Transportation Plan of Nord-du-Québec

Technical Study

Marine Transport:

Overview Networks, Infrastructures, Operations and Management in Nord-du-Québec

WORK DOCUMENT
FINAL VERSION

October 2002

Transports Québec

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ACKNOWLEDGEMENTS

We wish to thank all those who have contributed comments and suggestions in the making of this document.

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ACRONYMS

KRG	Kativik Regional Government
DGPS	Differential Global Positioning System
FCNQ	Fédération des Coopératives du Nouveau-Québec
IMDG	International Maritime Dangerous Goods Code
MARPOL	International Convention on the Prevention of Pollution from Ships
MTL	Moosonee Transportation Limited
MTQ	Ministère des Transports du Québec
NEAS	Nunavut Eastern Arctic Shipping
NORDREG	Arctic Canada Traffic System
NTCL	Northern Transportation Company Limited
IMO	International Maritime Organization
MCTS	Marine Communications and Traffic Services
GMDSS	Global Maritime Distress and Safety System
SOPEP	Shipboard Oil Pollution Emergency Plans
GPS	Global Positioning System
TEU	Twenty Equivalent Units
TDGR	Transportation of Dangerous Goods Regulations

NOTICE TO THE READER

Unless otherwise indicated by the context, the following expressions and words mean:

"Technical study"	**This technical study has no scientific pretence. It is not an opportunity study by any means, nor an exhaustive research on the subject. It aims at drawing up an overview of the situation in the specific area of transportation in Nord-du-Québec. Although the study is internal, the Ministère is nonetheless pleased to make it available to the reader.**
"The Ministère"	**The Ministère des Transports du Québec**

In the text, words in italics are found in the glossary; except for laws, regulations and document titles.

SUMMARY

In the Nord-du-Québec region, marine transport is of paramount importance. For centuries now, Aboriginals have used the sea as a means of communications. In recent years, marine freight from southern Québec has become necessary in order to support the rapid socio-economic development of Nord-du-Québec communities. Furthermore, in the case of Nunavik, the lack of a regional and provincial road network makes it necessary to use marine transport for heavy and bulky goods.

Once organized and coordinated by the Ministère des Transports du Québec (MTQ), steamship services have been entirely provided by private sector enterprises since 2001.

In spite of the importance of marine transport in the region, marine infrastructures are rudimentary, even non-existent in some places. It forces navigators to adapt their way of doing things. They resort to unusual unloading methods (cargo ships and oil tankers) for supply operations. Mariners must also deal with several natural constraints. Navigators have to synchronize their trips with seasons, tides and wind conditions.

Because of the risks involved with these constraints, the Nunavik Marine Infrastructure Program is presently underway. Overseen by Makivik Corporation and financed by Transport Canada, this program primarily aims at making the access to sea, safe and easy for the local population. Moreover, the partnership agreement signed on April 9, 2002 between the Inuit and the Québec government provides that the latter will participate in the Marine Infrastructure Program. In James Bay, a few villages are equipped with marine infrastructures that facilitate domestic operations, while commercial infrastructures have practically fallen into disuse, since the opening up of the region has greatly diminished marine freight.

Safety at sea was significantly enhanced by the onset of new technologies. The use of the Global Positioning System (GPS) and satellite communication systems markedly increased the safety of marine transport. The infrastructures built in the framework of the Nunavik Marine Infrastructure Program also contribute to an improved safety in marine operations. The implementation of simple facilities, strict and efficient measures and emergency response plans would also promote safety and reduce the risk of impacts on the environment that could occur during commercial and domestic marine operations.

INTRODUCTION

In the preparation of the *Transportation Plan of Nord-du-Québec*, this technical study draws an overall picture of networks, infrastructures, operations and management in Nord-du-Québec. The aim is to have an overview of marine transport in Nord-du-Québec.

To do this, we will first discuss marine transport networks that already exist in this area. Then, we will describe the marine infrastructures of Ungava Bay, Hudson Strait, Hudson Bay and James Bay. We will see that marine infrastructures are rudimentary in spite of the importance of marine transport in the region. An infrastructure construction program that is presently underway in Nunavik will also be discussed.

In Chapter 2, we will take a closer look at marine supply operations in villages and various locations of the region. We will see that unloading methods used by shipping lines for petroleum products and general cargo, are well-adapted to the region's specific conditions. These supply operations require impressive logistics. We will discuss transport services provided by shipping lines and attempt to demonstrate the importance of supply ships, by reviewing the data available on freight quantities over the last few years. We will close this chapter with a look at the environmental impacts of marine operations in Nord-du-Québec.

Chapter 3 deals with marine constraints in the general region and for each supply site. We will observe that constraints are numerous and strongly affect the use of the sea as a means for transportation.

Finally, we will focus on the importance of marine transport for the area's socio-economic development for the region. Then we will discuss recent improvements made to increase safety and marine transport services. We will also make a few suggestions to foster safety even more and mitigate the environmental impacts of marine transport in the region.

1. Overview of the Networks, Infrastructures and Equipment for Marine Transport in Nord-du-Québec

Several geographers agree on dividing the vast Nord-du-Québec region (840,000 square kilometres) in two territories: Nunavik and James Bay (see Map 1). This region is characterised by the length of its littoral that extends from the bayhead of James Bay to the north-eastern tip of Ungava Bay (Killinik Point). Fourteen Inuit communities and five Cree communities are located in the coastal area. The 14 Inuit communities and the Whapmagoostui Cree community are not connected by road, while the four Cree coastal communities of Chisasibi, Eastmain, Waskaganish and Wemindji are connected to Québec’s road network. Appendix 1 shows a waterway distance chart for the communities of region Nord-du-Québec.

1.1 History and Evolution of the Overall Marine Transport System in the Nord-du-Québec Region and Surrounding Area

Table 1 illustrates the evolution of the organisation of steamship services in Nunavik and Nunavut. Ships have sailed in northern Canada and Québec for several decades. From occasional departures, the ships' visits to these territories have intensified after World War II. At that time, the Canadian Government wished to reaffirm its sovereignty over the territory and set up governmental stations (military stations, research stations and meteorological stations) and dispersed the Inuit villages over the territory[1]. Since it was necessary to service these facilities, ships started visiting more and more often. In 1959, the Canadian Coast Guard became responsible for steamship services in northern communities. Map 2 shows the villages and operational facilities visited for supply operations in the eastern Canadian Arctic and Nord-du-Québec areas. In 1978, responding to the Gouvernement du Québec's request, the Canadian Government transferred to Québec its responsibility in the management and coordination of marine services to the Nunavik.

1 Landry, Raymond (1982) *Desserte maritime des villages du Nouveau-Québec.* Ministère des Transports, p. 29.

TABLE 1
ORGANIZATIONAL EVOLUTION OF MARINE SERVICES IN NUNAVIK AND NUNAVUT

TERRITORY	FEDERAL GOVERNMENT TRANSPORT SERVICES	PROVINCIAL/TERRITORIAL GOVERNMENT TRANSPORT SERVICES	COMMERCIAL TRANSPORT SERVICES
Nunavik	1959-1978	1979-2000	2001
Nunavut	1959-2000	2001	

Sources: Landry, Raymond (1982), *Desserte maritime des villages du Nouveau-Québec.*
Marcil, Guy, Ministère des Transports (2001), Personal communication.

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Map 1: Nord-du-Québec coastal communities

Transportation Plan of Nord-du-Québec

Maritime transport: overview,networks, infrastructures, operation and management in Nord-du-Québec

Localisation

- Cree village
- City or town
- Inuit municipality
- Naskapi village
- Operational site
- Mine

Administrative limit

- Municipalité de la Baie James
- South limit Nord-du-Québec region
- Other Québec regions

Road

Financial responsability

- MTQ - National, regional, collector
- MTQ - Access and mining
- MTQ - Other roads
- Hydro-Québec

Rail and marine routes

- 22 — Marine route and distance in nautical miles (1 nautical mile = 1,852 meters)
- n/d = No data
- Rail road

Source:
- Ministère des Transports du Québec
- Fisheries and Oceans Canada, (1988) Sailing directions, Labrador et Baie d'Hudson, 491 pages

Basic map:
- Ministère des Ressources naturelles, digital maps, scale 1 : 250,000 and 1 : 8,000,000

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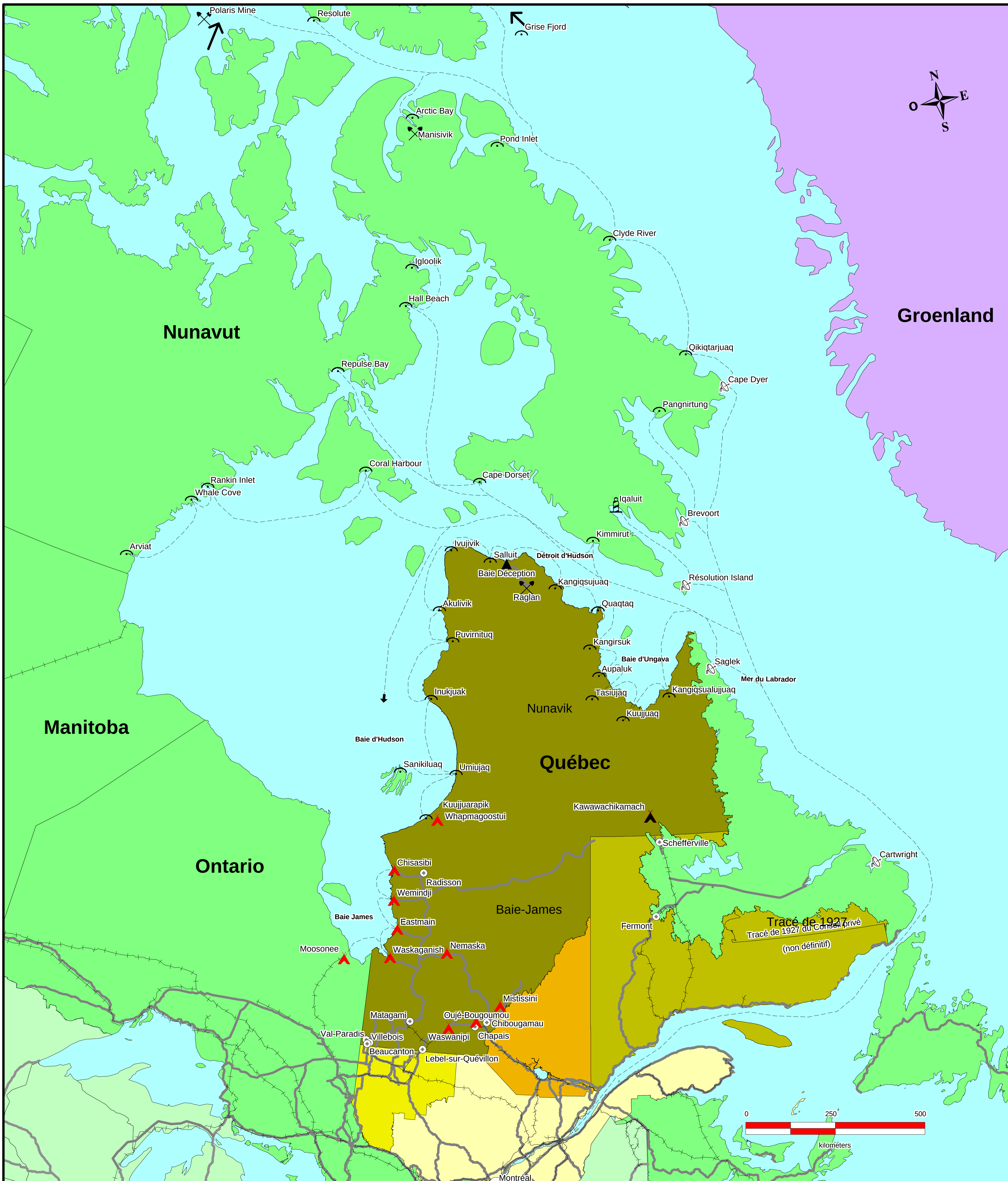

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Map 2: Location in Nord-du-Québec and Nunavut "Baffin" area supplied by ship in 2001

Legend

- Canadian Coast Guard station
- Radar station
- Mine
- Operational site
- Cree village
- City or town
- Inuit municipality
- Naskapi village
- Sea traffic route
- Rail road
- Surface road

Transportation Plan of Nord-du-Québec

Maritime transport: overview,networks, infrastructures, operation and management in Nord-du-Québec

Source:
- Ministère des Transports du Québec
- Fisheries and Oceans Canada, (1988) Sailing directions, Labrador et Baie d'Hudson, 491 pages

Basic map:
- Ministère des Ressources naturelles, digital maps, scale 1 : 250,000 and 1 : 8,000,000

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The Gouvernement du Québec's first marine services were set up in the summer of 1979. MTQ was given the mandate to organize and coordinate marine services for Nunavik communities. Through competitive bidding, shipping contracts were given to a marine transport company for governmental and para-governmental institutions (Hydro-Québec, Société d'habitation du Québec, Kativik School Board, Kativik Regional Government). Moreover, during the 1979-1999 period and pursuant to the service contract, all stakeholders who wished to ship goods to Nunavik could take advantage of the terms established between the carrier and MTQ. The purpose of this transport service was to provide a suitable supply service and regulate transport prices[2]. Changes were made during the summer of 2000 however; thenceforth, only governmental and para-governmental organizations could take advantage of the marine transport service terms.

1.1.1 Current Situation

At summer of 2001, important changes occurred in the organization of marine transport services for the Nunavik and Nunavut territories.

Nunavik

In Nunavik, MTQ is withdrawing from the organization of marine transport services. For the first time, the operations are not coordinated by a governmental entity. Thus, the various customers, government and private agencies, construction contractors and others must negotiate shipping prices on their own and independently, to come to an agreement with sea carriers to ship goods to Nunavik. In order to properly meet the demand and position themselves appropriately to secure contracts, transport companies established partnerships with various industry stakeholders to offer integrated services to customers. They now offer packing, storage, insurance and transport services to the Nunavik and Nunavut communities.

Nunavut

In Nunavut, following a request from the new regional government and in accordance with its policy of withdrawal from marine transport, the federal government transferred to the regional government its responsibility in the organization of transport services. The Canadian Coast Guard is, however, still responsible for supplying the villages of Pelly Bay and Eureka, since an ice-breaker is necessary to safely operate in these waters[3] under the *Arctic Waters Pollution Prevention Act*. According to the data of the new regional government, more than 11,000 metric tons of goods are shipped annually to the Baffin area of Nunavut[4].

2 Marcil, Guy, Ministère des Transports (2001), Personal communication.
3 Canadian Coast Guard (September 2001), General information.
Web site address: www. ccg-gcc.gc.ca
4 Spitzer, Aaron, Sealift charts new course. *Nunatsiaq News,* June 15, 2001.

It should be mentioned that even though there is a clear distinction between the territories concerned by transport services (Nunavik and Nunavut), and that the management and coordination of these transport services are provided by distinct organizations, it is actually difficult to set them totally apart since marine transport companies active in Nunavik also service the eastern Nunavut communities[5]. Concerning marine supply operations (ship loading and unloading, itineraries), both transport service systems are integrated. During a supply trip, a ship will service Nunavik villages as well as Nunavut villages.

James Bay

In the James Bay territory, the volume of marine transport has greatly diminished since the recent acces to the Cree villages by roads. In the past, Cree communities got their supplies from Moosonee (James Bay Ontario coast). They are now connected to Québec's road network and goods are mainly shipped by truck.

1.1.2 Involvement of the Canadian Coast Guard

Even though it is no longer directly involved in supply operations any more, the Canadian Coast Guard plays an essential role in ensuring the smooth operation of marine transport. It offers ship escorting services with an icebreaker and is responsible for the main navigational aids. These aids have been installed on the territory to meet specific needs with regards to navigation. Moreover, with its radio station in Iqaluit and such structures as MCTS (*Marine Communications and Traffic Services*) and NORDREG (*Arctic Canada Traffic System*), the Canadian Coast Guard sees to the management and safety of marine traffic in the Canadian and Québécois North. It issues daily ice maps and recommended routes intended for navigators who travel the arctic waters. Another NORDREG specific goal is to prevent the pollution of these waters in accordance with the *Arctic Waters Pollution Prevention Act*.

1.1.3 Commercial Fisheries Network in Nunavik[6]

The Inuit and the Cree practice traditional subsitence fishing intended for the food supply of a village or area. To this end, they use fishing boats (peterheads) and canoes with outboard motors. Also, fishermen from the villages of Salluit and Quaqtaq occasionally harvest scallops for the local market. Only the inhabitants from Nunavik are engaged in commercial fisheries as such.

5 Marcil, Guy, Ministère des Transports (2001), Personal communication.
6 Allard, Marc, Makivik Corporation (2001), Personal communication.

Shrimp Fishery

Makivik Corporation holds a shrimp fishing licence. They have been allocated a quota of 2,189 tons per year in five zones outlined in the licence agreement and they have joint access to three fishing zones with other licence holders. Unaaq Fisheries inc., a company set up by Makivik Corporation and Qikiqtaaluk Corporation from Baffin, has a similar shrimp fishing allocation they share equally. These two allocations are harvested by factory ships owned by Nova Scotia based companies.

The Northern Coalition, a group made up of seven of the 17 shrimp-fishing licence holders in Québec, has an additional allocation of 6,120 tons. This allocation being shared equally, Makivik Corporation harvests 875 additional tons.

Therefore, the Inuit from Nunavik have shrimp-fishing allocations that allow them to catch 4,160 tons per year, plus a shared fishing allocation, for an approximate total of 4,800 tons per year.

Studies conducted by Makivik Corporation show that processing the resource in Nunavik would not be profitable. Accordingly, the ships do not transit through Nunavik.

Halibut Fishery

Makivik Corporation holds a halibut fishing allocation (Greenland halibut) allowing them to catch 140 tons per year. Harvesting is done in Davis Strait with different vessels.

Labour

Inuit labour is recruited by the companies, from a workers bank of approximately 50 individuals. They receive a training delivered partly by Makivik Corporation and partly by specialized Newfoundland and Nova Scotia schools. Tuition fees are paid by Kativik School Board. They make up from one fifth to one half of the workers, depending on the ship.

Marine Infrastructure Development in Nunavik

According to a local stakeholder, improving marine infrastructures in Nunavik would not be sufficient to foster fisheries development as the Nunavik fishermen can hardly compete with other fishing companies. This can be explained by the fact that:

- the fishing season is limited to 10 to 12 weeks;
- fuel is twice as expensive as elsewhere;
- export costs are high;
- there is no processing plant on site that would allow them to offer value added products.

Inuits and Crees also engage in traditional subsistence fishing intended for the food supply of a village or region. To do this, they use small fishing boats (peterhead boats) and canoes equipped with outboard engines.

1.2 Background and General Description of the Infrastructures and Equipment for marine transport in Nord-du-Québec

Marine infrastructures are rudimentary in the 14 Inuit villages and five coastal Cree communities of the Nord-du-Québec region. A few villages are equipped with modest infrastructures. These are mostly facilities built either by MTQ or by Makivik Corporation (financed by Transport Canada), or by the Cree villages' band councils. The existence of a deep-water wharf at Deception Bay should be mentioned. Moreover, some navigational aids have been installed on the northern Québec coasts for navigational safety purposes. Table 2 lists the marine infrastructures for every village as well as various data related to each. Empty boxes in the table demonstrate that in several cases, we still ignore the funding sources, the owners or the operators of marine infrastructures. It would be desirable to pursue research on this aspect and determine the exact role of each stakeholder regarding marine infrastructures.

Map 3 locates the operational sites and villages in Nord-du-Québec, that are equipped with marine infrastructures and Appendix 2 gives a description of these infrastructures.

TABLE 2
MARINE INFRASTRUCTURES IN NORD-DU-QUEBEC (2001)

LOCATION	MARINE INFRASTRUCTURES	FUNDING	OWNER	OPERATOR	CONSTRUCTION YEAR
Kangiqsualujjuaq	Breakwater Access ramp Access road	Canadian Government	Municipality of Kangiqsualujjuaq		1999
Kuujjuaq	Access ramp Storage area		Municipality of Kuujjuaq		2000 (major alterations)
	Floating pontoons		Municipality of Kuujjuaq		Not available
	Navigational aid (alignment and recognition lights)		Shell Canada Kuujjuamiut Corp. Canadian Coast Guard		From 1975 to 1985
Aupaluk	Navigational aid (4 alignments)	Canadian Government	Canadian Coast Guard	Canadian Coast Guard	1984 and 1985
Kangirsuk	Access ramp Storage area	Gouvernement du Québec			1986
	Navigational aid (6 alignments)	Canadian Government	Canadian Coast Guard	Canadian Coast Guard	1979
Quaqtaq	Breakwater Access ramp Access road	Canadian Government	Municipality of Quaqtaq		2000
Kangiqsujuaq	Breakwater Access ramp Mooring area	Canadian Government	Municipality of Kangiqsujuaq		2001
Deception Bay	Deep water wharf Sheltered storage area	Société Minière Asbestos	Société Minière Raglan	Société minière Raglan	1963-1966
	Navigational aid (2 alignments)	Canadian Government	Canadian Coast Guard	Canadian Coast Guard	From 1966 to 1976
Puvirnituq	Navigational aid (4 alignments)	Canadian Government	Canadian Coast Guard	Canadian Coast Guard	1981
Inukjuak	Access ramp		Municipality of Inukjuak		1987
Umiujaq	Breakwater Access ramp Mooring area	Canadian Government	Municipality of Umiujaq		2001
Kuujjuarapik-Whapmagoostui	Floating pontoons	Gouvernement du Québec	Ministère des Transports du Québec	Ministère des Transports du Québec	1966 (Construction by Public Work Canada) 1970-1971 (Major improvement by Transport Canada) 1989 (Property transfer to MTQ)
Chisasibi	Access ramp		Chisasibi Band Council		Not available
	Navigational aid (1 alignment)	Canadian Government	Canadian Coast Guard	Canadian Coast Guard	1974
Wemindji	Slip ways		Wemindji Band Council		Not available
	Markers		Wemindji Band Council		Not available
Eastmain	Floating pontoons		Eastmain Band Council		Not available
Waskaganish	Access ramp		Waskaganish Band Council		Not available
	Markers		Waskaganish Band Council		Not available

Infrastructures built in the framework of Phase 1 of Nunavik Marine Infrastructure Program.

Sources: Yang, Shun Hui. Makivik Corporation (2001), Personal communication.
Génium (1995) *Prefeasibility Studies*. All villages.
Génivar (1998) *Construction of Marine Infrastructures at Quatqaq*
Fisheries and Oceans Canada (1988) *Sailing Directions*.
Band councils of the villages of Chisasibi, Wemindji, Eastmain and Waskaganish (2001) Personal communication.

Map 3: Marine infrastructures in Nord-du-Québec, 2002

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Localisation

- Cree village
- City or town
- Inuit municipality
- Naskapi village
- Operational site
- Mine

Administrative limit

- Municipalité de la Baie James
- South limit Nord-du-Québec region
- Other Québec région

Marine infrastructure

Alignment	(6)
Mooring area	(2)
Breakwater	(6)
Floating pontoon	(4)
Deepwater wharf	(1)
Acces ramp	(11)

Transportation Plan of Nord-du-Québec

Maritime transport: overview,networks, infrastructures, operation and management in Nord-du-Québec

Source:
- Ministère des Transports du Québec
- Makivik Corporation, personal communication
- Band Councils (Chisasibi, Wemindji, Eastmain, Waskaganish)
- Génium (1995) pre-feasibility study

Basic map:
- Ministère des Ressources naturelles, digital maps, scale 1 : 250,000 and 1 : 8,000,000

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1.2.1 Nunavik Marine Infrastructures

Kangiqsualujjuaq

Kangiqsualujjuaq was the first village in Nunavik to be equipped with marine infrastructures through the Nunavik Marine Infrastructure Program of Makivik Corporation (see 1.3). Since 1999, Kangiqsualujjuaq is equipped with an access ramp and two breakwaters. The main breakwater and the access ramp were built at the mouth of Akilasakallak Cove. The breakwater offers a good protection against waves and southern winds. A secondary breakwater was also built in proximity to the village in order to protect outboard canoes and boats during periods of strong winds (Photo 1).

PHOTO 1
SECONDARY BREAKWATER, KANGIQSUALUJJUAQ

Anick Guimond, 2001.

Kuujjuaq

In Kuujjuaq, the site presently used for barge unloading operations was redeveloped during the summer of 2000 by Kuujjuamiut Corporation (local socio-economic development corporation). Work was done to reinforce the ramp and storage area. A parking lot was also built close to the access ramp. As in almost all Nunavik villages, the site is used by the local population and by marine transport operators. North of the landing, in Nascopie Cove, floating pontoons are launched every year by the municipality of Kuujjuaq. These pontoons used for mooring local canoes, are poorly protected and vulnerable during periods of southerly and westerly winds.

Kangirsuk

In Kangirsuk, the access ramp and storage site were built in 1986 by MTQ[7]. The access ramp makes it possible for local people to launch their boats; it also facilitates marine transport operations. In fact, even though it is too narrow and steep, this ramp eases the grounding of barges used to supply the village. The storage site is also useful, but it rapidly becomes cluttered with piles of cargo during supply operations.

Quaqtaq

Quaqtaq infrastructures were built in 2000 in the framework of the Nunavik Marine Infrastructure Program. A breakwater and a slide for small boats were built at Mission Cove. A road was also built to allow access to the ramp.

Kangiqsujuaq

Still in the framework of the Nunavik Marine Infrastructure Program, a main breakwater, secondary breakwater, mooring basin, access ramp and small parking area were also built in Kangiqsujuaq, during the fall of 2001.

Inukjuak

The village of Inukjuak is equipped with a pier built by MTQ in 1987. Some 65 metres in length and 20 metres in width[8], it makes access to the sea much easier. There is also a small wooden dock at the end of the pier that is frequently used by local fishing boats.

7 Génium (1995), Projet d’aménagement d’infrastructures maritimes nordiques dans la région du Nunavik. *Étude de préfaisabilité, Kangirsuk*, p. 29.

8 Génium (1995), Projet d’aménagement d'infrastructures maritimes nordiques dans la région du Nunavik. *Étude de préfaisabilité, Inukjuak,* p. 29.

Umiujaq

In Umiujaq, work was carried out during the summer of 2001 (Photo 2), to build two breakwaters, a mooring basin and an access ramp for local boats. This work was under the supervision of Makivik Corporation.

PHOTO 2
CONSTRUCTION OF THE UMIUJAQ BREAKWATER

Anick Guimond, 2001.

Kuujjuarapik-Whapmagoostui

There are also marine infrastructures in Kuujjuarapik-Whapmagoostui. These are floating pontoons located in the Great Whale River. These pontoons are maintained and managed by MTQ. The Ministère mandates a local business to launch the pontoons in the spring and take them out of the water in the fall. They are mainly used by small local fishing boats.

1.2.2 James Bay Marine Infrastructures

Marine infrastructures are rudimentary in the James Bay territory. The Eastmain community village is nonetheless equipped with floating pontoons used by local boats. In Chisasibi, there is an old access ramp that is abandoned et left without maintenance[9]. In

9 Chiskamish, William, Chisasibi Band Council (2001), Personal communication.

Wemindji, the Cree nation owns a slide used by Moosonee Transportation Limited (MTL) to launch its barges and tugs in the spring and take them out of the water in the fall[10]. The Waskaganish Band Council owns a ramp that was previously used by MTL for supply operations[11]. It should also be noted that there are buoys on the approach channels to the communities of Wemindji and Waskaganish. These navigational aids belong to the band council of each community.

1.2.3 Deception Bay

The most impressive marine facilities in the region can be found at Deception Bay. They belong to Société Minière Raglan and are operated as part of the Raglan mining project. The wharf built in 1963-1966 by Asbestos Corporation, can accommodate ships with a 10.7 metre draft. This wharf is made of two metal caissons filled with material. In Deception Bay, there is also a hangar and a storage dome with a capacity de 45,000 tons, used for stockpiling nickel concentrate. Another wharf, some five kilometres upstream from the first, was built in the 1990's to facilitate the unloading of huge sections of a plant. This structure was only used once[12]. This dock's specific design limits the possibilities of using it; it is not expected to serve other purposes and no maintenance is done.

1.2.4 Canadian Coast Guard Navigational Aids

Transport Canada owns the navigational aids dotting the coasts of Nord-du-Québec. These navigational aids help navigators to position their ship with precision, which is vital to a safe navigation.

Navigational aids include day alignments and luminous alignment markers, racons, radar reflectors, recognition lights and radio beacons. Of these aids, the first four are still frequently used by navigators while radio beacons are obsolete[13] as they are replaced by the *Global Positioning System* (GPS).

There are alignment markers on the shores of rivers with narrow channels and where navigation must be very accurate. Each alignment pair comprises two landmarks covered with a wooden trellis usually painted orange. By aligning both markers, navigators get a precise course and can navigate safely. Luminous alignments are simply topped with a light; these allow navigation at night. In Nord-du-Québec, the villages of Kuujjuaq, Aupaluk, Kangirsuk, Puvirnituq, community of Chisasibi and the Deception Bay site are equipped with alignments.

Racons indicate to the navigator the location of the mouth of a bay or river. Navigators can therefore know this location from open sea or during low visibility periods. These beacons are equipped with a radar wave reflection system, so navigators can see their

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10 Watson, Tom, Wemindji Band Council (2001), Personal communication.
11 Patpon, Bob, Waskaganish Band Council (2001), Personal communication.
12 Harvey, Jeannot, Falconbridge (2001), Personal communication.
13 Crépeau, Daniel, Canadian Coast Guard (2001), Personal communication.

signal on a radar screen. Moreover, each beacon emits a unique signal which informs the navigator of his exact position[14]. In Nord-du-Québec, we find racons at the mouth of every river or bay where there is a site of interest.

Radar reflectors are passive instruments; they do not emit any precise signal. They include a dome and are often located at places where the coast is flat and where radar waves are not well-reflected by the terrain. These aids indicate to navigators their position in relation to the coast.

Finally, recognition lights are simple lights indicating the presence of an obstacle: an island, a rocky point or any other danger.

1.3 Inventory of Implementation Projects for Marine Infrastructures in Nord-du-Québec

Nunavik

Pre-feasibility studies for the construction of marine infrastructures have been completed by the Government of Canada in 1993-1994 for the villages of Kangiqsualujjuaq, Quaqtaq and Puvirnituq. In 1995, the Gouvernement du Québec funded pre-feasibility studies for the 11 other villages[15]. Following an agreement in 1998 between Makivik Corporation and the Federal Government, the latter made a commitment to provide some $30M for the construction of infrastructures in three villages (Kangiqsualujjuaq, Quaqtaq and Puvirnituq). It was later decided to make a new distribution of these funds to complete infrastructures in eight Nunavik communities[16].

The initial goal of the Nunavik Marine Infrastructure Program was to build access ramps for supply operations, slides for local boats, service areas, docks for local fishing boats as well as sheltered mooring basins[17]. Because of the high cost of these works, the infrastructure construction projects were modified through the years. In agreement with local poeple, Makivik Corporation divided the construction projects in two phases. The objective of the first phase is to improve the local population's access to the sea and make it safer[18]. The focus is on the construction of access ramps and breakwaters. To be completed at a later date, Phase 2 will aim at facilitating marine supply operations for the villages. Ramps and service areas will be built at this time. Phase 2 schedules have not been completed yet by Makivik Corporation. Until now, MTQ made sure that the crushed material necessary for the second phase of infrastructure construction, would be available by the end of the first phase[19]. The crushing work, paid by the Ministère des

14 Crépeau, Daniel, Canadian Coast Guard (2001), Personal communication.
15 Arseneault, Josée, Ministère des Transports (2001), Personal communication.
16 Gouvernement du Québec, Ministère des Transports (October 2001), General information. Web site address: http://:www.mtq.gouv.qc.ca
17 Génium (1996) Programme d'infrastructures maritimes au Nunavik. Concept d'aménagement révisé, p. 1.
18 Klinking, Eileen, Makivik Corporation (2001), Personal communication.
19 Arseneault, Josée, Ministère des Transports (2001), Personal communication.

Transports, is done by Makivik Corporation, under the supervision of the Kativik Regional Government.

As mentioned above (1.2.1), Phase 1 of the program has already been completed in the villages of Kangiqsualujjuaq, Quaqtaq, Kangiqsujuaq and Umiujaq.

Table 3 shows the marine infrastructure construction projects to come. Infrastructures will be completed in the villages of Kuujjuaq and Ivujivik during the summer of 2002 and in Salluit and Kangirsuk during the summer of 2003[20]. In each of these villages, two breakwaters and an access ramp for small boats should be built. Breakwaters will be oriented in such a way as to create a sheltered zone or harbour where boats can safely come to anchor (at high tide). The access ramps will normally be protected from storm waves by the breakwaters. There are actually no plans for neither soft docking facilities nor dredging to facilitate access to the infrastructures at low tide or to allow boats to anchor during low water time.

TABLE 3
CONSTRUCTION PROJECTS - MARINE INFRASTRUCTURES IN NORD-DU-QUEBEC

Location	Completion Year	In Charge of Work	Type of Infrastructures
Kuujjuaq	**2001 and 2002**	**Makivik Corporation**	**Breakwater and access ramp**
Ivujivik	**2002**	**Makivik Corporation**	**Breakwater and access ramp**
Salluit	**2003**	**Makivik Corporation**	**Breakwater and access ramp**
Kangirsuk	**2003**	**Makivik Corporation**	**Breakwater and access ramp**

Sources: Yang, Shun Hui and Kleenking, Eileen, Makivik Corporation (2001), Personal communication.

James Bay

In the James Bay area, a pre-feasibility study was completed on the construction of marine infrastructures on the coast. This study was financed by the Gouvernement du Québec (1/3), the Government of Canada (1/3) and the band councils of Chisasibi and Wemindji (1/3). A work group comprising officers from these three entities, met a few times during 1999 and 2000 to discuss this project and a preliminary report was produced in March 2000.

1.4 Factors Affecting the Infrastructures' Condition and Maintenance

20 Klinking, Eileen, Makivik Corporation (2001), Personal communication.

Various factors can impact the infrastructures' condition. Table 4 lists these factors (natural or man-made), the effects these factors can have on the condition of the infrastructures and the maintenance work that might be required to keep them in good condition.

No precise information is available on the nature of maintenance work on the infrastructures. Each year, in the framework of its Marine Infrastructure Program, Makivik Corporation completes a technical follow-up on the infrastructures' condition[21]. A list of recommendations is sent to the concerned villages and these will carry out the maintenance work, if they want to.

TABLE 4
FACTORS AFFECTING THE INFRASTRUCTURES' CONDITION AND MAINTENANCE

	Type of Factor	Effects on the Infrastructures' Condition	Maintenance Work that Could Be Carried Out[a]
Natural Factors	**Waves**	Risk of causing erosion	Reconsolidating the facilities
	Sedimentation	Risk of sanding in sensitive zones	Dredging
	Ice	Risk of rock transport and accumulation	Yearly clean-up of channel and beach
		Risk of ice build-up in the spring	Clearing the facilities
ANTHROPOGENIC FACTOR	**Maintenance**	Degradation of infrastructures if not maintained	Regular follow-up on infrastructures' condition and execution of maintenance work

a Exact nature of maintenance work is unknown.
Sources: Génium (1995) *Prefeasibility Studies. All villages.*
Public Works Canada (1994) *Marine Infrastructure Development Project, Quaqtaq, Kangiqsualujjuaq and Puvirnituq.*

1.4.1 Natural Factors

Weather conditions and natural factors specific to the various communities inevitably impact the infrastructures' condition. Shore ice, waves and sediment transport are all factors that can cause alterations to the facilities. They act in a different manner on each of the facilities, since they are unique and part of different environments.

Usually present from mid-November to mid-June, ice exerts considerable pressure on the infrastructures and the stones they are made of[22]. However, calculations by Groupe-

21 Yang, Shun Hui, Makivik Corporation (2001), Personal communication.
22 Génium (1995) Projet d’aménagement d’infrastructures maritimes nordiques dans la région du Nunavik. *Étude de préfaisabilité*, Kuujjuaq, Appended study completed by Groupe-Conseil Lasalle Inc., p. 9.

Conseil Lasalle demonstrate that ice cannot move blocks over 500 kg. These results should be taken into account when building infrastructures. Ice also plays a major role in the transport of blocks over the flats each spring; changes in the layout of stones can be seen on the foreshore. Every year, these rock movements alter the navigation zones and a clean up of the foreshores should be done yearly to avoid marine incidents. It should be noted that it is also possible that existing breakwaters capture the ice in the spring, preventing ice evacuation at break-up. In this case, it would be necessary to either wait for the ice to melt on the spot, or clear it with machinery to facilitate access to the infrastructures.

Sediment transport, which varies according to location, can also alter marine infrastructures. Infrastructures built at a right angle to the beach inevitably affect the dynamics of sediment transport. A study of each location's characteristics is required in order to quantify the importance of these impacts. It would probably be necessary to use heavy machinery to clear areas of sediment accumulation on and around the breakwaters, to maintain a safe access to the infrastructures.

1.4.2 Anthropogenic Factors

The infrastructure use and maintenance practices will have a significant impact on the facilities' condition. Regular maintenance work must be carried out to prevent their rapid deterioration.

To keep them in good condition, the built structures should also be used appropriately. To insure this, a portmaster should be designated in each village equipped with infrastructures[23]. This person would be responsible for making sure the facilities are used in a safe manner and properly maintained.

23 Génium Urbatique Inc. (1997), Environmental Impact Study, Marine Infrastructures Project, Kangiqsualujjuaq, Summary, p. 10

2.0 OVERVIEW OF MARINE TRANSPORT SERVICES AND OPERATIONS IN NORD-DU-QUÉBEC

During summer and fall periods, various marine transport companies offer marine supply services to the villages and operational sites of Nord-du-Québec. Since many Nord-du-Québec villages are not connected to Québec's road network and considering the competitive advantage of marine transport for several categories of goods, this service is the only means of transportation for certain kinds of goods shipped to this area. Consequently, the communities depend on these supply services. Each summer, ships loaded with various goods (general cargo and petroleum products) service the communities of Ungava Bay, Hudson Strait and Hudson Bay's east coast. Because of the remoteness of the communities and sites to supply, short navigation season, climate variability and lack of marine infrastructures, these operations require a great deal of know-how on the part of sea carriers.

2.1 General Description of Marine Transport Services in Nord-du-Québec: Equipment and Services

Today, the Nord-du-Québec marine supply market is almost exclusively restricted to Nunavik. Since the Cree villages located on James Bay's east coast are now accessible by road, goods are mainly transported by truck. In Nunavik, Transport Desgagnés, through its subsidiary Desgagnés Transarctik, and Nunavut Eastern Arctic Shipping (NEAS) share the major part of the total volume of general cargo. Two other companies, Fednav and Moosonee Transportation Limited (MTL) offer specific marine transport services in Nord-du-Québec. Table 5 lists Canadian shipowners who occasionally work in Nord-du-Québec and in the Baffin region (east) of Nunavut.

Marine transport companies that service Nord-du-Québec and Nunavut from Canadian ports must use ships registered in Canada. Actually, under the *Coasting Trade Act*, ships doing coastal shipping in Canada must be registered in the country. In fact, a foreign ship can get a coasting trade licence in Canada only if there are no Canadian ships available to carry out the transport in question[24]. This measure aims at protecting the Canadian coastal shipping market. It should be noted that foreign shipowners, whose ships are not registered in Canada, supply the Nunavut communities in petroleum products from foreign ports.

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24 Gaudreau, Richard, Langlois Gaudreau (2001), Personal communication.

2.1.1 Transport Desgagnés

Transport Desgagnés has been active in northern Canada and Québec since 1967. This company has an expertise based on its lengthy experience of navigation in arctic waters. First specialized in transporting general cargo, Transport Desgagnés, through its Petro-Nav subsidiary, also operates a fleet of oilers, some of which are used to supply petroleum products to Nunavik and Nunavut.

TABLE 5
CANADIAN SHIPOWNERS SUPPLYING NORD-DU-QUÉBEC AND NUNAVUT'S BAFFIN AREA

Shipowners	Number of Ships[a]	Territory Serviced	Coordinates
Nunavut Eastern Arctic Shipping (NEAS)	2 cargo ships	Nunavik and Nunavut	P.O. Box 186 Station M Montréal (Québec) H1V 3L Tel.: (514) 597-0186 www.neas.ca
Transport Desgagnés Inc.	3 or 4 cargo ships and 2 oilers	Nunavik and Nunavut	21, du Marché Champlain Room 100 Québec (Québec) G1K 8Z8 Tel.: (418) 692-1000
Crosbie Shipping	2 cargo ships	Nunavut	276 St-Jacques Suite 822 Montréal (Québec) H2Y 1N3 Tel.: (514) 849-6194
McKeil Marine	Not available	Visited Nunavik villages on a few occasions during the last few years	208 Hillyard Street Hamilton (Ontario) L8L 6B6 Tel.: (905) 528-4780 www.mckeilmarine.com
Moosonee Transportation Limited (MTL)	3 barges and 2 tugboats	Mainly the west coast of James Bay and Hudson Bay	P.O. Box 156 Moosonee (Ontario) P0L 1Y0 Tel.: (705) 336-2225
Northern Transportation Company Limited (NTCL)	Several barges and tugboats	North-West Territories and Western Nunavut	42003 Mackenzie Hwy Hay River, NWT X0E 0R9 Tel.: (867) 874-5100 www.ntcl.com
Fednav	1 cargo ship	Deception Bay	1000, de la Gauchetière West Suite 3500 Montréal (Québec) H3B 4W5 Tel.: (514) 878-6500 www.fednav.com

a The number of ships varies according to contracts.

■ Companies that regularly service Nord-du-Québec villages.

Sources: Gaudreau, François. Personal experience
Corporate documents. Transport Desgagnés and NEAS.
Web sites of Fednav, NTCL and McKeil Marine.

Recently merged with Northern Transportation Company, Nortran and Arctic Co-op under the N3 Alliance banner, Transport Desgagnés and its partners now service all of Nunavut and Nunavik communities. This partnership now offers integrated services to customers who want to ship goods to the Nunavut. The N3 Alliance provides packing services, shipping to loading port, storage before ship loading and marine transport services. Within this alliance, Transport Desgagnés has the mandate of carrying out marine transportation to the communities of Nunavut's Baffin area, as well as to Nunavik villages.

Transport Desgagnés normally uses three or four ships (see Appendix 3 for their description) to transport general cargo to the communities and various supply sites in Nunavik and Nunavut. Most of these ships are certified for ice navigation by major ship registration firms (Lloyd’s and Bureau Veritas). The ships carry a variety of equipment used for unloading goods. This equipment essential to the operations, must be used to make up for the absence of a dock at the various supply locations. These are barges, tugboats, loaders, light tower generators, bunks, outboard canoes, buoys and trailers.

Petro-Nav operates two oilers (see Appendix 3) in order to supply oil products to Nunavik and Nunavut villages. These are modern ships that meet the most recent requirements concerning bulk oil product transportation in arctic waters (double-hulled). They are also equipped with the necessary emergency equipment to deal with a potential oil spillage (absorbing pads, booms, dispersants), as required by the *Arctic Waters Pollution Prevention Act* and by the *Shipboard Oil Pollution Emergency Plan* (SOPEP) of the *International Convention on the Prevention of Pollution from Ships* (MARPOL 73/78).

2.1.2 Nunavut Eastern Arctic Shipping (NEAS)

Nunavut Eastern Arctic Shipping is owned by Nanuk Transport and Nunavut Umiaq Corporation. Nunavut Umiaq Corporation, which holds 60% of NEAS shares, is the property of Sakku Investment Corporation, Makivik Corporation and Qikiqtaaluk Corporation[25]. Nanuk Transport is owned by Logistec Navigation and Northern Store. It should be noted that Northern Store used to own its supply ship and this company has a lengthy experience in supplying northern communities. Logistec Navigation has been supplying Nunavik and eastern Nunavut villages for almost half a century. NEAS offers one-stop services to customers who wish to ship general goods to the North.

Two cargo ships (see Appendix 3), that meet ice navigation requirements, are used by NEAS to service Nunavik and Nunavut villages. These ships are equipped with the same unloading equipment as Transport Desgagnés' ships.

2.1.3 Fednav

25 Nunavut Eastern Arctic Shipping. NEAS (May 2001), General information. Web site address: www.neas.ca

Fednav is a Canadian multinational company that owns an impressive fleet of ships travelling all oceans. Its involvement in Nord-du-Québec is limited to transporting general cargo and nickel ore between the port of Québec City and the Raglan mine facilities at Deception Bay (Raglan project). All year long, the N/M Arctic (see Appendix 3) goes back and fort between Deception Bay and Québec City harbour. In Québec, it loads machinery, containers, chemical products and various materials intended for the Raglan mining operations. The return shipment mainly comprises nickel concentrate, with some outdated equipment and waste oil.

The N/M Arctic is a unique ship built in 1978. This ship is in fact a real icebreaker cargo with a hull as strong as that of an icebreaker and a very powerful engine. In spite of thick ice, it is therefore capable of reaching Deception Bay in the middle of winter, which is exceptional for a cargo.

2.1.4 Moosonee Transportation Limited (MTL)

Moosonee Transportation Limited was previously involved in the transportation of general cargo on the Québec coast of James Bay. The Cree villages of the Québec James Bay territory now being linked to the Québec road network, most freight is shipped by truck. Even though it operates there occasionally (to complete some specific contracts), MTL is not very active any more on the eastern coast of James Bay. By contrast, its activities have rather intensified on the west coast of the bay[26]. The company is, however, still very present at Wemindji, where its equipment is stored (barges and tugboats) during the winter season.

2.2 General Description of Marine Transport Services in Nord-du-Québec: Traffic

Freight companies generally start loading their ships during the third week of June. The first ships thence head north at the end of June or in early July. Depending on weather and ice conditions and the ship's speed, the trip lasts six or seven days before reaching the first village. Depending on the village's importance and the quantity of goods to deliver at each location, the ship will make between two and five visits during the season.

General goods loaded on cargo ships include all sorts of goods, packaged in various ways. Simard et al. (1996) made a short list of the types of goods carried by Transport Desgagnés for governmental transport services in 1984 (Appendix 4). There are main goods (consumer goods, supplies), construction materials, cement, steel, wood, prefabricated materials, insulation material, furniture and various other dry goods. Petroleum products (oil and diesel) in barrels on pallets as well as voluminous items such as trailers, vehicles, tanks and electrical power units are also transported. Perishable foods (usually in small quantities), canoes or boats, snowmobiles and ATVs can be added to this list.

26 Cool, Rhea, Moosonee Transportation Limited (2001), Personal communication.

There are several types of packaging for all these products. Now more and more, the goods are containerised for a safe shipment. Modern machinery makes it easier to handle the containers, even when the terrain is not very adequate for this kind of operation. In general, there is little packaging for materials (wood, steel and insulation); they are in fact strapped and covered with a plastic sheet. More fragile materials and of various shapes are placed into crates. Furniture, personal property and small equipment used for construction are packed in wood crates. A lot of goods are also simply packed in waterproof cardboard boxes attached to wood pallets. Perishable goods are transported in refrigerated or freezing containers, according to food type. Small cars are regularly put into containers, while larger vehicles (pick-up trucks) are loaded on board without protection. Packaging is not always effective in protecting the contents; repeated handling of packages and the nature of the carrier sometimes contribute to damaging poorly packaged parcels.

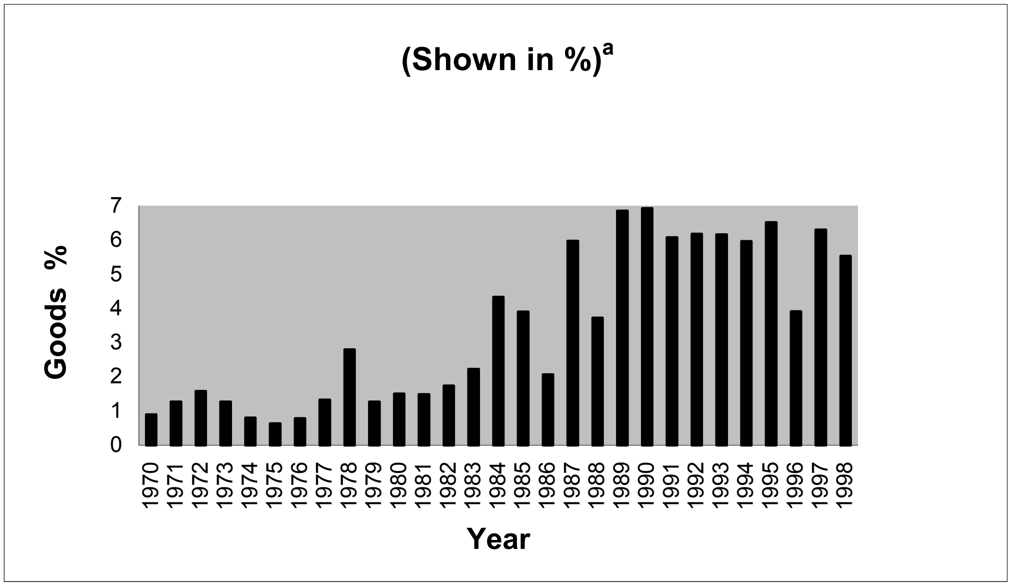
2.2.1 Volume of Cargo Handled in the Past

Transport companies and shippers are somewhat reluctant to reveal information concerning freight quantities, thus the available information is limited. In the following paragraphs, we will nonetheless attempt to draw a picture of the evolution of freight volumes in the past.

Nunavik

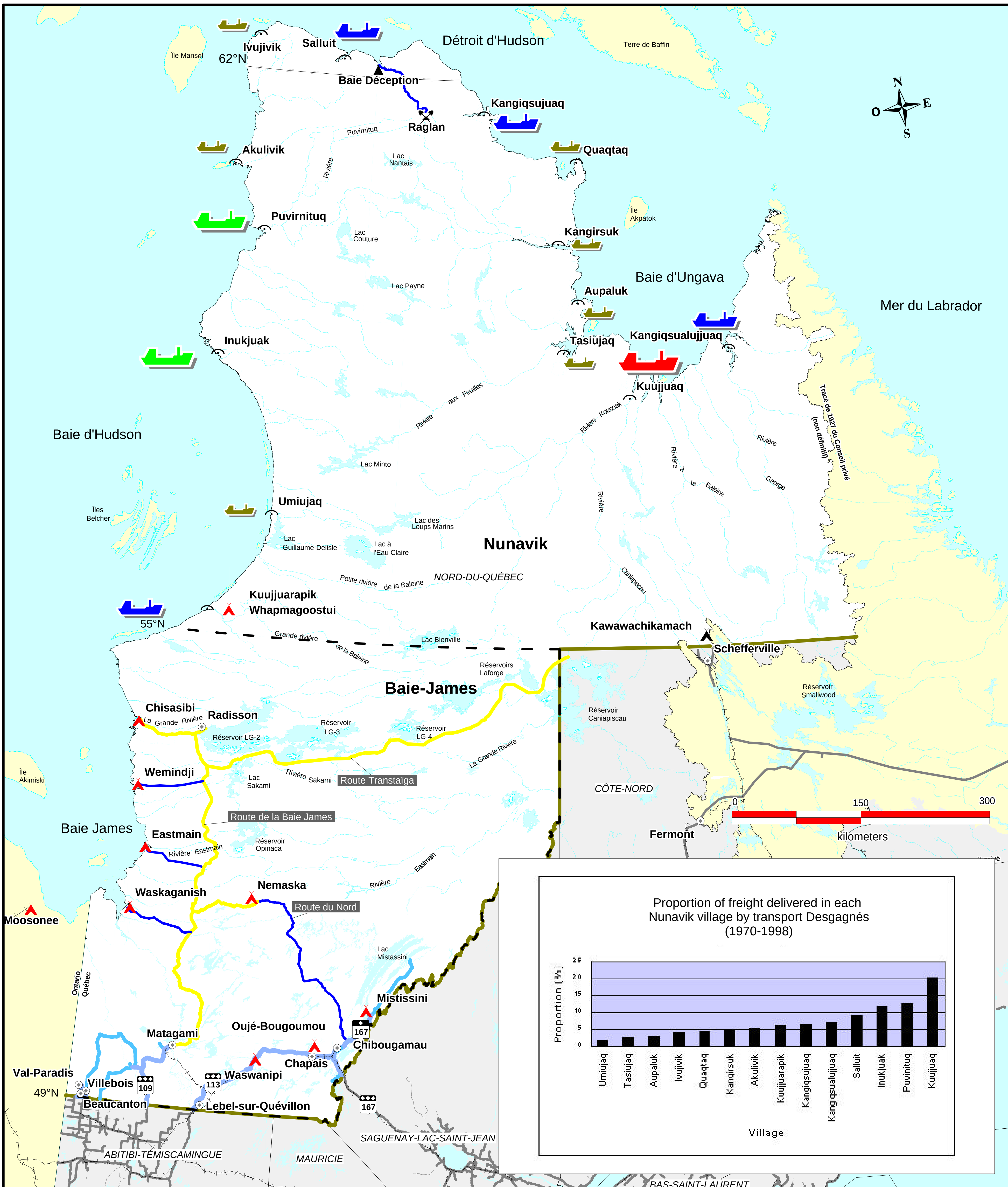
Chart 1 shows the evolution of cargo quantities carried to Nunavik by Transport Desgagnés from 1970 to 1998. Data is given in percentages for confidentiality purposes. It should be stressed that this data does not cover all the freight in Nunavik and the growth shown on this chart is not an exact indication of the global trend. It shows however, that there is in the long term a clear increase in the quantity of freight shipped to Nunavik. In the short term, numbers vary considerably.

CHART 1
FREIGHT HANDLED BY TRANSPORT DESGAGNÉS IN NUNAVIK, 1970-1998



a Yearly rates indicate proportions of freight shipped to Nunavik during the 1970-1998 period.
Source: SNC Lavallin Inc. and Paul F. Wilkinson & Associates Inc. (2000) *James Bay Marine Facility Pre-feasibility Study: A Comparative Evaluation of Chisasibi and Wemindji.* p. 34.

Map 4 and its accompanying chart 1 show proportions of general goods delivered by Transport Desgagnés in each Nunavik village from 1970 to 1998. This map shows that the quantities of delivered goods vary considerably from one village to another. Kuujjuaq received 20% of the freight during this period, while Umiujaq received only 2%. The freight delivered seems to be proportional to the population of northern villages. So it is possible to ascertain that Kuujjuaq, Puvirnituq, Inukjuak and Salluit are the villages that received the most freight; these villages are also the most densely populated with Kuujjuarapik-Whapmagoostui.



Transports Québec

Direction de la coordination
du Nord-du-Québec

Map 4: Proportion of freight delivered in each Nunavik village by transport Desgagnés (1970-1998)

Transportation Plan of Nord-du-Québec

Maritime transport: overview,networks, infrastructures, operation and management in Nord-du-Québec

Localisation

- Cree village
- City or town
- Inuit municipality
- Naskapi village
- Operational site
- Mine

Administrative limit

- Municipalité de la Baie James
- South limit Nord-du-Québec region
- Other Québec region

Proportion of freight delivered in each villages

- From 16 to 20 % (1)
- From 11 to 15 % (2)
- From 6 to 10 % (4)
- From 0 to 5 % (7)

Source:
- Ministère des Transports du Québec
- SNC Lavallin et Paul F. Wilkinson & Associates

Basic map:
- Ministère des Ressources naturelles, digital maps, scale 1 : 250,000 and 1 : 8,000,000

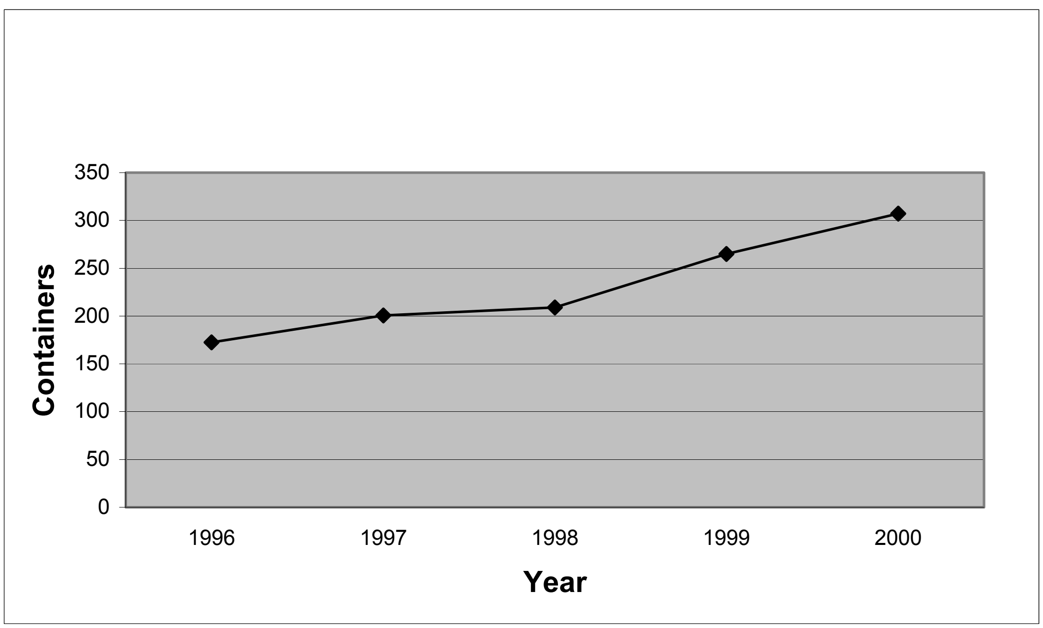
October 2002

It was not possible to obtain data on NEAS' freight volume, but some unofficial information and findings tend to reflect that with time, freight quantities vary on the short term, according to development and construction projects, while on the medium and long term, they are slightly on the increase[27].

It should be noted that overall, all transport companies put together, approximately 150,000 cubic metres of general cargo is shipped to Nunavik every year[28].

Chart 2 shows the evolution trend of the number of 20' containers (TEU) carried for the Fédération des Coopératives du Nouveau-Québec (FCNQ) to 14 Inuit villages of Nunavik. The FCNQ owns stores in every Nunavik village. It sells all kinds of goods: food, clothes, fishing and hunting gear, appliances, furniture, snowmobiles, all-terrain vehicles as well as canoes. All these goods, except for snowmobiles, all-terrain vehicles and canoes, are transported in containers. The number of containers shipped in Nunavik rose from 172 in 1996 to 307 in 2000. This strong increase of the number of containers sent to Nunavik is mostly due to the implementation of construction or alteration projects in the stores[29]. This also supports the trend towards containerisation in the last few years.

CHART 2
NUMBER OF CONTAINERS (TEU) SHIPPED TO NUNAVIK FOR THE FCNQ, 1996-2000



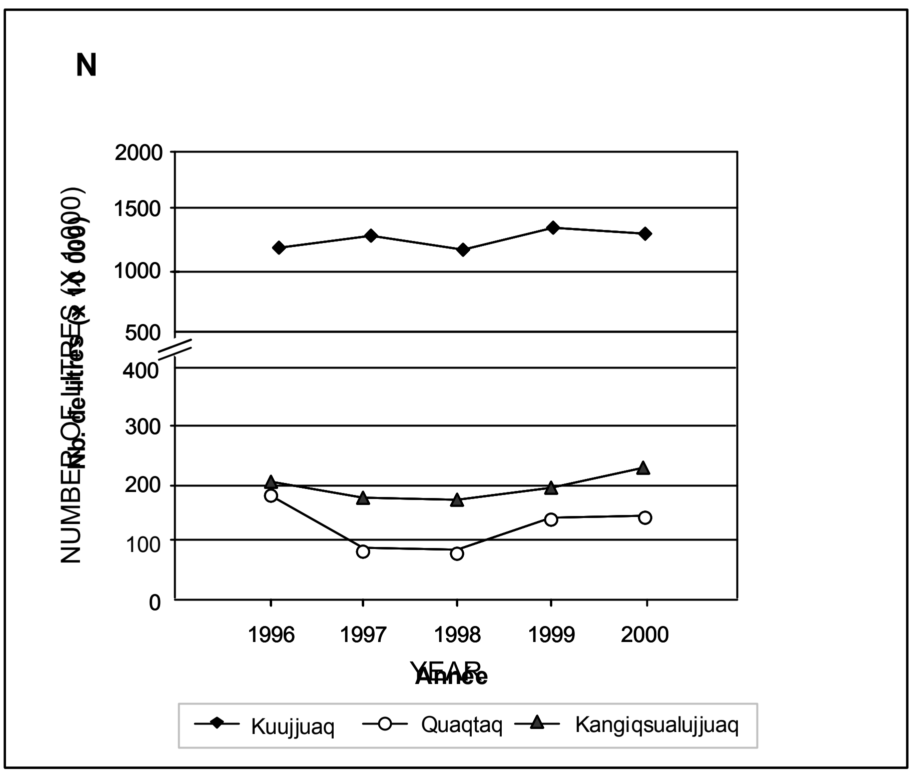
Source: FCNQ (2001) Personal communication.

27 Paquin, Suzanne, NEAS (2001), Personal communication.
28 SNC Lavallin Inc. and Paul F. Wilkinson & Associates Inc. (2000) *James Bay Marine Facility Pre-feasibility Study :* A Comparative Evaluation of Chisasibi and Wemindji. p. 43.
29 Sautette, Guy, FCNQ (2001), Personal communication.

The ships that supply Nunavik frequently return with cargo to the ports of the St-Lawrence River or carry freight between northern villages. However, there is no data available on the quantity of goods handled in this way. We do know that these containers are the property of, or rented by, construction contractors and stores (FCNQ and Northern Store). Sea carriers also return obsolete machinery, equipment used on construction sites as well as personal property. The goods transferred from one village to another are usually equipment and tools that belong to contractors.

Concerning petroleum products, we have obtained data on the freight volumes for Shell Canada over the last five years. Chart 3 shows there is a slight increase in the number of litres of petroleum products delivered to the villages of Kangiqsualujjuaq, Kuujjuaq and Quaqtaq. Although slight, this increase could be explained by the fact that the automobile population as well as the number of snowmobiles and all-terrain vehicles is constantly on the rise in Nunavik villages. The FCNQ ships and sells petroleum products in the other villages of Nunavik; but since freight volume data is confidential, it is impossible for us to analyse it.

CHART 3
NUMBER OF LITRES OF OIL PRODUCTS SHIPPED TO NUNAVIK FOR SHELL CANADA, 1996-2000



Source: Chabot, Yvon. Shell Canada (2001), Personal communication.

Deception Bay

For each of its five or six yearly trips to Raglan Mine, the N/M Arctic loads some 24,000 metric tons of nickel concentrate and some 150 to 300 tons of waste oil and general cargo bound for the Québec City harbour. It returns to Deception Bay loaded with some 3,200 cubic metres of general cargo (machinery, containers, reagents and explosives). Oilers visit Deception Bay three times every year and each time, approximately ten million litres of oil products are delivered[30].

James Bay

It was impossible to obtain data for the James Bay Cree villages about the evolution of freight volumes by sea over the last few years.

Prices

Today, freight prices for supply operations in Nunavik are subject to market fluctuations. Since there was no governmental transport service for the 2001 season, there was no price smoothing. It is therefore difficult to know the rates charged by carriers for the 2001 season, because they are set differently according to volumes, locations, customers, etc.

2.2.2 Forecast of Cargo Volume to be Handled in the Future

The stakeholders in the maritime sector involved in shipping goods to Nunavik, who were contacted in the framework of this study, refused to make any projections about cargo quantities that could be transported in the future. This is understandable, considering the strong competition between carriers to get shipping contracts. It was nevertheless mentioned that freight volumes should be maintained and would vary according to various construction projects.

By reviewing Nunavik's socio-economic data, it is possible to foresee a freight increase in the coming years. According to some sources, Nunavik needs 400 new houses[31]. This data is explained by the growth of Nunavik's Inuit population. A rapid glance at the age pyramid issued by Santé Québec in its *Rapport sur la santé des Inuits du Nunavik* (Appendix 5) allows us to anticipate that the demand for housing should remain high in the coming years[32]. The Inuit population is actually very young and the number of occupants per housing unit is high[33]. All these social indicators tend to indicate that freight volumes to Nunavik will increase or at least be maintained in the future. Since the main infrastructures (schools, health clinics, day care centres and municipal

30 Robillard, François and Harvey Jeannot. Falconbridge (2001), Personal communication.
31 George, Jane. Nunavik's Housing Crunch Continues. *Nunatsiaq News*. August 24, 2001.
32 Santé Québec (1992) *Et la santé des Inuits, ça va?* Report on the Santé Québec survey of the Nunavik Inuit. p. 46.
33 Chamberland, René, Société d'Habitation du Québec (2001), Personal communication.

buildings) have already been built, it is not possible to contend that freight quantities to Nunavik will increase as rapidly as in the past[34].

The young population of the Cree communities located on the James Bay Coast is an indication of the region's rapid growth. The demand for housing and various infrastructures should increase and therefore result in additional freight to Cree villages[35].

2.3 General Description of the Logitics of Marine Transport Operations in Nord-du-Québec

Because of time constraints and the lack of marine infrastructures, supply operations in Nunavik villages require specific logistics. The crews of cargo ships and oilers must perform special operations to service the communities and various locations of Nord-du-Québec.

2.3.1 General Cargo

Ship Loading

Sea carriers usually receive goods for freight up to a few days before ship loading. Freight is first temporarily stored at the port, then taken out on the docks a few hours before loading. Significant preparation is previously carried out to separate and classify the goods in order to facilitate and speed up the transfer on board. Ship loading is a key event for the success of the supply trip to the North. Apart from basic rules such as ship stability, dockworking crews must deal with specific constraints, especially the weight and size of each parcel, the maximum use of space, the sorting of parcels by village and according to the planned itinerary. The management of loading operations is not a simple matter, considering that thousands of parcels destined to some ten different villages must be loaded on the same ship. It is important to take into account the parcels' shape and weight to avoid breakage during transport. Also, for the operations to be profitable, shipowners make sure the ships are fully loaded. Parcels must be loaded on board in reverse order to unloading at destination and cases where parcels intended for a village are mixed up with parcels destined to another village, must be eliminated by all means. Moreover, strict and complex rules dictated by the *Transportation of Dangerous Goods Regulations* (TDGR) and the *International Maritime Dangerous Goods Code* (IMDG) must also apply to the handling, placing and tie-down of dangerous goods. In consequence, Class 1 (explosives) and Class 2 (gas) or 3 (flammable liquids) cargo must be separated during ship loading. Also, certain parcels must be placed on the deck of the ship, particularly those containing flammable gas (propane). All these obligations force shipowners to prepare precise loading plans to give directions to dock workers.

34 Marcil Guy, Ministère des Transports (2001), Personal communication.
35 SNC Lavallin Inc. and Paul F. Wilkinson & Associates Inc. (2000) James Bay Marine Facility Pre-feasibility Study : A Comparative Evaluation of Chisasibi and Wemindji, p. 93.

Routes

After navigating for six days on the St. Lawrence River and Gulf, the Strait of Belle Isle and the Labrador Coast, ships head towards the supply sites. Upon the ships' arrival at proximity to these sites, the officers perform difficult and precise manoeuvres to take the ships as close as possible to the various sites and drop anchor. In fact, the closer the ship is anchored to the beach, the shorter the unloading operations.

The routes travelled by the ships, as well as the order of visited sites, are not regular. Carriers decide on routes according to various constraints. Obviously, the issue of distance between locations is the first constraint; therefore a ship will service locations successively located close to each other. Furthermore, according to the type of cargo to deliver to a location and the placing of these goods on board, carriers will start unloading the ship at a location instead of another. In order to offer the best service possible to their customers, carriers can also decide to supply a location in priority. It should be added that ships can change their route along the way, to respond to a transport request or other constraints (access limited by ice, bad weather).

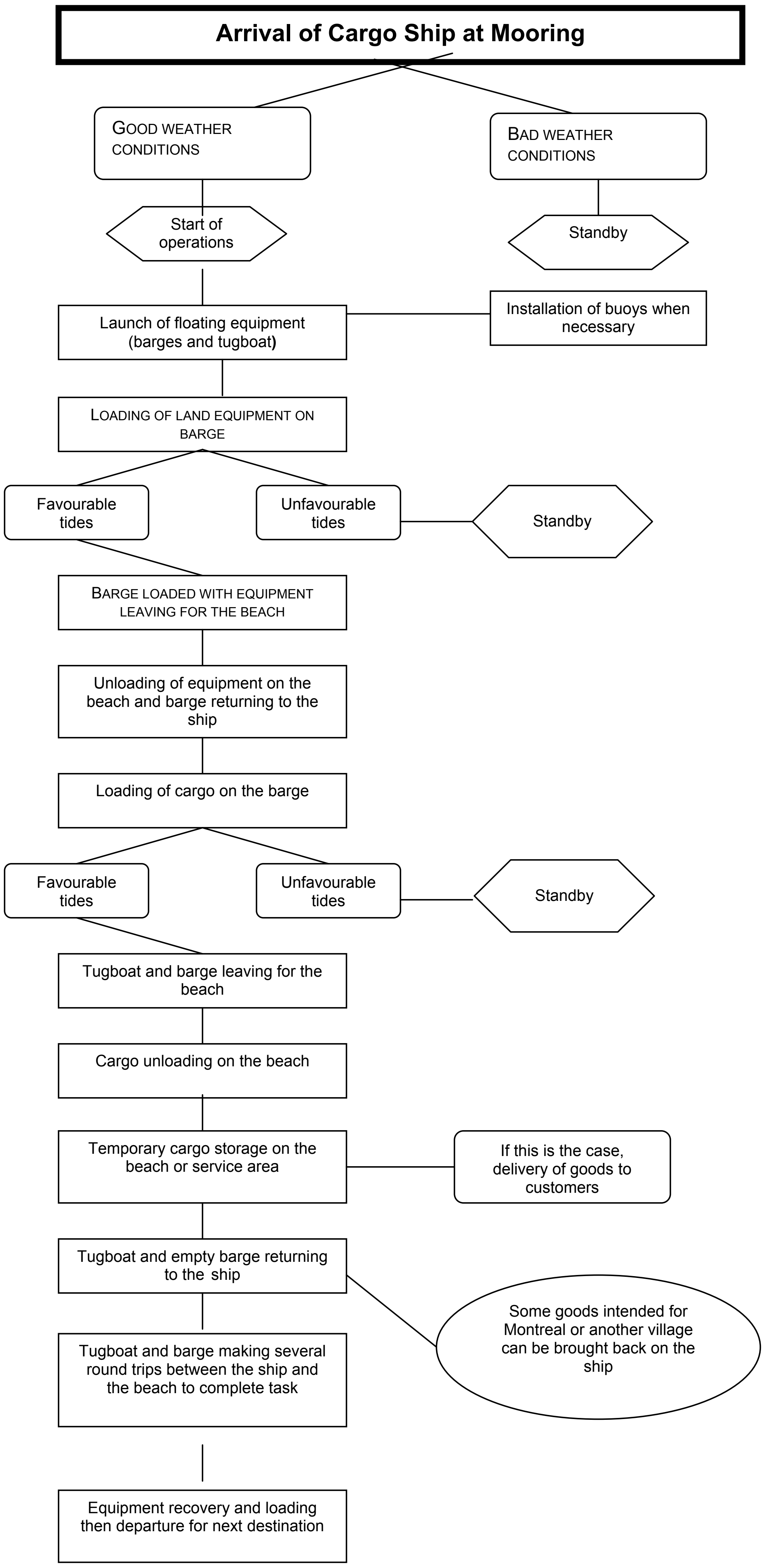
Unloading

As shown on Figure 1, various operations are carried out when unloading the ships.

Barges and tugboats are first launched by deck cranes. Where there is no dock, this equipment is used to go back and forth between the anchored ship and the supply site. During that time, some of the unloading crewmembers go to the village by canoe to prepare the site and ensure the smooth running of the operations. The main task is then to install buoys to clearly indicate the approach channel and reduce the risks for incidents while tugboats and barges approach the shore.

Afterwards, land equipment is loaded on barges and brought to shore. When the barges return to the ship, they are tied to its hull and deck cranes start the loading process (Photo 3). All the cargo is then loaded onto the barges. This operation must be carried out with great care to avoid damaging the cargo and to use the maximum available space on the barges. The more goods are put on each barge, the less round trips will have to be done to complete the task. We should also bear in mind that loading the barges must be done while taking into account floatation and stability regulations relating to the barges. The precise handling of parcels by deck cranes is very sensitive.

FIGURE 1
CARGO UNLOADING PROCESS



Source: Gaudreau, François (2001), Personal experience

PHOTO 3
LOADING OF CARGO ON THE BARGE

François Gaudreau, 2000.

Cranes do not actually rest on stable bases, so parcels handled are twice or three times as much affected by the teeter totter action caused by the ship's pitching motion.

After the barges are loaded, and if the tide allows it, they are taken to the beach by the tugboat. The tugboat literally grounds the front part of the barges on the beach and removable ramps are set on the barges to allow land machinery to climb on. Photo 4 shows unloading operations on land from barges. Loaders equipped with forks climb on the barges and unload them. The parcels are then separated according to customer and temporarily stored on the beach or some vacant lot (Photo 5). They are later delivered to the various locations in the villages either by the shipping company, by contractors or by the municipalities. Barge unloading must be done rapidly where the tide limits access to the beach, in order to be able to return the barges to the ship before getting stuck at low tide when this happens the operations are delayed over one tide cycle which is very costly.

PHOTO 4
BARGE UNLOADING

Jean Côté, 2000.

PHOTO 5
TEMPORARY CONTAINER STORAGE AT INUKJUAK

Anick Guimond, 2001.

When cargo must be sent to another village or to Montréal, it is put on the barge and returned to be loaded on board the ship. These operations are repeated until the village supply is complete. Once the operation is completed, land and floating equipment is recovered on the ship and the latter heads to the next location.

Other Unloading Method

The unloading method described above is the one most often used for supply operations. These methods vary slightly depending on the ships and the persons in charge of operations; each ship's own equipment dictates how things will be done. For example, the N/M Aivik is equipped with a large ramp on which cargo is transferred. The barges are moored at the back of the ship and the ramp is lowered on the barges; cargo is then taken to the barges with forklifts, therefore reducing the sensitive use of cranes to load the barges.

The smooth conduct of cargo unloading operations using barges depends on field and weather conditions. In the cases where tides limit access to the beach, round trips to the beach must be synchronised with high tide periods (twice a day for semi-diurnal tides in the concerned area). As explained earlier, these operations are very delicate and therefore should be conducted under fair skies. It would be too dangerous for the safety of the crew and cargo to do this work under windy conditions. Since mooring areas and beaches are not sheltered, as soon as the wind starts blowing, waves get bigger and operations are halted.

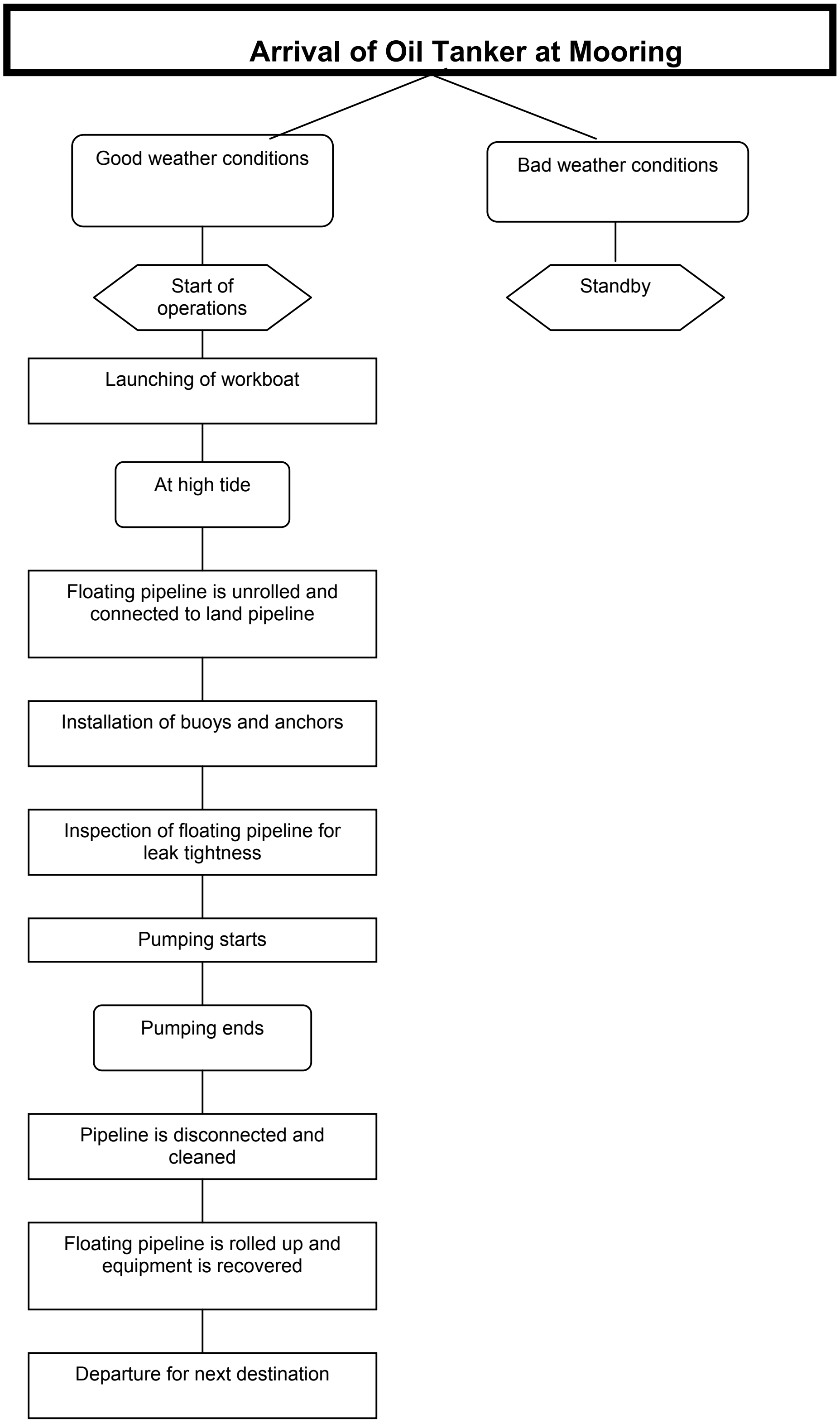
2.3.2 Petroleum Products

There are mainly two ways of unloading petroleum products in Nunavik. In fact, the same technique is used for all supply sites except for the village of Kuujjuaq, where a very different supply method is used because of particular conditions.

Floating Pipeline

Figure 2 shows the various steps involved in supplying petroleum products at most locations. Following approach manoeuvres, which are also tricky for oilers, the captain positions his ship and gives the order to drop anchor. It should be noted that oil tankers drop anchors in the front and back of the ship to prevent turning around the anchor when currents change direction. This normally occurs when a ship is only anchored at the front. Next, the ship's crew launches a workboat using the ship's deck crane. This boat is used to unroll the floating pipeline and connect it to the land pipeline located on shore these operations are done at high tide, because it is easier to lay out the pipeline on water than on land. Oil tankers are equipped with a big roller around which some 1,900 metres of floating pipeline are rolled up. Following the connection of the floating pipeline with the land pipeline, buoys are attached to the floating pipeline to clearly indicate its presence on the water surface and therefore reduce risks of collision with boats.

FIGURE 2
OILER UNLOADING PROCESS



Source: Tremblay, Sylvain. Transport Desgagnés (2001), Personal communication.

Anchors are sometimes attached to the pipeline to keep it in place and prevent it from drifting during periods of strong winds and currents. Before the pumping starts, compressed air is pushed into the floating pipeline to check for leak tightness. After the inspection, petroleum products can be pumped to storage tanks. The rate of these pumps is 70 to 80 m^3 per hour[36]. At this rate, for an average village and in ideal conditions, approximately two days are necessary to complete the operations. The floating pipeline and connections between pipelines are inspected every thirty minutes during the pumping; at the slightest doubt, the operations are halted and the pipeline is repaired. When pumping is over, the pipeline is cleaned and rolled up on board the ship. The workboat is recovered on board and the oil tanker leaves for the next destination.

Various occurrences can make the crew's task more complicated during pumping operations. First, mainly in Ungava Bay, tidal range and the strength of tidal currents exert considerable pressure on the floating pipeline. In some villages, such as Kangiqsualujjuuaq, the morphology of the mooring basin combined with tidal range cause tidal currents so strong, it is sometimes difficult to keep the ship in place[37]. To avoid any incident, the crew must pay close attention to the ship's slightest movement as well as the floating pipeline's movements. At Kuujjarapik, the oiler's mooring area is very far from shore and the floating pipeline has to be almost completely rolled out, which makes the operations much more complicated under windy conditions. It does not matter where the ships are, their crew constantly watches the weather forecast and when winds over 25 knots are announced, pumping is halted until conditions improve[38]. There has been neither accident nor spillage over the last years during these operations.

Barges

In Kuujjuaq, moorings used by oil tankers are located 12 to 20 nautical miles from the supply site, so it would be impossible to use a floating pipeline[39]. Petroleum product supply is therefore done using barges and tugboats. Two barges (each equipped with four tanks) pushed by two tugboats, go back and forth between the oil tanker and the beach. Photo 5 shows barges and tugboats aground on the beach and storage tanks in the background (Shell Canada facilities). Given the importance of tides in Koksoak River, tugboats can only access the beach at high tide. They therefore leave the beach about two hours after high tide to head out to the oil tanker.

36 Tremblay, Sylvain, Transport Desgagnés (2001), Personal communication.
37 Ibid.
38 Ibid.
39 Lamarre, Denis, Shell Canada (2001), Personal communication.

PHOTO 6
SHELL CANADA EQUIPMENT IN KUUJJUAQ

Jean Côté, 2000.

Drawing close to the tanker, they come alongside it and pumping operations are undertaken to fill the barges with petroleum products. These barges can respectively carry 210 and 240 m^3 of petroleum products[40]. When they are loaded and the tide is adequate, tugboats leave the tanker and push the barges to the beach. Depending on the tanker's mooring area and the weather conditions, tugboats will take between 1 hour 30 minutes and 2 hours 45 minutes to make the trip. Getting to the beach, the front of the barges runs aground and the pumping of petroleum products to the tanks can start. Pumping will be over in about 2 hours 30 minutes[41]. Kuujjuaq's supply operations always extend over some twenty days according to weather conditions.

Once again, like with the pipeline petroleum method, the crew always pays close attention to weather forecasts and takes no risks during the operations. As soon as the winds blow and tides are not sufficiently high, supply is halted and resumes with improving conditions. Neither incident nor spillage has occurred in Kuujjuaq during fuel supply operations.

40 Tremblay, Denis, Transport Desgagnés (2001), Personal communication.
41 Lamarre, Denis, Shell Canada (2001), Personal communication.

It should be noted finally that oil tankers are all equipped with booms, absorbing pads and dispersants to contain any oil spillage in case of an accident. This equipment meets the standards of the *Arctic Waters Pollution Prevention Act.* The barges used for supplying Kuujjuaq are also equipped with material to mitigate damages in case of an accident.

2.3.3 Transhipment of Goods at Deception Bay

Dry Bulk and General Cargo

In Deception Bay, cargo transhipment methods are more conventional because of the infrastructures in place. When the ship is docked, the nickel concentrate stored in a dome by the wharf, is brought to the ship by a complex system of screw auger and pneumatic conveyor. The concentrate is never in contact with free air during ship loading operations. Machinery, other material and waste oil are loaded on board with a land crane or the ship's deck cranes. The ships' loading and unloading operations usually last seven days at Deception Bay.

Petroleum Products

The petroleum product transhipment operations are simplified in Deception Bay. The wharf is connected to storage tanks by a land pipeline. The moored oiler is linked to the land pipeline by a short hosepipe. The pumping of petroleum products starts once the pipe's leak tightness has been checked. A constant surveillance is done by the ship's crew and Raglan Mine employees to make sure no leaks occur. A marine emergency crew set up every year attends to pumping work and is ready to take action at any time[42].

2.4 Activities Related to Marine Transport Operations that can Have a Negative Impact on the Environment

The marine transport industry can have various environmental impacts in Nord-du-Québec. Few studies have been conducted on these potential impacts and there is little discussion about this in the literature. We will discuss the impacts related to marine infrastructures and the impacts directly related to maritime transport.

2.4.1 Environmental Impacts Related to Marine Infrastructures

The construction and presence of marine infrastructures such as breakwaters, launching ramps and access roads have a definite impact on the environment. Construction work inevitably results in alterations to the intertidal zone and lands used to build the various

42 Robillard, François and Harvey Jeannot. Falconbridge (2001), Personal communication.

infrastructure elements (road and quarry). When possible, mitigation measures are taken to reduce the significance of the impacts on the environment. As for the intertidal zone, the rearrangement on the beach of materials removed from it during construction work as well as the reuse of stone blocks taken from the foreshore during the construction of breakwaters are valid mitigation measures[43]. The implementation and existence of coastal infrastructures affect the erosion, sediment transport and sedimentation processes that maintain the environment's dynamic balance. The alteration of sediment dynamics at each site will also have repercussions on the wildlife and flora that occupy these habitats. The benthic fauna, ichtyological fauna, sea mammal and plant habitats will be altered[44]. It should be mentioned however that marine infrastructures that were implemented as well as infrastructure construction projects are mostly located on sites already used for marine operations. These locations are generally not very affected by intense sediment transport. Moreover, given the human activities occurring at these locations, they are generally not very rich habitats. Consequently, there is little traditional gathering, fishing and hunting activities in these zones.

2.4.2 Environmental Impacts Related to Marine Operations

Whether domestic or commercial, marine operations also pose a risk to the environment.

Domestic Navigation

Domestic navigation and marine operations do not pose a great risk for the environment. The navigation and repeated passage of local boats can certainly disrupt wildlife and flora but these effects remain minimal. The transhipment of various products by the local population can also involve some environmental hazards. The transhipment of hunting and fishing products and petroleum products is done manually. This is the only way to transfer material from a peterhead to a canoe and eventually to the beach. These transhipment operations are carried out under difficult conditions when the weather is bad and there is a risk of spilling small quantities of fuel in the water.

Commercial Navigation

Commercial marine operations also involve environmental hazards and can have severe impacts on the environment in case of an incident. Measures have been implemented however, to mitigate environmental impacts and hazards.

43 Génium Urbatique (1997) Environmental Impact Study, Marine Infrastructures Project. Kangiqsualujjuaq, Summary. p. 8.

44 Génium (1995) Projet d'aménagement d'infrastructures maritimes nordiques dans la région du Nunavik. *Étude de préfaisabilité*, Kuujjuaq. p. 55.

The traffic of cargo ships and oil tankers in certain sensitive zones can result in impacts on or alterations to the natural habitat. Measures exist to mitigate, among others, the effects of this activity on wildlife. By virtue of an agreement between Société Minière Raglan and the Inuit villages of Salluit and Kangiqsujuaq, the N/M Arctic, which supplies the Raglan facilities, is prohibited from going through certain areas between May 15 and June 15 (seal calving season)[45]. Unloading operations for general cargo and petroleum products do not entail real impacts on the environment. Of course, there is a resuspension of sand and silt while land machinery unloads the barges, but this is only temporary and the water quality improves rapidly soon after the end of operations. It should be reminded that barge unloading operations are usually carried out at the location used by the local population for its own marine activities and these areas are seldom the site of fishing and hunting.

However, ship unloading activities do involve environmental hazards in cases where incidents occur during the operations. A potential spillage of petroleum products could be catastrophic for the natural habitat. On this subject, it should be mentioned that no incidents have been reported during petroleum product unloading operations. In the present situation (lack of infrastructures), strict procedures followed by the crews and their professionalism are the best guarantee against potential accidents. If a spillage should happen, it should be noted that oilers are equipped according to the requirements of the *Arctic Waters Pollution Prevention Act* to stop and contain a spillage. Moreover, the Coast Guard's icebreakers are also equipped to fight pollution and ready to take action in case of a spillage. In Iqaluit, there is a big equipment depot to fight pollution[46]. This equipment, which belongs to the Coast Guard and is managed by Iqaluit's radio station (SCTM) and by NORDREG, will be used to intervene in case of an incident.

In spite of all the precautions taken by machinery operators during the unloading of general cargo, the extensive handling of parcels can sometimes lead to minor incidents. General cargo comprises all kinds of goods including dangerous goods, and incidents could impact the environment. It usually concerns a small quantity of cargo that is rapidly recovered by the crews.

45 Robillard, François and Harvey Jeannot. Falconbridge (2001), Personal communication.
46 Pelletier, Sylvie. Canadian Coast Guard (2001), Personal communication.

3.0 STRENGTHS AND CONSTRAINTS OF MARINE TRANSPORT IN NORD-DU-QUÉBEC

Marine transport in Nord-du-Québec is subject to several constraints. Whether physical or human, considered as a whole or individually, these constraints are obstacles that stakeholders must circumvent to carry out their task. These constraints exist at the regional scale and at the local scale.

3.1 Strengths and Constraints for the Entire Region

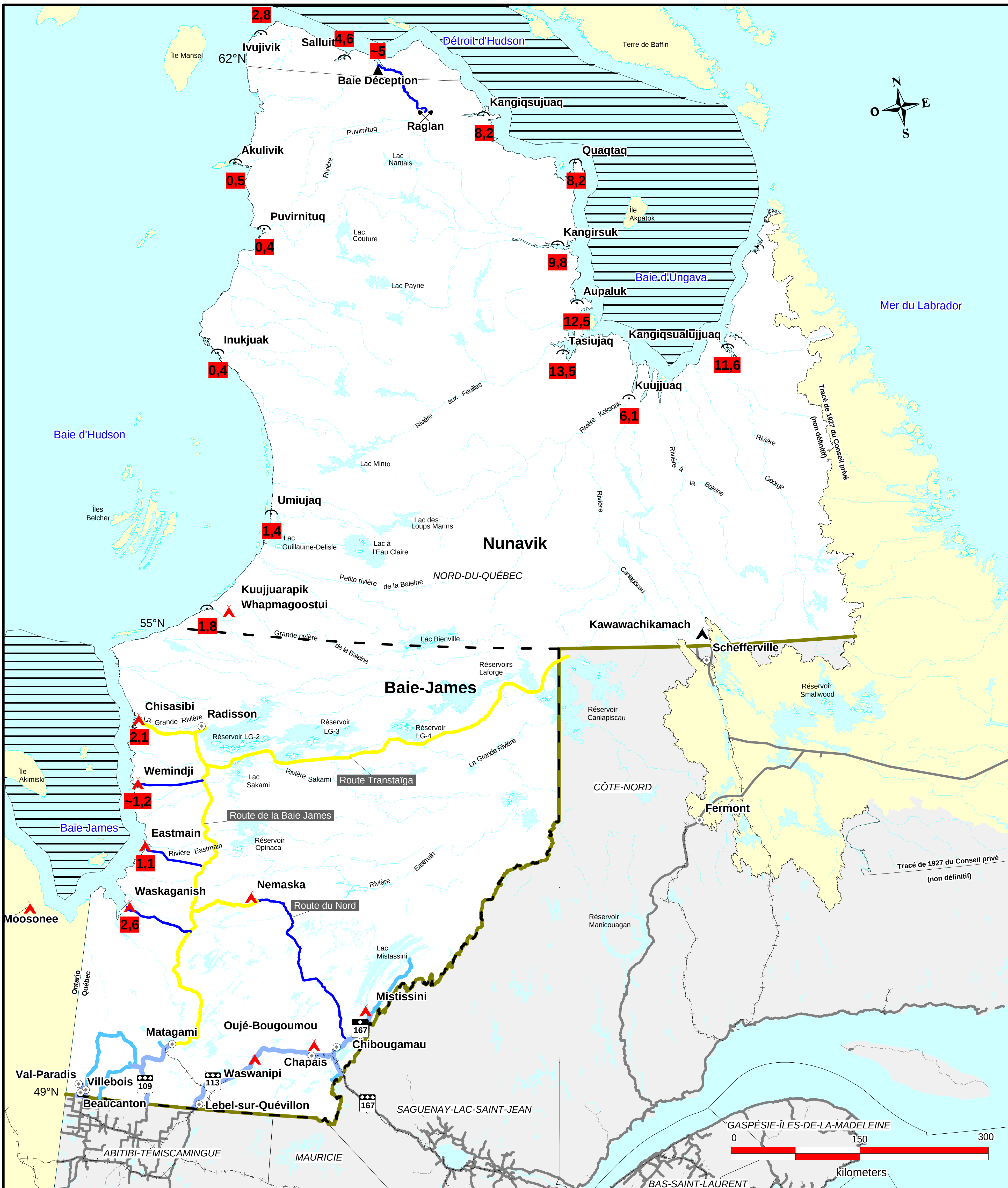
The Nord-du-Québec area is vast and constraints have different effects according to location. Ice and tide conditions are not the same in Ungava Bay, Hudson Strait, Hudson Bay and James Bay. On this matter, Map 5 shows areas of access constraints caused by tidal conditions.

3.1.1 Ice

The ice cover, present for seven months every year, is certainly one of the main constraints for marine transport in Nord-du-Québec. The ecological laws and processes that rule freeze-up and break-up are very complex and vary a lot according to location and latitude. This results in a multitude of ice types. We will only draw a brief picture of the ice conditions in the region. Appendix 6 shows a series of maps produced by the federal government's Ice Centre, that explain sea ice evolution in the Ungava, Hudson and James bays and in the Hudson Strait all year long.

Ice starts to form in the bay head and coves where water is more still, around the middle of November. Spring thaw is usually over at the end of June. Given the latitude differences between the bays of Ungava, Hudson and James, freeze-up and break-up do not occur at the same time. In the fall, ice forms from the Foxe Basin and advances toward the south; while thawing starts in James Bay in the spring and progresses onto Hudson Bay's east coast. Ice is gradually cleared through the Hudson Strait, which is ice free by mid-July[47]. This ice cover limits the duration of the navigation season, which starts at the end of June and is over by mid-November. From December to June, most ships cannot travel these waters, and even if they could, it would be impossible for the barges to go back and forth between the beach and the ship.

47 Fleet Technologies Ltée, (1994) *Étude des infrastructures maritimes au Nunavik.* Final Report, p. 71.



Transports Québec

Direction de la coordination
du Nord-du-Québec

Map 5: Aera of access constraints caused by tidal conditions

Transportation Plan of Nord-du-Québec

Maritime transport: overview,networks, infrastructures, operation and management in Nord-du-Québec

Localisation

- Cree village
- City or town
- Inuit municipality
- Naskapi village
- Operational site
- Mine

Administrative limit

- Municipalité de la Baie James
- South limit Nord-du-Québec region
- Other Québec region

Tide

- 13,5 Amplitude (meters)
- Area where the tide limits access to the sites

Source:
- Ministère des Transports du Québec
- Fisheries and Oceans Canada, (1988) Sailing directions, Labrador et Baie d'Hudson, 491 pages

Basic map:
- Ministère des Ressources naturelles, digital maps, scale 1 : 250,000 and 1 : 8,000,000

October 2002

3.1.2 Tides

In the Nord-du-Québec region, tide amplitudes vary depending on the location; whether it is the Ungava Bay, Hudson Strait, Hudson Bay or James Bay. Moreover, the morphology of the various basins also greatly influences the tide's amplitude. The Hudson Strait and the Ungava Bay are affected by strong tidal falls, the harmonic component that originates in North Atlantic, flows into the strait and its amplitude is increased by the basin's morphology. This phenomenon reaches a high at the head of Ungava Bay where the tide fall reaches 15.2 metres[48]. In Hudson Bay and James Bay, the impact of tides is not so strong. Because of the bay's morphology, its depth and physical factors, the tides' amplitude is somewhat weak.

Tides have a significant impact on marine traffic and supply operations in Nord-du-Québec. In Ungava Bay, a ship must frequently wait for slack tide or at least an abating of tidal current to go upriver. It would be too risky, even impossible, for a ship to go against currents that can reach 12 knots at times (21.5 km/h)[49]. In these cases, ships drop anchor or reduce their speed in order to avoid periods of strong current and go upriver under the best conditions.

The other significant result of tides is the direct access to villages for small boats. In certain villages at low tide, the intertidal zone dries up completely and it is impossible to reach the beach by water. It is necessary to wait for high tide and navigate in narrow channels that lead to the village. In these cases, the beach is only accessible during a few hours of the day to operators of marine transport services. This access constraint is limited to Ungava Bay villages and to certain Hudson Strait and James Bay villages.

3.1.3 Absence of Marine Infrastructures

The fact that marine infrastructures are precarious or absent in certain villages of Nord-du-Québec, is obviously a major constraint to marine transport in this region. As mentioned earlier, there are a few access ramps, floating pontoons for small boats and a program for the construction of infrastructures that is underway, but there is no wharf (for small or large boats) where it would be possible to dock and that would significantly facilitate transhipment operations. The exception is the private wharf at Deception Bay. This constraint forces marine carriers to use barges and tugboats to go back and forth between the village and the ship lying at anchor and that substantially increases the length of operations and their related risks. Obviously, it would not be appropriate to build a deep water wharf at each supply site, it would however be warranted to implement simple facilities to make navigation and unloading activities safer. The infrastructures built in the framework of the Nunavik Marine Infrastructure Program will help in making marine operations safer.

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48 Fisheries and Oceans Canada (1988), Sailing Directions, Labrador and Hudson Bay, p. 96.
49 Ibid.

3.1.4 Other Constraints

Apart from the constraints listed above, several other occurrences contribute to the difficulty of marine operations in Nord-du-Québec. Very changeable weather conditions constitute significant constraints for the operations. The fog, drizzle and snow greatly reduce visibility at sea. Moreover, strong winds that suddenly start blowing can catch many navigators by surprise and cause them problems. We should not omit to mention the presence of icebergs and drifting ice, especially on the Labrador Coast. This situation forces navigators to be extremely cautious at sea.

3.2 Strengths and Constraints for Each Site

Appendix 7 shows a table, which summarizes the strong and weak points for each location visited concerning supply operations. Certain constraints are specific to each site, while others (regional constraints) exist at several locations, but have different effects depending on the site. Here is a brief view of site-specific constraints. This information was collected from stakeholders responsible for marine supply operations.

Kangiqsualujjuaq

Kangiqsualujjuaq is a village located 14 nautical miles upstream from the mouth of George River. This impressive river that flows into the southeast end of Ungava Bay, is narrow in places and sometimes shows very strong currents. This forces navigators to wait for dawn as well as the reduction of tidal currents to go upriver for mooring. Also, because of the tidal range (11.6 metres) and the intertidal zone's weak slope, the village's beach used to be only accessible during high tide periods. The access ramp built in the summer of 1998, in the framework of the Nunavik Marine Infrastructure Program, now facilitates access to the village. Access is now possible for shallow draft boats, during a time frame of approximately four hours (two hours before and two hours after high tide) for each tidal cycle. Navigators piloting in the narrow channel that leads to the access ramp, must have an extensive knowledge of the area, since there are numerous obstacles and navigational aids (buoys) are scarce. As is the case in several villages, and even though the ramp was built to be used by the local population, marine transport operators use it for unloading operations; this poses certain problems of traffic congestion. The new landing site has a solid bottom that makes circulation much easier for heavy machinery.

Kuujjuaq

In Kuujjuaq, the tide range is 6.1 metres at the level of the village located some 31 nautical miles from the river's mouth. Alignments are arranged on the river banks to direct navigators going upriver. The Koksoak River, just like George River, is very narrow in some places and currents reaching ten knots are fairly common. So here too, one must wait for daylignt and slack tide to go upriver[50]. Certain ships drop anchor a few miles from the village, while others, with deeper drafts, must drop anchor much further

50 Desgagnés, Sylvain, Port master (2001), Personal communication.

downriver. Access to the beach is also severely limited by tides. It is possible to get there two hours before high tide and one must leave two hours after it. There are a few alignments and recognition lights (public and private) to guide tugboat captains when they go back and forth between the ship and the beach, but these are clearly insufficient given the difficulty of navigating the Koksoak River[51]. As is the case with Kangiqsualujjuaq, there can be some conflicts between the local population's needs and those of transport service operators, since they use the same location to access the sea. Kuujjuaq being Nuvavik's biggest village, a lot of cargo is unloaded there and the site rapidly becomes congested. Steel plates installed on the beach are very useful, because machinery easily gets bogged down in the fine sand. It would be advisable however to add more steel plates to enlarge the circulation area for machinery.

Tasiujaq

Tasiujaq is located on the shore of Rivière-aux-Feuilles, 35 nautical miles from Ungava Bay. A large basin connects the river to the Ungava Bay. Tidal range is 13.5 metres. Because of tide driven strong currents, ships usually have to wait for a drop in tidal current speed to cross certain parts of the river. Navigation between the beach and the ship is difficult and requires the installation of buoys to clearly mark the channel. The weak beach slope and the tidal range make it possible to reach the beach two hours before high tide and one has to leave one hour and a half after it. Even if little cargo is unloaded in Tasiujaq, the site rapidly becomes congested. Crews must be careful with machinery on the beach of Tasiujaq, since it can get bogged down in the soft bottom.

Aupaluk

Aupaluk is one of the smallest villages of Nunavik. Even if tidal range is 12.5 metres, tidal currents do not hinder the ships' approach to the village. Navigation must be precise however, since certain sections are quite narrow, which explains the presence of alignments. It is also cautious to go upriver during daylight. Here too, the weak beach slope (see Photo 7) and the tide fall limit access to the beach at two and a half hours before high tide and two hours after it. It should be noted that the access channel to the beach is maintained by the municipality, but that it is not well marked. The space available backshore is sufficient for the temporary storage of the few goods to be delivered to Aupaluk. Machinery can easily operate without the risk of getting stuck on the beach.

51 Leclerc, Félix, Transport Desgagnés (2001), Personal communication.

PHOTO 7
AUPALUK BEACH

Anick Guimond, 2001.

Kangirsuk

The village of Kangirsuk, some nine nautical miles upstream from the mouth of Payne River, has tides of 9.8 metres. Very strong tidal currents force navigators to cross the river during slack periods. Also, because of the difficult navigation on Payne River, five pairs of alignments are arranged on its shores to direct navigators. These manoeuvres must be carried out during daylight. The ramp built by MTQ in 1987 facilitates access to the village. This way, even if tides have a certain amplitude, the village is accessible during 18 or 20 hours each day. Navigation is not too difficult between the ship's mooring and the beach; it is not necessary to put buoys to indicate the channel. The solid bottom offers a good carrying capacity for machinery.

Quaqtaq

Quaqtaq is located at the northwestern end of Ungava Bay. Access to Quaqtaq's mooring station is relatively simple for navigators, it is however not very well-sheltered and waves grow rapidly under northerly and westerly winds[52]. Barge loading operations then become very complicated. Tidal range (8.2 metres) limits access to the beach (two hours before high tide and one hour thirty minutes after it) and the channel that leads to

52 Fisheries and Oceans Canada (1988) Sailing Directions, Labrador and Hudson Bay, p. 359.

the beach is poorly marked. The breakwater built during the summer of 2000 largely contributes in reducing the waves that enter Mission Bay. Similarly to the other villages, there are also problems here concerning the use of space during unloading operations and congestion of the beach because of the accumulation of goods. The circulation of machinery on the beach is sometimes difficult, because the bottom is soft in some places.

Kangiqsujuaq

The Kangiqsujuaq community is located six nautical miles from the mouth of a fjord that ends in the Hudson Strait. Tidal range is 8.2 metres in the bay of Kangiqsujuaq. Approach is rather easy for ships and the anchorage area is close to the village. The infrastructures built by Makivik Corporation in the fall of 2001 will significantly ease marine operations. Once limited to 33% of the time, access to the beach is now possible 90% of the time, facilitated by the available water depth and the access ramp[53]. Two breakwaters constitute a sheltered mooring area accessible at all times for small boats. In the case where marine transport operators would use this site, there should be a clear agreement on the issue of priority use to avoid conflicts and reduce hazards during unloading operations. An efficient buoyage of the channel would also be desirable at Kangiqsujuaq.

Deception Bay

In contrast with the other locations of Nord-du-Québec, the Raglan site has impressive infrastructures (wharf, storage area, machinery, unloading equipment). Two pairs of day alignments ensure that navigators will not go off their way and will reach the wharf without danger. Tidal range is not available for Deception Bay but it is believed to be approximately five metres. Ocean currents are weak and pose no problems to navigators. The wharf at Deception Bay can host deep draft ships (10.7 metres).

Salluit

The Salluit northern village is located south-east of the Sugluk Inlet. Tidal range (4.6 metres) is much less significant here compared with Ungava Bay. Approach to the mooring area is safe and it is possible to drop anchor relatively close to the village. The channel leading to the landing site is poorly marked and access to the beach is limited to two hours before and two hours thirty minutes after high tide. The beach's solid bottom is not a problem for the machinery.

53 Yang, Shun Hui, Makivik Corporation (2001), Personal communication.

Ivujivik

Ivujivik is located at the northern tip of Québec. The ships' approach to the anchorage area is without danger. The Ivujivik mooring site is however very poorly sheltered and as soon as the wind blows, waves come into the harbour and operations become hazardous. Tides of 2.8 metres and the beach's strong slope do not hinder access to the landing site. Crews can work there almost around the clock; only slack low tide periods limit access. In Ivujivik, there are also some problems with the priority of beach use during unloading operations. The beach's bottom is too soft and this causes problems for heavy machinery circulation.

Akulivik

The village of Akulivik is located on Hudson Bay's northeastern coast. Tidal range is only 0.5 metre in Akulivik, and that poses no problem for the ships' approach and access to the beach. The beach is accessible 24 hours a day. Since space is limited, there is little room for storing goods temporarily in Akulivik. The beach's solid bottom is good for heavy machinery circulation.

Puvirnituq

Puvirnituq is one of the big villages on the Hudson Bay coast. Navigation must be very precise to approach the village of Puvirnituq; four day alignment pairs have incidentally been installed by the Coast Guard to make approach manoeuvres easier and safer. These manoeuvres must be carried out during the day to avoid any incident. Ships exceeding 121 metres in length with more than 6.7 metres of draft must drop anchor outside the river, while smaller boats can approach the village[54]. Weak tides (0.4 metre) do not hinder access to the unloading site. There is a severe lack of space in Puvirnituq. As the village is relatively large and a significant amount of cargo is delivered there, that local users and marine transport operators use the same site and that the latter which is quite confined, it rapidly becomes congested and cargo has to be stored on adjacent roads. Machinery can easily operate at the landing site.

Inukjuak

Inukjuak is also a big village on the Hudson Bay. Approach manoeuvres are simpler here than in Puvirnituq and it is possible to drop anchor at proximity to the village. The pier and weak tidal range (0.4 metre) allow access to the village at all times. Tugboats must approach the pier very carefully since there is a sandbank next to it. It would be advisable to clearly mark the latter with a buoy. As in the other villages, because of the quantity of cargo and traffic in the area, there are congestion problems at the landing site. Machinery can operate without problems on the beach.

54 Chaudhary, Azhar and Desgagnés, Dominique (1995), *Guide pour les opérations dans le Nord.* Transport Desgagnés Inc. p. 70.

Umiujaq

Umiujaq was established by Inuit people from the village of Kuujjuarapik-Whapmagoostui in 1979. It is a small village with a population of 350 in 1995. Approach navigation is relatively simple and it is possible for ships to drop anchor close to the village. The infrastructures built during the summer of 2001 in the framework of the Nunavik Marine Infrastructure Program, contribute in making marine operations safer. Two breakwaters offer a sheltered mooring area accessible at all times. Moreover, the beach has been redesigned to facilitate boat launching. The weak tidal range (1.4 metre) and the beach slope allow access to the facilities 24 hours a day.

Kuujjuarapik-Whapmagoostui

Kuujjuarapik-Whapmagoostui is located at the mouth of Great Whale River. Approach to the mooring area is quite simple in Kuujjuarapik-Whapmagoostui, big ships however must drop anchor far from the village in a poorly sheltered location. Tidal range (1.8 metre) does not limit access to the floating pontoons and neighbouring beach used to land cargo from the barges. These facilities are located upstream from the mouth of Great Whale River. Floating pontoons are used by local fishing boats (peterheads) for domestic transhipment operations. Marine carriers do not use floating pontoons anymore, as they use the adjacent beach instead, where they run their barges aground to unload them like in other villages. The beach bottom is somewhat soft and can cause problems for heavy machinery during unloading operations.

Chisasibi

Chisasibi is located at the mouth of the La Grande River. Approach to the Cree village is risky and must be done during the day, because certain sections are narrow and strong tidal currents exist in this area. Alignment lights guide navigators toward one of the available mooring areas. Tidal range is 2.1 metres at Chisasibi.

Wemindji

Since there are no navigational aids to access the Cree village of Wemindji, it is recommended to navigators to have a good knowledge of the area before entering it[55]. In Wemindji, there is a slide used by Moosonee Transportation Limited to pull its boats out of the water in the fall and launch them in the spring.

55 Fisheries and Oceans Canada (1988), Sailing Directions, Labrador and Hudson Bay. p. 408.

Eastmain

The Eastmain community is located two miles upstream from the mouth of the Eastmain River. Navigation on the river must be precise, since there are a lot of rocks and sandbanks that dry up at low tide (amplitude of 1.1 metre). The Eastmain River is not accessible to ships with a draft above 2.4 metres, and this at high tide during high water periods[56]. Floating pontoons that belong to the Band Council allow docking for shallow draft boats.

Waskaganish

Waskaganish is located on the shores of Rupert River where there used to be private markers (wooden posts) indicating the access channel. Here also, ships with a draft less than 2.4 metres can go upriver during high tide periods. The access ramp, once used by MTL, is therefore only accessible during high tides. Tide range is 2.6 metres in this area.

56 Fisheries and Oceans Canada (1988), Sailing Directions, Labrador and Hudson Bay. p. 409.

4.0 TRENDS AND ACTION LEADS IN MARINE TRANSPORT IN THE NORD-DU-QUÉBEC REGION

4.1 Importance of Marine Transport for the Socio-Economic Development of the Nord-du-Québec Communities

In the Nord-du-Québec region, and more particularly in Nunavik, the lack of a road network and the competitive advantages provided by this transportation mode makes marine transport of goods a necessity. A marine link between north and south is essential to support the development of the villages and coastal communities' operations sites.

4.1.1 Necessary Marine Link

Because of Nunavik's particularities (remoteness and lack of a road link to the south of Québec) and its fast development (population growth, mining), it can be stated that a north-south marine link is a must for this region. It would be economically unfeasible and often technically impossible to use air transport for bulky goods such as vehicles, reservoirs, containers, sections of prefab houses, construction material and any other bulky object. Marine transport is the only and most economical way to transport large quantities of freight (approximately 150,000 m^3 per year).

It should be reminded that domestic marine transport is also essential for Aboriginal people. Since time immemorial, they have used this transportation mode to travel across the territory for their traditional hunting and fishing activities.

4.1.2 Local Communities' Involvement in the Industrial Sector

The local community members have an opportunity to get involved in the marine industry. Makivik Corporation, in association with the Kativik Regional Government and the Kativik School Board, offers academic and practical training to the Inuit with a view to preparing future labour. For example, under the Makivik Corporation's Marine Infrastructure Program, 70% of the jobs are held by Inuit people when infrastructures are built in a village[57].

57 Klinking, Eileen, Makivik Corporation (2001), Personal communication.

Shipping companies involved in supplying Nunavik also offer jobs to Aboriginal people. However, it should be mentioned that past experiences tend to show that Inuit workers have adjustment difficulties in such work environments. Structured programs have been set up as an incentive for Inuit to get involved in the marine industry.

For example, a clause in the marine transport contract between the Nunavut Regional Government and the shipping company involved provides that three cadet positions must be reserved for the Inuit on the ships[58].

The knowledge the Inuit have about the territory could also support their involvement in marine transport security. Indeed, a feasibility study has been made by the Canadian Coast Guard to assess the possibility of implementing local groups of volunteers who could assist the Coast Guard during search and rescue operations[59].

As a further incentive for Inuit to get involved in marine transport, the Ministère des Transports, through its marine and river transport policy, aims at increasing the Nunavik institutions' participation in steamship services. The MTQ will also facilitate the training and hiring of Inuit people to allow them to get further involved in marine operations and marine infrastructure maintenance in Nunavik[60].

4.2 Environmental Risks and Impacts Related to Marine Transport

First, it should be noted that due to the *transported goods / fuel consumption ratio*, marine transport is one of the less damaging transportation mode for the environment. And this is even more so when transportation has to take place over long distances[61].

4.2.1 Risks and Impacts Related to Marine Infrastructures and Transhipment Operations

Marine infrastructures

The landing facilities that make up the marine infrastructures modify the dynamic profile of the water front. These fragile ecosystems are automatically disturbed when such facilities are built.

Transhipment operations

Commercial and domestic transhipment of general goods and petroleum products taking place on beaches have minor environmental impacts. Commercial transhipment

58 Desgagnés, Daniel, Transport Desgagnés (2001), Personal communication.
59 Pelletier, Sylvie, Canadian Coast Guard (2001), Personal communication.
60 Gouvernement du Québec, Ministère des Transports (2001), Politique de transport maritime et fluvial(marine and river transport policy), p. 43.
61 Hamelin-CfoRT-Gesco (2000), Étude comparative des impacts environnementaux des modes de transport de marchandises dans l'axe du Saint-Laurent. Saint-Laurent Vision 2000 et SODES, p. 104.

of petroleum products may however represent a risk of major impacts should an accident occur.

4.2.2 Impact Mitigation Masures

Marine infrastructures

During the construction of the marine infrastructures, measures such as putting back the removed material on the beach helps lower the environmental impacts.

Transhipment operations

Building breakwaters and creating protected berthing areas help lower spill-related risks during domestic transhipment operations. Sheltered from the waves by the breakwater, the vessels are a lot more stable and transhipment manoeuvres less risky.

When barge unloading areas are also protected by a breakwater, there is a lesser risk of spilling material during the commercial unloading operations.

To lower the risk of incident, strict measures and procedures must be followed when transhipping petroleum products. Let us keep in mind that oil tankers and ice-breakers have on-board spill control equipment that allow to limit the damages in case of a spill. The Canadian Coast Guard also has a major depot of spill control and hazardous material recovery equipment. This equipment is stored in Iqualuit.

The implementation of contingency plans in each site and village of the Nord-du-Québec region would increase the speed of intervention during accidental spills[62]. This idea is a response to a study conducted by the Coast Guard on the possibility of setting up search and rescue teams and to the Ministère des Transports' wish to promote the involvement of Aboriginal people in the marine industry. A study could be made on the need for local teams specialised in rescue and intervention in case of environmental emergency in order to assess the impact related to the quality of intervention during accidents.

4.3 Improved Quality of Services and Infrastructures

4.3.1 Improved Services

The services offered by ocean carriers have significantly improved over the years. As mentioned in chapter 1, shipping companies are making efforts to offer integrated services to their clients. Moreover, with the improvement of communication between ships and land, it is now possible to communicate easily and at all times with the ships. Satellite telephones (sat-phone) are now in common use for communication. In

62 Noëlle Lemos enr. Consultant (1994), Étude environnementale préliminaire du projet d'aménagement d'infrastructures maritimes au Nunavik, Final version, Kangiqsualujjuaq. p. 81.

addition, Internet communication systems using the GMDSS platform (see item 4.4.1) are also widely used to share information between land and ships[63]. The services offered and the safety of navigation have been significantly improved with the use of these new communication systems.

The Ministère des Transports' withdrawal from the organization of marine services for the 2001 season has raised concerns among certain stakeholders. But the competition resulting from this withdrawal has been beneficial to certain shippers. It is now possible for individual clients to negotiate their own transportation fees and obtain better prices through publicly advertised tender calls. Conversations with several local stakeholders lead to believe that transportation companies offer better services. Ships make more stops in each village, which facilitates the procedures for ordering and purchasing goods for shippers. It would not be inappropriate to conduct a study on the shippers' satisfaction level towards the services offered by shipowners.

4.3.2 Improved Infrastructures

The marine infrastructures in the coastal villages of Nord-du-Québec represent a positive interest in terms of goods mobility and will be considered by many as sufficient, for the time being, to meet the communities' needs. This is why the idea of the construction in each village of major and more complex infrastructures including docks, dredged channel, access ramp for the local population, access ramp for supply operations, mooring basin, storage areas and breakwaters, has been received with caution. In this regard, Makivik Corporation's decision to split up its infrastructure project in two and concentrate first on the construction of breakwaters and access ramps for the local population has not been questioned, and this choice seems to offer advantages at the planning level.

It is therefore important for all the stakeholders involved in the marine infrastructure construction project in the region to take a position on how to priorise the actions in the villages where significant marine activities (domestic and commercial) take place. In these villages, the construction of two access ramps (one for supply operations and one for Aboriginal people) would be appropriate as the areas are congested with users. A suitable service area would also be very useful for the supply operations.

In the villages where marine activities are not as important, one ramp would seem to be sufficient. However, a clear agreement should be made between local users and marine operators regarding the priority of access to the ramp during unloading operations in order to avoid any conflict and to lower the risk of accidents. Indeed, it would not be appropriate to build two ramps in a village that is visited only three times a year for supply operations.

In all the villages, an efficient and standardised buoying of the access channel would be advisable[64]. This simple and affordable improvement would permit navigators to safely

63 Desgagnés, Daniel, Transport Desgagnés (2001), Personal communication.
64 Leclerc, Félix, Transport Desgagnés (2001), Personal communication.

do the final approach to the beach or unloading site. These installations could be set up and managed by a local or regional Aboriginal organisation, in association with the water carriers and the Coast Guard (through its *Private Buoy Regulations*). In the spring, local agents in each village could place buoys along the channel and remove them in the fall. The implementation of this service would certainly promote the safety of domestic and commercial approach-to-land navigation. Moreover, as a result of such buoying program, the local communities' involvement in the marine industry would be increased.

4.4 Improved Security in Marine Transport

4.4.1 Navigation

Concerning regional navigation and navigation between supply sites, security has significantly improved with the use of new navigation and communication instruments. All merchant ships, in addition to using radar, are now equipped with a geographical positioning system (GPS) that allows navigators to know their ship's exact position and thus to be able to navigate safely. This instrument receives signals sent by the 24 GPS satellites orbiting around Earth. By calculating the distance and the position of the satellites, as well as by triangulation, the GPS can give us a position with a ten-metre accuracy. This accurate information is very useful for sailors, because when we know our exact position, navigation becomes a lot simpler. There now exists a Differential Global Positioning System (DGPS) but it is used only on waterways with high density traffic and where navigation must be very accurate (St. Lawrence River for instance). This system works like a GPS but for increased accuracy, a correction received from a ground signal is made to the calculations made by the GPS. Using this system requires a ground structure. It is not used in the North and it is thought that it would not be appropriate to implement it right now[65].

Concerning security and emergency at sea, the new World System for Emergency and Safety at Sea (SMDSM or GMDSS), substantially increases the performance of the former communication systems. This system, developed by the International Maritime Organisation (IMO), uses improved terrestrial and satellite technology and ship-board radio systems[66].

The primary objective of the GMDSS is to save lives by enhancing communications between ships and shore-based rescue and communications authorities. With this system, a whole maritime and terrestrial network will maintain continuous listening watch on vessels, which, if problems occur, increases the rapidity of emergency interventions.

However, these instruments do not offer a full guarantee against all navigation-related problems. The officers' skills and experience are still the best factors to ensure safe navigation.

65 Desgagnés, Sylvain, Harbour Master (2001), Personal communication.
66 Canadian Coast Guard (September 2001), General information, Web site: www.ccg-gcc.gc.ca

The safety of approach navigation to unloading sites or villages has also improved over the years. Tugboats towing barges are now all equipped with radar and some of them also have GPS. These boats are also equipped with VHF radio through which they can communicate with the main ship or with the team working on the beach. Aboriginal people's boats (peterheads) are increasingly equipped with these electronic navigation instruments. All these instruments are used for safer navigation when approaching the villages, but it would be easy to further encourage such practice. As mentioned in the previous section, the installation of small standardised lighted buoys in the channels of each village would also be much appreciated by navigators. This would represent a significant improvement as final approaches are often dangerous and the channels' morphology changes regularly due to sediment flow and ice movement.

4.4.2 Transhipment Operations

Sea supply operations represent different risks, and improvements can be made to lower these risks.

First, as already mentioned, barge unloading operations is done rapidly with heavy equipment (three wheeled loaders), in limited and congested space. These operations are also carried out at the sea-land interface and they involve large quantities of goods. During these operations, there is a combination of high risk factors for the security of the workers involved as well as for the people not involved in the operations. This is why it would be crucial to establish priorities for using the area during the unloading operations. This would ensure the security of both people and goods.

It is not uncommon that parcels are damaged at the end of the supply operation line due to the very nature of the transportation mode and the multiple handling to be done. To avoid these unfortunate situations, particular emphasis should be put on packaging. Each parcel is unique. It contains either fragile or hazardous material, it is heavy or lightweight, and its weight is distributed in a particular way. So these variables must be taken into account during packaging. Too often, poorly packaged parcels or insufficiently resistant packaging are sent by boat to Nunavik, causing damages to the material. Particular care should be taken for parcels containing hazardous material. Preference should be given to containerising goods to ensure safe shipping. In addition to simplifying the handling of numerous multiple size parcels, containers provide sturdy and water-proof packaging for transported goods. Parcel identification could also be improved; this would facilitate sorting during the unloading procedures and could inform the machinery operators on the type of goods they handle.

The local transhipment operations are also risky at times. In the coastal communities without a wharf, the residents must manually transfer the goods from an anchored vessel to another and bring it on the beach. This operation becomes risky in windy weather as the roadsteads to shelter the vessels are scarce.

Finally, it is important to mention that due to time constraints and the particular nature of these operations, it is not possible to eliminate all risks and that the attitude and professionalism of the people conducting these operations still represent the best guarantee against potential problems. However, this should not preclude further research on and implementation of new working methods that would facilitate the operations and make them safer.

CONCLUSION

The physical and human features of the Nunavik and James Bay territories being different, it is difficult not to separately consider the two territories when it comes to drawing conclusions from this study.

The recent land access to the Cree coastal communities of James Bay did not happen without an undeniable impact on the transport mode shifting from marine to road.

In Nunavik, domestic and commercial marine transport (supply operations by boat) is a must. Despite this fact, several villages still do not have marine infrastructures. The infrastructures currently being put in place by Makivik Corporation certainly contribute to facilitate marine operations and make them safer, but they do not meet all the needs. Adding simple installations (such as buoys) and implementing a contingency plan, in addition to promoting Aboriginal involvement, would further enhance safety in marine operations.

The implementation of the new *Politique de transport maritime et fluvial* (Marine and River Transport Policy) of the Ministère des Transports offers new opportunities for partnership.

The multiplication of agreements, consultation committees and discussion forums between government agents and local representatives, and even between the communities themselves, will perhaps allow for the development of new projects to support the marine activities, notably in the area of transportation. These opportunities point out to the importance of ensuring a follow-up of the marine transport activities in the Nord-du-Québec region and its impacts on the economy, the environment and safety.

GLOSSARY

Access ramp
Inclined ramp used for launching boats from a trailer hitched to a motor vehicle.

Alignment (leading line, range)
A set of two land structures used by navigators to ensure accurate navigation. By aligning two landmarks, navigators obtain a safe route for their ship.

Barge or towing scow
Generally, a ship without propulsion pushed or towed by a tugboat and used for transporting a variety of goods.

Bow thruster
Motor located at the front of a ship allowing to move the bow laterally.

Breakwater
Long structure made of heavy masonry, enrockment, big stones, sections of reinforced concrete or other, built on the offshore side of a harbour to protect it against waves.

Cargo ship
Ship used for transporting general goods and solid bulk material.

Coastal shipping
Water transport of goods between ports of a same country.

Draft
Depth of water to the keel of a ship. The depth vary according the size of the ship, the weight of the cargo and the water density.

Floating pipeline
Flexible and floating pipe running on the water surface and linking an oil tanker to a land pipeline.

Floating pontoon
Floating structures, usually tied to posts driven in a harbour's bed and used to moor vessels.

Foreshore
See tide land.

Freight
Transported goods.

Intertidal zone
See tide land.

Landmark
Fixed and visible object located onshore and used as a reference point.

Marker
Mark (picket) indicating the course of a channel.

Mooring basin
Generally sheltered basin, with enough water depth to allow the mooring of vessels.

Port master
Person supervising and ensuring the safe and efficient operations in a harbour.

Racon
Sea-marker equipped with a system that reflects radar waves. Racons also transmit signals.

Shipowner
Owner and operator of a ship or fleet.

Tide land
Area between the low tide and high tide lines.

Tide rise and fall
Tidal range, difference between the highest high tide (spring tide) and the lowest low tide (spring tide).

Twenty equivalent unit (TEU)
20-foot container.

Wharf
Marine structure used for mooring vessels or for boarding or unloading cargo and passengers.

Workboat
Small boat equipped with a powerful motor and used for various work purposes.

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APPENDICES

APPENDIX 1
MARITIME DISTANCE CHART, NORD-DU-QUEBEC

MARITIME DISTANCE CHART, NORD-DU-QUEBEC

Montréal – Kuujjuaq:	1 697 nautical miles
Montréal – Salluit:	1 834 nautical miles
Montréal – Inukjuak:	2 187 nautical miles
Montréal – Kuujjuarapik:	2 443 nautical miles

<u>Ungava Bay, approximate distances</u>

Kangiqsualujjuaq – Kuujjuaq:	106 nautical miles
Kuujjuaq – Tasiujaq:	109 nautical miles
Tasiujaq – Aupaluk:	65 nautical miles
Aupaluk – Kangirsuk:	75 nautical miles
Kangirsuk – Quaqtaq:	Unavailable

<u>Hudson Straight, approximate distances</u>

Quaqtaq – Kangiqsujuaq:	75 nautical miles
Kangiqsujuaq – Deception Bay (Bay entrance):	97 nautical miles
Deception Bay (Bay entrance) – Salluit:	22 nautical miles
Salluit – Ivujivik:	Unavailable

Hudson Bay, approximate distances

Ivujivik – Akulivik:	128 nautical miles
Akulivik – Puvirnituq (Bay entrance):	54 nautical miles
Puvirnituq (Bay entrance) – Inukjuak:	94 nautical miles
Inukjuak – Umiujaq:	Unavailable
Umiujaq – Kuujjuarapik:	Unavailable
Inukjuak – Kuujjuarapik:	256 nautical miles

James Bay: approximate distances

Moosonee – Chisasibi:	183 nautical miles
Moosonee – Wemindji:	127 nautical miles
Moosonee – Eastmain:	101 nautical miles
Moosonee – Waskaganish:	81 nautical miles

Note: One nautical mile is 1 852 metres.

APPENDIX 2

DESCRIPTION OF MARINE INFRASTRUCTURES IN NORD-DU-QUEBEC
(OTHER THAN NAVIGATION AIDS)

KANGIQSUALUJJUAQ

Marine Infrastructures:

- Main breakwater at the mouth of Akilasakallak Cove.
- An access road for all-terrain vehicles runs on the breakwater.
- Elevation: approximately 14 metres.
- Access ramp protected by a breakwater.
- Width: varies from 10 to 20 metres.
- Secondary breakwater in front of the village.
- Elevation: approximately 14 metres.
- Beach and tide land cleaned between the main breakwater and village beach.

Purpose:

- The access ramp was built to facilitate access to water for the local population. Shipping companies also use this ramp to unload barges.

Access Road:

- An access road has been built along the hillside. The municipality is responsible for its maintenance.

Entity in Charge and Year of Construction:

- Under the responsibility of Makivik Corporation in summer 1999.

Services Available in Kangiqsualujjuaq:

- Fuels available at the Shell station.
- Possibility of making minor repairs at the municipal garage.
- Shell Canada has equipment to control a potential spill of petroleum products on land.

Accessibility of Infrastructure:

- Approximately 25% of the time.

Condition of Infrastructures:

- Recently built infrastructures, in good condition.

Maintainer:

- The municipality, under the supervision of Makivik Corporation, is responsible for maintaining the installations.

KUUJJUAQ

Marine Infrastructures:

- Access ramp, located in the Nascopie Cove.
  Width: approximately 20 metres.
- Storage area, in front of the ramp.
  Size: approximately 5 000 m^2
- Floating pontoons, located on the beach in front of the village.
- Cleaned beach: rocks are removed.

Purpose:

- The access ramp is used by the local population and shipping companies who supply the village.
- The floating pontoons are used by the local population.

Access Road:

- Under the responsibility of the municipality.

Entity in Charge and Year of Construction:

- Kuujjuamiut Corporation has made major renovations to the access ramp and the temporary storage area in summer 2000.

Services Available in Kuujjuaq:

- Fuels available at the Shell Canada station.
- Many resources available for equipment repair.
- Shell Canada has equipment to control a potential spill of petroleum products on land.

Accessibility of Infrastructure:

- Approximately 20% of the time.

Condition of Infrastructures:

- Work done recently; infrastructures in good condition.
- The floating pontoons are not protected by a breakwater, so they are exposed to winds during storms.

Maintainer:

- The municipality is responsible for maintaining the ramp, the storage area and the floating pontoons.

KANGIRSUK

Marine Infrastructures:

- Access ramp.
  Length: unavailable.
  Width: approximately 25 metres.
- Storage area.
  Size: approximately 60 metres x 60 metres.
  Elevation: 1 metre above high tide line (mean tide).

Purpose:

- The access ramp is used by the local population and shipping companies who supply the village.

Access Road:

- Under the responsibility of the municipality.

Entity in Charge and Year of Construction:

- The Ministère des Transports du Québec built the installations in 1986.

Services Available in Kangirsuk:

- Fuels available on site.
- Possibility to make minor repairs at the municipal garage.

Accessibility of Infrastructure:

- Approximately 80% of the time.

Condition of Infrastructures:

- General condition of infrastructures is satisfactory even if the works have been carried out some time ago. Storage area occasionally flooded during spring tides.

Maintainer:

- Undetermined.

QUAQTAQ

Marine Infrastructures:

- L-shaped breakwater located in the Mission Cove.
  Length: 160 metres.
  Height: 11 metres.
- Access ramp for small boats, also located in the Mission Cove.
- Access road (210 metres newly built and 2 800 metres renovated).

Purpose:

- Infrastructures primarily used by the local population.

Access Road:

- Under the responsibility of the municipality.

Entity in Charge and Year of Construction:

- Works carried out under the responsibility of Makivik Corporation in summer 2000.

Services Available in Quaqtaq:

- Fuels available on site.
- Possibility to make minor repairs at the municipal garage.
- Shell Canada has equipment to control a potential spill of petroleum products on land.

Accessibility of Infrastructure:

- No ramp available for marine service. It is possible to unload barges, on the upper part of the beach, 2 hours before and 2 hours after high tide. Beach accessibility: 16% of the time.

Condition of Infrastructures:

- Works carried out recently; infrastructures in good condition.

Maintainer:

- The municipality, under the supervision of Makivik Corporation, is responsible for maintaining the installations.

KANGIQSUJUAQ

Marine Infrastructures:

- Main breakwater.
  An access road for all-terrain vehicles runs on the breakwater.
  - Elevation: approximately 10.2 metres.
- Secondary breakwater.
  - Elevation: approximately 10.2 metres.
- Mooring basin sheltered by the breakwaters.
- Access ramp sheltered by the breakwaters.
  - Width: 30 metres.
  - Length: 60 metres.
  - Slope: 10%
- Beach cleaned on the inside of the breakwaters.
- Parking area.

Purpose:

- Infrastructures primarily used by the local population.

Access Road:

- Under the responsibility of the municipality.

Entity in Charge and Year of Construction:

- Works carried out under the responsibility of Makivik Corporation in fall 2001.

Services Available in Kangiqsujuaq:

- Fuels available on site.
- Possibility to make minor repairs at the municipal garage.

Accessibility of Infrastructure:

- Approximately 90% of the time.

Condition of Infrastructures:

- Works carried out recently; infrastructures in good condition.

Maintainer:

- The municipality, under the supervision of Makivik Corporation, is responsible for maintaining the installations.

DECEPTION BAY

Marine Infrastructures:

- Deep water wharf.
- Covered storage area.

Purpose:

- Commercial.

Access Road:

- Private infrastructures. Under the responsibility of Raglan Mine.

Entity in Charge and Year of Construction:

- Asbestos Corporation from 1963 to 1966.

Services Available in Deception Bay:

- Possibility to repair equipment on site.
- There is an emergency response team on site to control potential spills. They have oil slick booms and a workboat.

Accessibility of Infrastructure:

- Wharf access is not limited by tides.

Condition of Infrastructures:

- The wharf is in good condition.

Maintainer:

- Raglan Mine is responsible for operating and maintaining the site.

INUKJUAK

Marine Infrastructures:

- Access ramp.
  Length: approximately 65 metres.
  Width: approximately 20 metres.
- Small wooden wharf at the far end of the ramp.
  Size: approximately 5 metres x 8 metres.

Purpose:

- The access ramp is used by the local population and shipping companies who supply the village.
- The wharf is used by the local population.

Access Road:

- Under the responsibility of the municipality.

Entity in Charge and Year of Construction:

- The ramp was built in 1987 under the responsibility of the Ministère des Transports du Québec.
- Wharf construction date is unknown.

Services Available in Inukjuak:

- Fuels available on site.
- Possibility to make minor repairs at the municipal garage.

Accessibility of Infrastructure:

- There is always a good water depth at the far end of the ramp and wharf. Accessibility is 100% of the time.

Condition of Infrastructures:

- The ramp is in good condition.
- The wharf needs to be strengthened.

Maintainer:

- Undetermined.

UMIUJAQ

Marine Infrastructures:

- Main breakwater.
  An access road for all-terrain vehicles runs on the breakwater.
  Elevation: approximately 4 metres.
- Secondary breakwater.
  Elevation: approximately 4 metres.
- Mooring basin sheltered by the breakwaters.
- Beach re-organised to facilitate boat launching and grounding.
  Slope: 10%
- Parking area.

Purpose:

- Infrastructures primarily used by the local population.

Access Road:

- Under the responsibility of the municipality.

Entity in Charge and Year of Construction:

- Works carried out under the responsibility of Makivik Corporation in summer 2001.

Services Available in Umiujaq:

- Fuels available on site.
- Possibility to make minor repairs at the municipal garage.

Accessibility of Infrastructure:

- 100% of the time.

Condition of Infrastructures:

- Works carried out recently; infrastructures in good condition.

Maintainer:

- The municipality, under the supervision of Makivik Corporation, is responsible for maintaining the installations.

KUUJJUARAPIK-WHAPMAGOOSTUI

Marine Infrastructures:

- Floating pontoons located upstream of the mouth of the Great Whale River.
  Size: approximately 200 m^2

Vocation:

- Used by the local population.

Access Road:

- Under the responsibility of the municipality.

Entity in Charge and Year of Construction:

- The Ministère des Transports du Québec is responsible for the pontoons in Kuujjuarapik since 1989.

Services Available in Kuujjuarapik:

- Fuels available on site.
- Possibility to make minor repairs at the municipal garage.

Accessibility of Infrastructure:

- The pontoons and the neighbouring beach (used for marine service) can be accessed at all times by shallow-draft boats.

Condition of Infrastructures:

- Minor repairs are necessary.

Maintainer:

- The Ministère des Transports du Québec is responsible for maintaining the pontoons.

CHISASIBI

Marine Infrastructures:

- Old access ramp.

Vocation:

- The ramp is not used any more.

Access Road:

- Under the responsibility of the Chisasibi Band Council.

Entity in Charge and Year of Construction:

- Unavailable.

Services Available in Chisasibi:

- Fuels available on site.
- Possibility to repair equipment.

Accessibility of Infrastructure:

- Accessible only at high tide.

Condition of Infrastructures:

- The ramp is in poor condition, no maintenance done recently.

Maintainer:

- There is no maintenance of the ramp.

WEMINDJI

Marine Infrastructures:

- Landing ramp.
  Size: Unavailable.

Purpose:

- Commercial.

Access Road:

- Under the responsibility of the Wemindji Band Council.

Entity in Charge and Year of Construction:

- Moosonee Transportation Limited built the ramp in 1997.

Services Available in Wemindji:

- Fuels available on site.
- Possibility to repair equipment.

Accessibility of Infrastructure:

- Unavailable.

Condition of Infrastructures:

- The infrastructures are in good condition.

Maintainer:

- Moosonee Transportation Limited.

EASTMAIN

Marine Infrastructures:

- Floating aluminium pontoons.
  Size: Unavailable.

Vocation:

- Pontoons used by the local population.

Access Road:

- Under the responsibility of the municipality and Eastmain Band Council.

Entity in Charge and Year of Construction:

- Unavailable.

Services Available in Wemindji:

- Fuels available on site.
- Possibility to repair equipment.

Accessibility of Infrastructure:

- The infrastructures are accessible at all times.

Condition of Infrastructures:

- Unavailable.

Maintainer:

- Unavailable.

WASKAGANISH

Marine Infrastructures:

- Access ramp.
  Length: approximately 15 metres.
  Width: approximately 4,5 metres.

Vocation:

- Not used very much.

Access Road:

- Under the responsibility of the Waskaganish Band Council.

Entity in Charge and Year of Construction:

- Unavailable.

Services Available in Waskaganish:

- Fuels available on site.
- Possibility to repair equipment.

Accessibility of Infrastructure:

- The infrastructures are accessible only at high tide.

Condition of Infrastructures:

- The ramp is in poor condition, no maintenance has been done recently.

Maintainer:

- Waskaganish Band Council.

APPENDIX 3

DESCRIPTION OF SHIPS (SEASON 2001) AND EQUIPMENT USED
BY SHIPPING COMPANIES SUPPLYING THE NUNAVIK SITES

DESCRIPTION OF SHIPS (SEASON 2001) AND EQUIPMENT USED BY SHIPPING COMPANIES SUPPLYING THE NORD-DU-QUÉBEC VILLAGES

TRANSPORT DESGAGNÉS INC.

Head office: 21, rue du Marché-Champlain, room 100
Québec City, Québec
G1K 8Z8
Tel.:(418) 692-1000
E-mail: info@desgagnes.com

Cargo ships:

-N/M ANNA DESGAGNÉS

Built: *1986*

Type of vessel:	*Ro-ro ship (roll-on, roll-off)*
Class:	*Bureau Veritas I 3/3 E, Ice1*
Net tonnage:	*8 092 tons*
Deadweight tonnage:	*17 850 metric tons*
Draft:	*10 metres*
Overall length:	*173,5 metres*
Number of holds:	*4*
Bale capacity:	*24 935 m³*
Passenger transportation:	*None*
Engine:	*Man B&W 10 330 BHP*
Bow thruster:	*700 kW*
Mean speed:	*14,5 knots*
Cranes:	*Four x 12.5 metric tons cranes* *(25 tons in tandem)* *Two 25-ton derricks* *One 125-ton derrick*

-N/M CÉCILIA DESGAGNÉS

Built:	*1971*
Type of vessel:	*General cargo ship*
Class:	*Lloyd's +100A1, Ice 1*
Net tonnage:	*3 747 tons*
Deadweight tonnage:	*7 879 metric tons*
Draft:	*8,08 metres*
Overall length:	*114,25 metres*
Number of holds:	*7*
Bale capacity:	*11 157 m³*
Passenger transportation:	*None*
Engine:	*1 Burmeister & Wain 5 100 BHP*
Bow thruster:	*450 HP*
Mean speed:	*12 knots*
Cranes:	*Three x 12.5 metric tons cranes (25 tons in tandem)*

-N/M JACQUES DESGAGNÉS

Built:	*1960*
Type of vessel:	*General cargo ship*
Class:	*Transport Canada Cabotage*
Net tonnage:	*712*
Deadweight tonnage:	*1 298 metric tons*
Draft:	*3.39 metres*
Overall length:	*63.68 metres*
Number of holds:	*1*
Bale capacity:	*2 379 m³*
Passenger transportation:	*None*
Engine:	*2 Lister Blackstone, 6 000 BHP each*
Bow thruster:	*None*
Mean speed:	*7,5 knots*
Cranes:	*1 mobile crane fixed on the ship's deck*

-N/M MATHILDA DESGAGNÉS

Built:	*1957*
Type of vessel:	*General cargo ship*
Class:	*Lloyd's +100A1, Reinforced for ice navigation*
Net tonnage:	*2 656 tons*
Deadweight tonnage:	*6 985 metric tons*
Draft:	*7,21 metres*
Overall length:	*109,83 metres*
Number of holds:	*4*
Bale capacity:	*8 656 m³*
Passenger transportation:	*None*
Engine:	*2 Fairbanks Morse de 1 600 BHP*
Bow thruster:	*None*
Mean speed:	*11 knots*
Cranes:	*Two x 7 metric tons cranes* *One x 55 metric tons mobile crane fixed on the ship's deck*

Oil tankers:

N/C MARIA DESGAGNÉS

Built:	*1999*
Type of vessel:	*Oil and chemicals tanker*
Class:	*Lloyd's + 100A1, Double hull, Type 2, S.G. 1.55, ESP, IWS, LI, Ice 1*
Net tonnage:	*4 527 tons*
Deadweight tonnage:	*13 199 metric tons*
Draft:	*9 metres*
Overall length:	*120 metres*
Number of tanks:	*6, plus one residue container*
Tanks capacity:	*15 570 m³*
Passenger transportation:	*None*
Engine:	*1 Man B&W S42MC, 8 370 BHP*
Bow thruster:	*750 BHP*
Mean speed:	*14 knots*

-N/C JADE STAR

Owned by Rigel Shipping Canada and chartered by Pétro-Nav, subsidiary of Groupe Desgagnés.

Built:	*1993*
Type of vessel:	*Oil tanker*
Class:	*GL + 100 A5 E3 COLL 1, Chemical Tanker Type 2*
Net tonnage:	*Unavailable*
Deadweight tonnage:	*10 511 metric tons*
Draft:	*8.36 metres*
Overall length:	*123.71 metres*
Number of tanks:	*6*
Tank capacity:	*10 596 m³*
Passenger transportation:	*None*
Engine:	*MAN B & W 6L35MC*
Bow thruster:	*Yes*
Mean speed:	*12,5 knots*

Cargo ship loading site

-Côte-Sainte-Catherine harbour, Qc.

Oil tanker loading site

-Montreal harbour.

Ship repair and docking site

-Montreal harbour.
-Québec City harbour.
-Saint-Joseph-de-la-Rive wharf.

General cargo rates (season 2001)

-From Côte-Sainte-Catherine to Nunavik: Unavailable
-From Nunavik to Côte-Sainte-Catherine (Retrograde cargo): Unavailable
-In transit between two Nunavik villages (Lateral cargo): Unavailable

Equipment used during cargo unloading operations (for each ship)

-Two 17-metre X 7,9-metre barges (with ramps) with a 130-ton cargo capacity.
-Two small tugboats used to tow or push the barges.
-Three wheeled loaders to unload the barges.
-One cabin to receive the clients on the beach.
-One mobile lighting tower (generator) to light the unloading sites.
-One trailer to deliver goods.
-One canoe with an outboard motor.
-Buoys.

NEAS (NUNAVUT EASTERN ARCTIC SHIPPING)

Head office:

Box 1059
Iqaluit, Nunavut
X0A 0H0
Tel.: (867) 979-8400
www.NEAS.ca

Montreal Office

Box 186
Postal Station M
Montréal, Québec
H1V 3L8
Tel.: (514) 597-0186

Cargo ships:

-N/M AIVIK

Built:	*1980*
Type of vessel:	*Ro-Ro, heavy lift carrier*
Class:	*BV 1 3/3 E, RO-RO, Ice 111 UMS*
Net tonnage:	*5 043 tons*
Deadweight tonnage:	*4 860 metric tons*
Draft:	*5,92 metres*
Overall length:	*109,9 metres*
Number of holds:	*Unavailable*
Bale capacity:	*13 388 m³*
Passenger transportation:	*None*
Engine:	*Unavailable. 5 200 BHP*
Bow thruster:	*Yes*
Mean speed:	*14 knots*
Cranes:	*Two x 155 metric tons cranes (310 tons in tandem).*

-N/M UMIAVUT

Built:	*1988*
Type of vessel:	*General cargo carrier*
Class:	*Lloyd's 100 A1, Ice 1*
Net tonnage:	*Unavailable*
Deadweight tonnage:	*9 587 metric tons*
Draft:	*8,54 metres*
Overall length:	*113,16 metres*
Number of holds:	*Unavailable*
Bale capacity:	*11 840 m³*
Passenger transportation:	*None*
Engine:	*Unavailable. Horsepower: 6 000 BHP*
Bow thruster:	*Unavailable*
Mean speed:	*15 knots*
Cranes:	*Two x 50 metric tons cranes*

Cargo ship loading site

-Valleyfield harbour, Qc.

Ship repair and docking site

-Montréal harbour.

General cargo rates (season 2001)

-From Valleyfield to Nunavik: Unavailable
-From Nunavik to Valleyfield (Retrograde): Unavailable
-In transit between two Nunavik villages (Lateral cargo): Unavailable.

Equipment used during cargo ship unloading operations (for each ship)

-Two barges (with ramps). Certain barges are 17 metres by 7,9 metres while others are 30 metres by 10.
-Two small tugboats used for towing the barges.
-Three wheeled loaders to unload the barges.
-One cabin to receive the clients on the beach.
-One mobile lighting tower (generator) to light the unloading sites.
-One trailer to deliver goods.
-One canoe with an outboard motor.
-Buoys.

FEDNAV

Head office:	1000 rue de la Gauchetière Ouest Room 3 500 Montréal, Québec H3B 4W5 Tel.: (514) 878-6500 www.fednav.com

-**N/M ARCTIC**

Built:	*1978*
Type of vessel:	*General cargo ship* *(dry and liquid bulk)*
Class:	*Lloyd's +100 A1, LMC IGS*
Net tonnage:	*10 849 tons*
Deadweight tonnage:	*29 450 metric tons*
Draft:	*11.52 metres*
Overall length:	*220.82 metres*
Number of holds:	*7*
Bale capacity:	*34 522 m³*
Passenger transportation:	*None*
Engine:	*Unavailable*
Bow thruster:	*Unavailable*
Mean speed:	*13 knots*
Cranes:	*Four x 16 metric tons cranes*

Cargo ship loading site

-Québec City harbour.

Ship repair and docking site

-Montréal harbour.

General cargo rates (season 2001)

-From Québec City to Deception Bay: Unavailable.

Appendix 4

Marine service provided by the ministere des transports du Québec, per type of goods and per village, 1984 (metric tons)

MARINE SERVICE PROVIDED BY THE MINISTERE DES TRANSPORTS DU QUÉBEC, PER TYPE OF GOODS AND PER VILLAGE, 1984 (METRIC TONS)

Source: Simard, J.J. et al. (1996) Tendances nordiques. Les changements sociaux 1970-1990 chez les Cris et les Inuits du

Marchandise	KUJRAPIK Tm	KUJRAPIK %	INUKJUAK Tm	INUKJUAK %	PVGNITUK Tm	PVGNITUK %	AKULIVIK Tm	AKULIVIK %	IVUJIVIK Tm	IVUJIVIK %	SALLUIT Tm	SALLUIT %	HUDSON Tm	HUDSON %
Marchandises sèches	**165,5**	**81,5**	**516,0**	**87,8**	**2 360,5**	**87,5**	**665,1**	**90,8**	**389,8**	**64,7**	**1 162,2**	**84,1**	**5 259,1**	**84,8**
Denrées principales	3,0	1,5	3,0	0,5	4,0	0,1	1,5	0,2	2,0	0,3	2,5	0,2	16,0	0,3
Ciment	12,0	5,9	347,4	59,1	351,7	13,0	28,1	3,8	67,8	11,2	140,0	10,1	947,0	15,3
Acier	20,0	9,9	68,1	11,6	781,7	29,0	46,8	6,4	84,0	13,9	72,1	5,2	1 072,7	17,3
Bois	53,0	26,1	7,6	1,3	366,1	13,6	391,7	53,5	77,1	12,8	578,6	41,9	1 474,1	23,8
Matériaux de construction	36,0	17,7	15,4	2,6	505,1	18,7	59,1	8,1	73,5	12,2	142,0	10,3	831,1	13,4
Matériaux pré-fabriqués			1,3	0,2	40,3	1,5	0,1	0,0	50,0	8,3	1,2	0,1	92,9	1,5
Matériaux d'isolation	1,0	0,5	1,0	0,2	75,2	2,8	26,0	3,5	7,0	1,2	35,2	2,5	145,4	2,3
Meubles	12,5	6,2	1,0	0,2	5,0	0,2	12,9	1,8	2,0	0,3	14,4	1,0	47,8	0,8
Divers	28,0	13,8	71,2	12,1	231,4	8,6	99,1	13,5	26,4	4,4	176,2	12,8	632,2	10,2
Hydrocarbures	**1,8**	**0,9**	**1,2**	**0,2**	**10,3**	**0,4**	**0,5**	**0,1**	**0,1**	**0,0**	**1,8**	**0,1**	**15,7**	**0,3**
Huile diésel														
Essence	1,8	0,9	1,2	0,2	3,5	0,1	0,5	0,1	0,1	0,0	1,8	0,1	8,9	0,1
Autres					6,8	0,3							6,8	0,1
Fort cubage	**35,7**	**17,6**	**70,3**	**12,0**	**326,5**	**12,1**	**66,5**	**9,1**	**212,8**	**35,3**	**217,2**	**15,7**	**929,1**	**15,0**
Remorques			11,4	1,9			15,2	2,1			20,0	1,4	46,6	0,8
Véhicules	35,7	17,6	25,7	4,4	161,0	6,0	24,7	3,4	67,8	11,2	35,5	2,6	350,4	5,6
Réservoirs			1,2	0,2	1,5	0,1	0,8	0,1					3,5	0,1
Groupe électrogène			11,0	1,9			9,0	1,2			11,0	0,8	31,0	0,5
Autres			21,0	3,6	164,1	6,1	16,8	2,3	145,0	24,1	150,7	10,9	497,6	8,0
TOTAL	**203,0**	**100**	**587,5**	**100**	**2 697,3**	**100**	**732,2**	**100**	**602,7**	**100**	**1 381,2**	**100**	**6 203,8**	**100**
% marchand. / vil.	1,8		5,3		24,3		6,6		5,4		12,4		55,9	
Population	709		705		834		310		225		591		3 374	
% population	12,3		12,2		14,4		5,4		3,9		10,2		58,3	

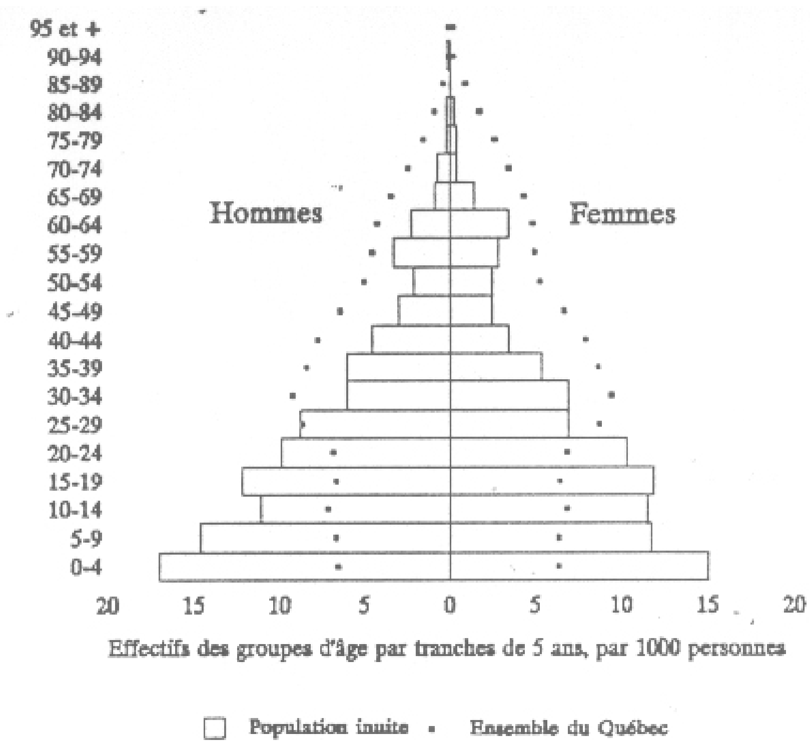
Marchandise	KNGSJUAQ Tm	KNGSJUAQ %	QUAQTAQ Tm	QUAQTAQ %	KNGIRSUK Tm	KNGIRSUK %	AUPALUK Tm	AUPALUK %	TASIUJAQ Tm	TASIUJAQ %
Marchandises sèches	**779,0**	**95,0**	**456,2**	**94,0**	**292,3**	**87,0**	**728,8**	**93,1**	**190,5**	**86,6**
Denrées principales	2,0	0,2	1,5	0,3	2,0	0,6	0,5	0,1	1,0	0,5
Ciment	95,8	11,7	6,3	1,3	209,0	62,2	180,2	23,0		
Acier	63,8	7,8	22,2	4,6	26,5	7,9	103,1	13,2	15,1	6,9
Bois	384,4	46,9	282,5	58,2	4,5	1,3	206,1	26,3	161,3	73,3
Matériaux de construction	83,1	10,1	48,9	10,1	2,0	0,6	77,1	9,8	7,5	3,4
Matériaux pré-fabriqués	7,1	0,9	0,1	0,0	0,1	0,0	3,7	0,5	0,4	0,2
Matériaux d'isolation	22,6	2,8	18,2	3,8			12,3	1,6	0,1	0,0
Meubles	6,6	0,8	4,8	1,0	8,0	2,4	3,0	0,4	0,5	0,2
Divers	113,6	13,9	71,6	14,8	40,3	12,0	142,8	18,2	4,8	2,2
Hydrocarbures	**1,1**	**0,1**	**0,8**	**0,2**	**0,1**	**0,0**	**2,2**	**0,3**	**0,5**	**0,2**
Huile diésel										
Essence	1,1	0,1	0,8	0,2	0,1	0,0	2,2	0,3	0,5	0,2
Autres										
Fort cubage	**40,0**	**4,9**	**28,2**	**5,8**	**43,4**	**12,9**	**52,2**	**6,7**	**28,9**	**13,1**
Remorques	10,0	1,2	15,0	3,1	10,0	3,0	15,0	1,9	10,0	4,5
Véhicules	20,0	2,4	11,2	2,3	23,6	7,0	31,2	4,0	2,4	1,1
Réservoirs										
Groupe électrogène	5,0	0,6			4,0	1,2	4,0	0,5	0,5	0,2
Autres	5,0	0,6	2,0	0,4	5,8	1,7	2,0	0,3	16,0	7,3
TOTAL	**820,1**	**100**	**485,2**	**100**	**335,8**	**100**	**783,2**	**100**	**219,9**	**100**
% marchand. /vil.	7,4		4,4		3,0		7,1		2,0	
Population	336		177		294		108		130	
% population	5,8		3,1		5,1		1,9		2,2	

Marchandise	KUUJJUAQ Tm	KUUJJUAQ %	KSUALUJQ Tm	KSUALUJQ %	UNGAVA Tm	UNGAVA %	TOTAL Tm	TOTAL %
Marchandises sèches	**2 057,2**	**96,7**	**92,9**	**72,6**	**4 597,0**	**93,8**	**9 856,1**	**88,8**
Denrées principales	4,0	0,2	2,0	1,6	13,0	0,3	29,0	0,3
Ciment	240,0	11,3	4,0	3,1	735,3	15,0	1 682,3	15,2
Acier	198,0	9,3	1,2	1,0	430,0	8,8	1 502,7	13,5
Bois	1 051,1	49,4	5,6	4,4	2 095,6	42,8	3 569,7	32,1
Matériaux de construction	175,7	8,3	64,0	50,0	458,3	9,4	1 289,3	11,6
Matériaux pré-fabriqués			1,2	0,9	12,6	0,3	105,5	1,0
Matériaux d'isolation	51,2	2,4			104,4	2,1	249,8	2,2
Meubles	14,3	0,7	2,5	2,0	39,7	0,8	87,5	0,8
Divers	322,9	15,2	12,4	9,6	708,2	14,5	1 340,4	12,1
Hydrocarbures	**1,8**	**0,1**	**4,1**	**3,2**	**10,6**	**0,2**	**26,3**	**0,2**
Huile diésel			1,5	1,2	1,5	0,0	1,5	0,0
Essence	1,8	0,1	1,6	1,2	8,1	0,2	17,0	0,2
Autres			1,0	0,8	1,0	0,0	7,8	0,1
Fort cubage	**68,4**	**3,2**	**31,0**	**24,2**	**292,1**	**6,0**	**1 221,2**	**11,0**
Remorques					60,0	1,2	106,6	1,0
Véhicules	68,4	3,2	12,5	9,8	169,3	3,5	519,7	4,7
Réservoirs							3,5	0,0
Groupe électrogène					13,5	0,3	44,5	0,4
Autres			18,5	14,5	49,3	1,0	546,9	4,9
TOTAL	**2 127,4**	**100**	**128,0**	**100**	**4 899,7**	**100**	**11 103,5**	**100**
% marchand. /vil.	19,2		1,2		44,1		100	
Population	968		400		2 413		5 787	
% population	16,7		6,9		41,7		100	

Québec. Une enquête statistique exploratoire. Université Laval, Québec. Page 30.

APPENDIX 5
QUÉBEC AND INUIT POPULATIONS AGE PYRAMIDS

QUÉBEC AND INUIT POPULATIONS AGE PYRAMIDS (1991) (PER 1000 PERS.) ((INUIT, 1992))

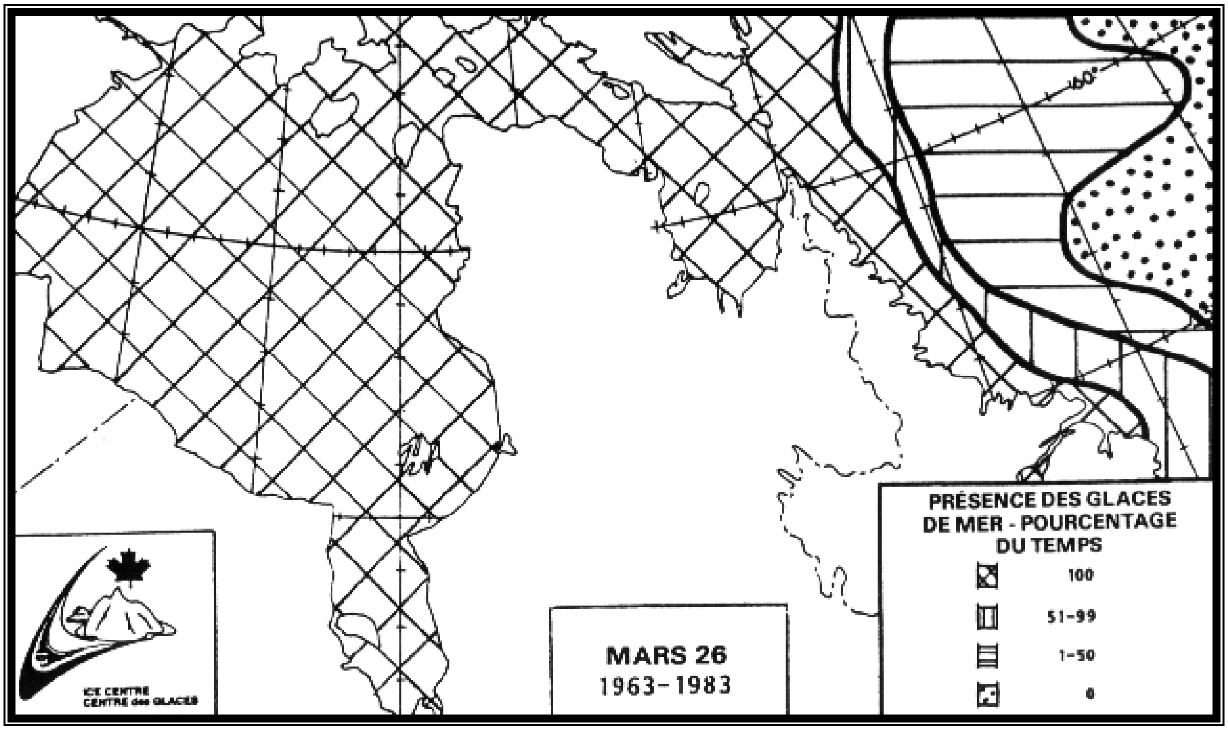


Source: Santé Québec (1992) *Et la santé des Inuits, ça va ?* Report on the Santé Québec survey of Nunavik Inuit. Page 46.

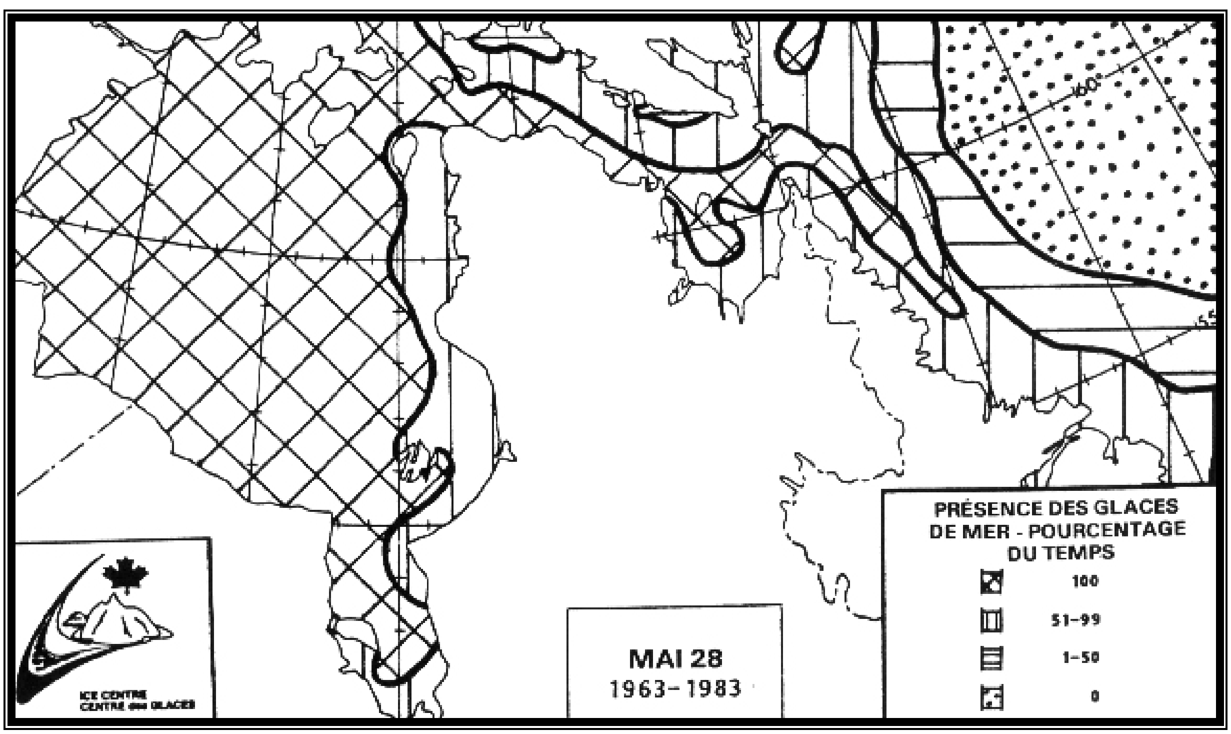
APPENDIX 6

MAPS SHOWING YEARLY EVOLUTION OF SEA ICE

YEARLY EVOLUTION OF SEA ICE

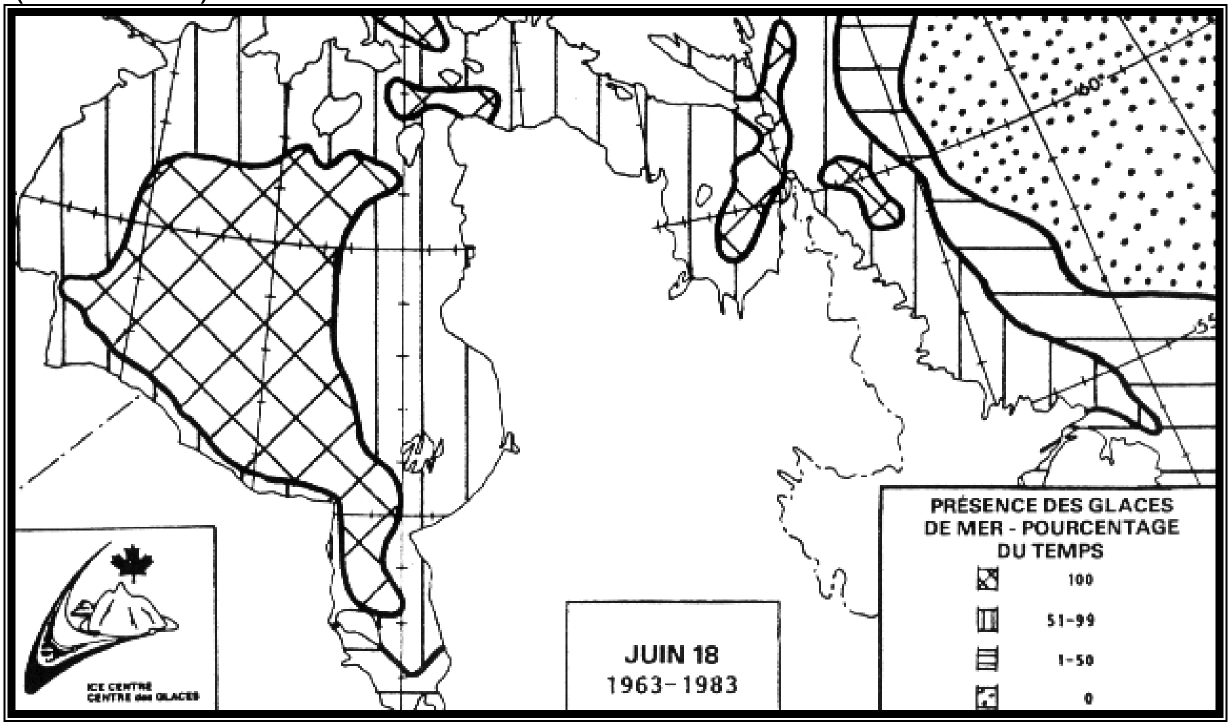


Source: -Fisheries and Oceans Canada (1988) *Sailing Directions, Labrador and Hudson Bay.* Page 75.

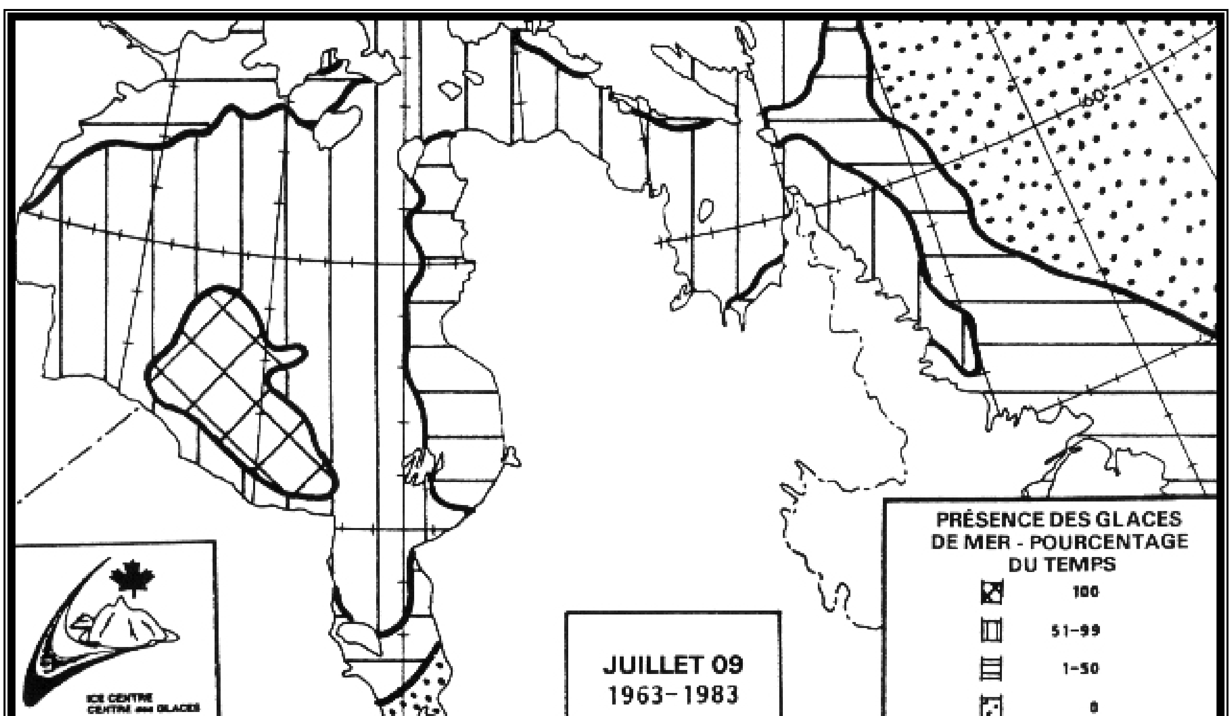


Source: -Fisheries and Oceans Canada (1988) *Sailing Directions, Labrador and Hudson Bay.* Page 75.

YEARLY EVOLUTION OF SEA ICE
(CONTINUED)

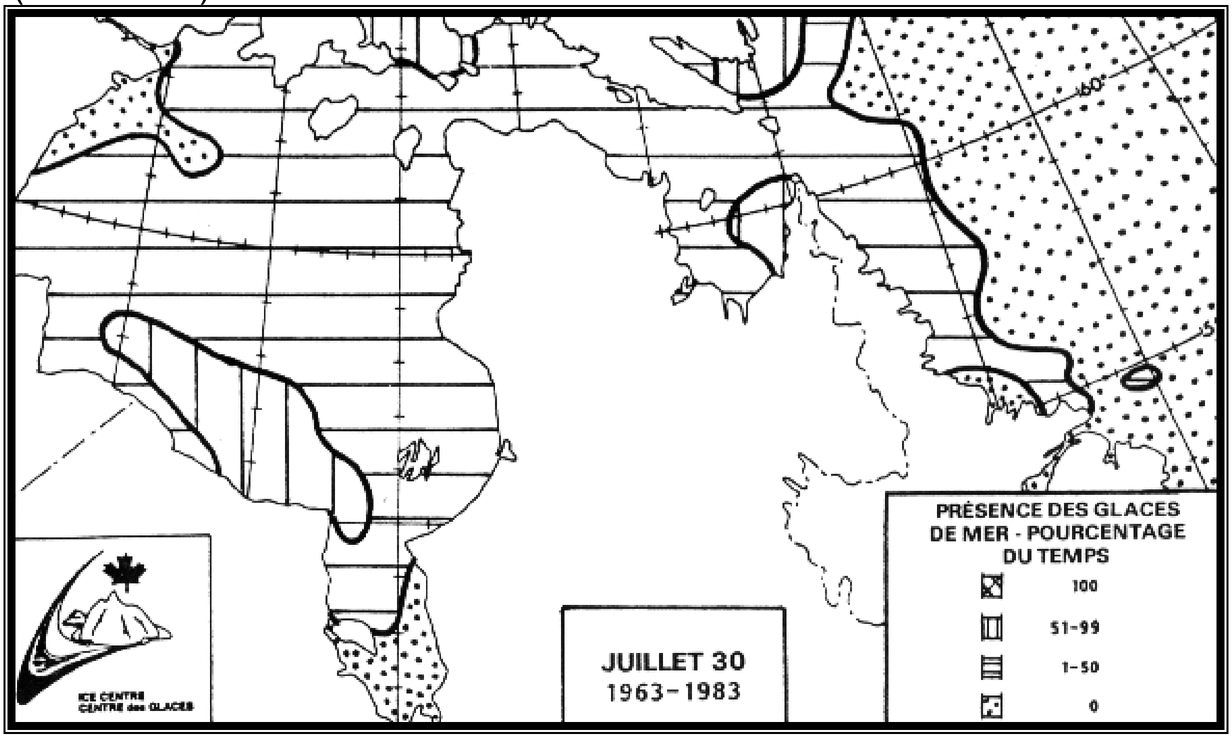


Source: -Fisheries and Oceans Canada (1988) *Sailing Directions, Labrador and Hudson Bay.* Page 76.

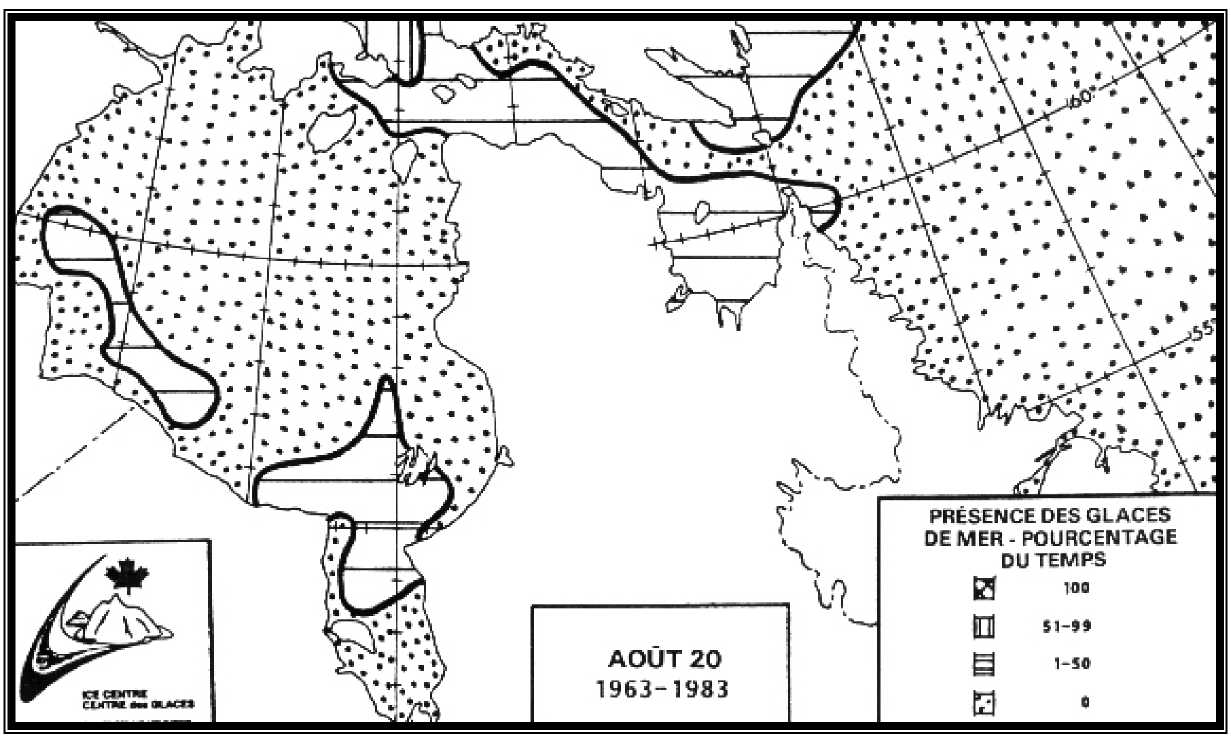


Source: -Fisheries and Oceans Canada (1988) *Sailing Directions, Labrador and Hudson Bay.* Page 76.

YEARLY EVOLUTION OF SEA ICE
(CONTINUED)

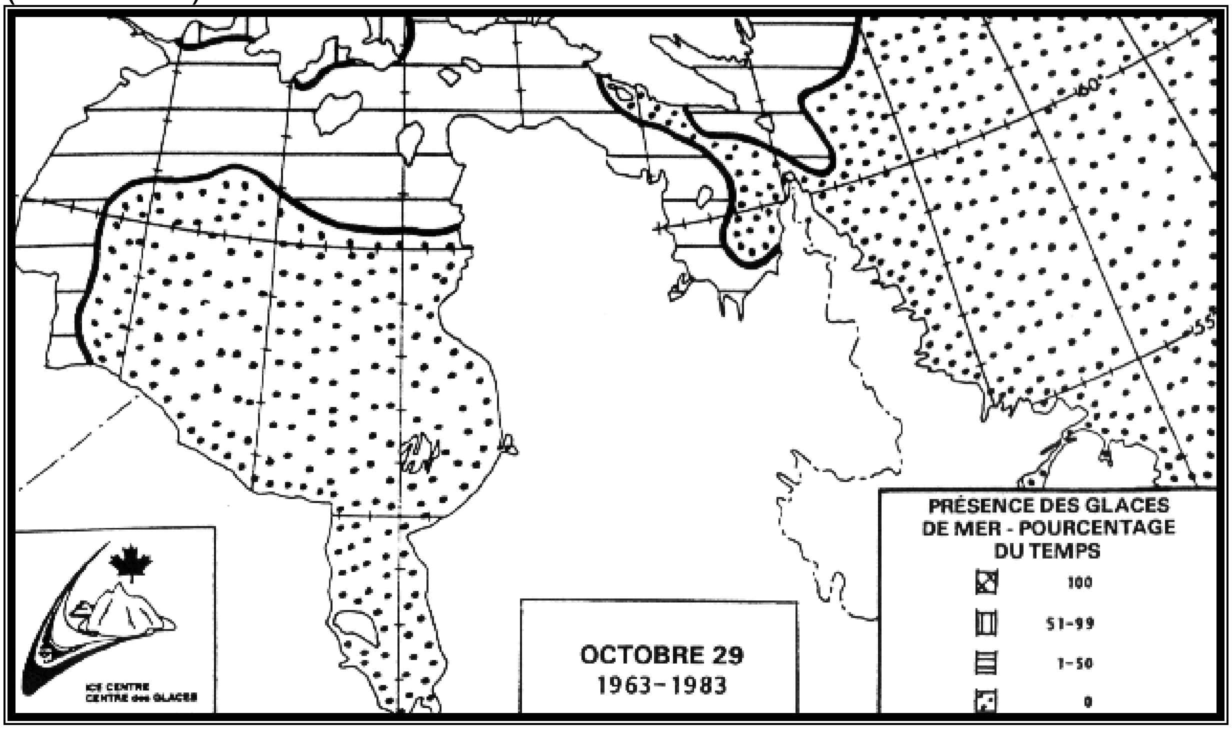


Source: -Fisheries and Oceans Canada (1988) *Sailing Directions, Labrador and Hudson Bay.* Page 77.

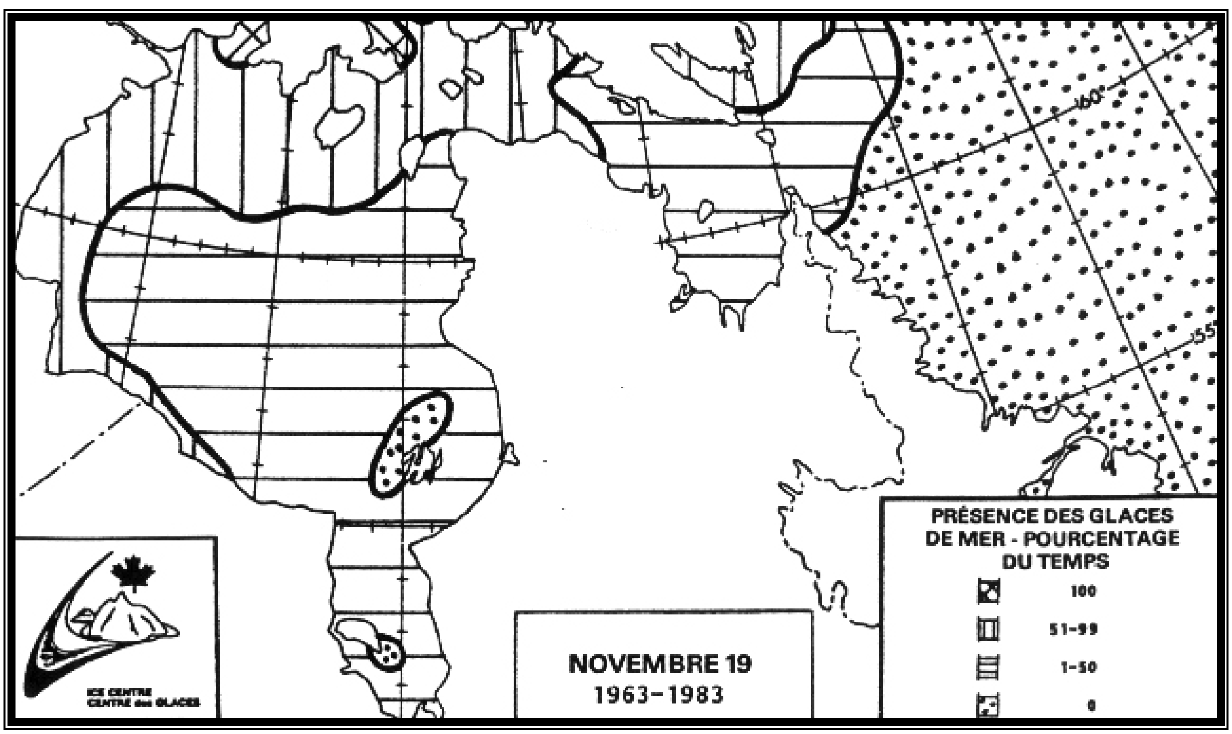


Source: -Fisheries and Oceans Canada (1988) *Sailing Directions, Labrador and Hudson Bay.* Page 77.

YEARLY EVOLUTION OF SEA ICE
(CONTINUED)

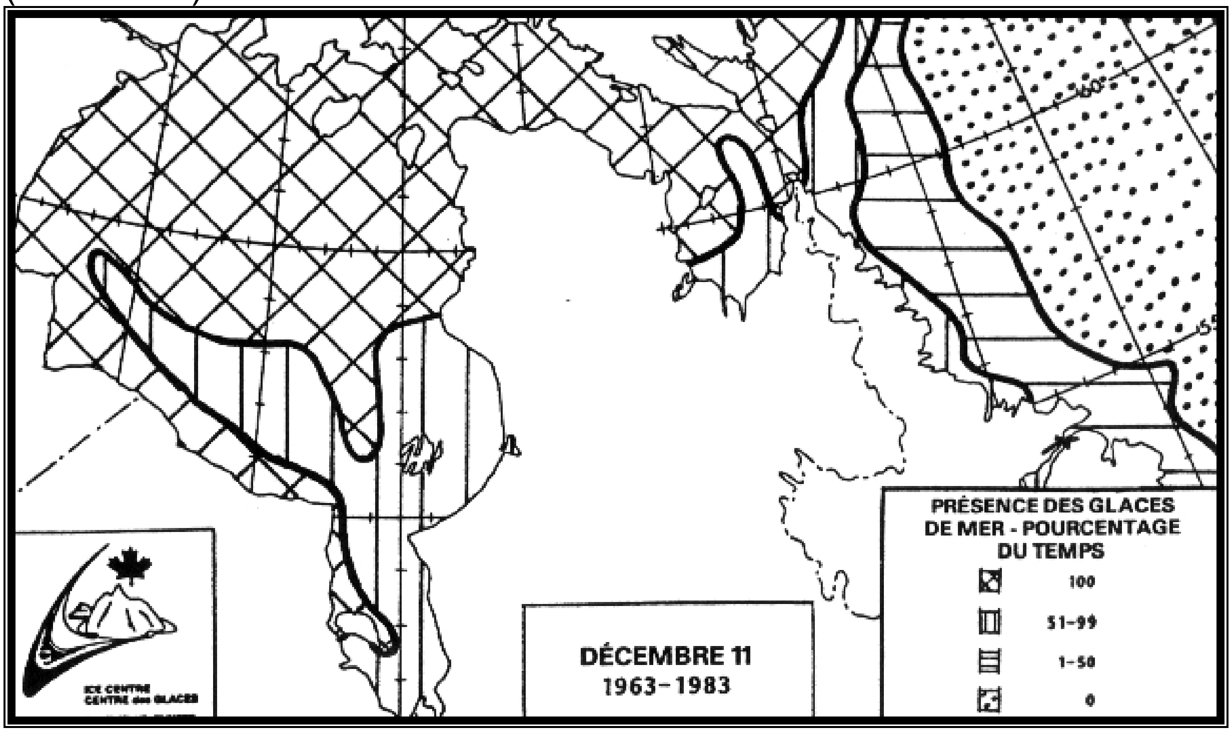


Source: -Fisheries and Oceans Canada (1988) *Sailing Directions, Labrador and Hudson Bay.* Page 73.

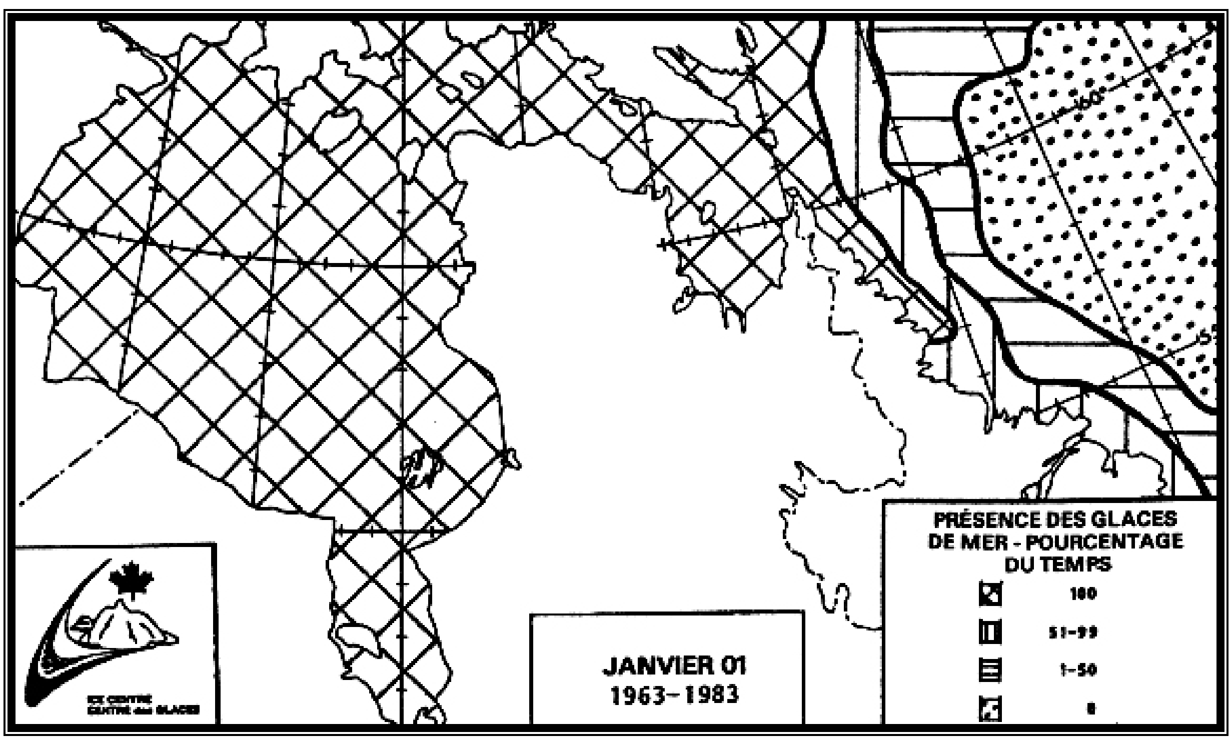


Source: -Fisheries and Oceans Canada (1988) *Sailing Directions, Labrador and Hudson Bay.* Page 73.

Yearly evolution of sea ice
(continued)



Source: -Fisheries and Oceans Canada (1988) *Sailing Directions, Labrador and Hudson Bay.* Page 74.



Source: -Fisheries and Oceans Canada (1988) *Sailing Directions, Labrador and Hudson Bay.* Page 74.

APPENDIX 7

TABLE OF STRENGTHS AND WEAKNESSES OF EACH SITE
CONCERNING UNLOADING OPERATIONS

Strengths and weaknesses of each site concerning unloading operations

LOCALITY	STRENGTHS			WEAKNESSES				
	Full-time access	Well protected ramp/beach	Compact and hard substrate	Access limited by tide	Few or no markers in channel	Lack of storage space	Conflict with local population**	Soft substrate
KANGIQSUALUJJUAQ		√		√	√	√	√	
KUUJJUAQ				√	√	√	√	
TASIUJAQ				√	√	√	√	√
AUPALUK			√	√	√		√	
KANGIRSUK			√	√	√		√	
QUAQTAQ			√	√	√	√	√	
KANGIQSUJUAQ		√	√	√	√	√	√	
DECEPTION BAY	√							
SALLUIT	√		√		√		√	
IVUJIVIK	√				√	√	√	√
AKULIVIK	√		√		√	√	√	
PUVIRNITUQ	√		√		√	√	√	
INUKJUAK	√		√		√	√	√	
UMIUJAQ	√	√	√		√		√	
KUUJJUARAPIK - WHAPMAGOOSTUI	√	√			√		√	
CHISASIBI	---------------NOT APPLICABLE--------------- There are no more marine supply operations in these communities							
WEMINDJI								
EASTMAIN								
WASKAGANISH								

* Good bearing capacity for machinery on the beach.

** Conflict on using the beach during the operations.

Sources: Leclerc, Félix. Transport Desgagnés (2001) Personal communication.
Gaudreau, François (2001) personal experience