overall large assimilative capacity for nutrients may result in unique arctic EQOs.

- **Initial Effluent Characterization**

The broad spectrum characterization of all parameters listed in the strategy (e.g. organics, all metals, phenolics, etc.) is generally unwarranted given the cost and difficulty of sampling in Inuit communities because landfill runoff leachate or industrial inputs are not received into wastewater facilities. Composite samples, as stated, will be difficult and expensive to undertake.

- **Compliance Monitoring of National Performance Standards (NPS)**

When NPS are not achieved, wastewater facilities must look for opportunities to reduce the discharge of substances at the source and/or improve the facility or its operation so the standards can be achieved. These restrictions, if applicable to Inuit regions, are unfairly biased because per capita usage of water is usually significantly lower for "trucked" communities than it is for southern Canadian communities. This results in higher concentrations, but not necessarily higher loadings.

- **Continuous or Intermittent Discharge Facilities**

Flow monitoring should be accurate to within 15% of the measured flow for continuous discharge facilities. This will be difficult for most Inuit communities to achieve. For lagoon systems that discharge only when lagoons are emptied, typically once or twice a year, one sample will be required during each discharge period. The sample must be taken during the last half of the discharge period and analyzed for TSS, and CBODS. Where wastewater is trucked rather than piped, flow may be estimated using generally accepted engineering principles. One of the difficulties with taking samples during "last half of the discharge period" is getting samples to the airport in time as flights from Inuit communities generally leave only a few times per week. This restricts when samples can be taken. "Generally accepted engineering principles" needs to be defined.

- **Source Reduction on Contaminants**

Most Inuit communities will have limited opportunities to reduce effluent at source. Growing communities will have even more difficulty reducing at source. Northern constraints must be taken into account and standards that will result in chronic failures to comply will not improve the situation. All agencies need to cooperate to find meaningful made in the north solutions to municipal wastewater effluent.

- **Municipal Wastewater Treatment**

The draft strategy describes resources for optimizing municipal wastewater treatment for facilities in southern Canada. Constraints and circumstances unique to the Inuit regions must be identified and wastewater treatment practices across the arctic need to be thoroughly researched and best practices disseminated.

- **Environmental Monitoring**

Environmental monitoring program should be implemented to confirm Effluent Discharge Objective (EDO) modeled outcomes. Details are anticipated within 5 years. Environmental monitoring programs need to be adapted to constraints and circumstances in arctic communities. No mention in strategy about how forthcoming environmental monitoring guidelines will be adapted to the north.

- **Standard Method Objective and A Step-by-Step Standard Method**

The draft strategy has a standard method or the strategy. A standard method should be developed for an Arctic methodology for implementing the requirements for Inuit communities.

Conclusions

Inuit communities have limited resources available to them, and the reality of sewage treatment in the Inuit regions of Canada is that most communities can only make incremental improvements to their community sewage treatment infrastructure. Those systems which are technologically simple, and engineered for sufficient capacity tend to perform well.

The majority of communities of the Inuit regions of Canada are “very small”, very remote, and very cold; therefore the sewage treatment technology must be appropriate to these conditions and must be applied in the context of these conditions. The knowledge of the appropriateness and context for

arctic sewage treatment may only gained through research in science, applied science and social science.

Unless significant resources and commitment are applied the research into all aspects of arctic sewage treatment the Canada-wide Strategy for Management of Municipal Wastewater Effluent will have significant impacts and produce significant hardship on the Inuit regions of Canada. These impacts will be financial (capital cost and operation-maintenance cost), human resource, and administrative.

Recommendations

- The Canada-wide Strategy for Management of Municipal Wastewater Effluent must include a geographic definition of the arctic instead of climatic definition, which should include the Inuit regions of Canada.

- The Canada-wide Strategy for Management of Municipal Wastewater Effluent must have a realistic timelines, and funding for research into, and implementation of the science of arctic wastewater treatment.

- The Canada-wide Strategy for Management of Municipal Wastewater Effluent must have timelines, and funding for research into and the implementation of the applied science (engineering) of arctic wastewater treatment.

- The Canada-wide Strategy for Management of Municipal Wastewater Effluent must have a realistic timelines, and funding for research into and the implementation of the social science of arctic wastewater treatment.

- The Canada-wide Strategy for Management of Municipal Wastewater Effluent must have sustained funding for implementation of wastewater improvements based upon the science, applied and social science research.

Specific Actions and Financial Needs

- Support the development of capital plans (5 year and 20 year) for Inuit communities for incremental improvements in wastewater treatment technology. Timeline – 5 years. Budget – $500,000.
- Support the characterization of wastewater discharges in Inuit communities. Timeline – 5 years. Budget – $1,500,000 ($30,000 in each of 50 Inuit communities).
- Support the long term incremental improvements to wastewater treatment processes in Inuit communities. Timeline – 20 years. Budget – based capital plans and demands of strategy.
- Support the research into “best appropriate technology” for wastewater treatment in Inuit communities. Timeline – 10 years. Budget – $3,000,000 ($500,000 in each Inuit region, including, Inuvialuit, Kitikmeot, Kivalliq, Qikiqtani, Nunavik, and Nunasiavut).

- Support the establishment of a regulatory framework (databases, design manuals, operation and maintenance manuals) in conjunction with the research for "best appropriate technology" for wastewater treatment in Inuit communities. Timeline – 10 years. Budget – $1,000,000.
- Support the education and training of wastewater treatment facility operators in Inuit communities. Timeline – 15 years. Budget – $5,000,000 ($100,000 in each of 50 Inuit communities).
- Support public education programs on wastewater treatment in Inuit communities. Timeline – 5 years. Budget – $500,000.
- Support community consultation program (regional meetings) for implementation of strategy. Timeline – 5 years. Budget – $500,000.

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Appendix A: Inuvialuit Regional Impact Assessment

Appendix B: Nunavut Regional Impact Assessment

Appendix C: Nunavik Regional Impact Assessment

Appendix D: Nunatsiavut Regional Impact Assessment