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NORTHWEST TERRITORIES
PUBLIC WORKS AND HIGHWAYS

KEEWATIN PORT FACILITIES STUDY

MARCH 1989

IBI GROUP
IN ASSOCIATION WITH
STEVENSON HLUCHAN ASSOCIATES LIMITED

IBI
GROUP

March 31, 1989

Mr. Gordon Barber
Assistant Deputy Minister
Department of Public Works and Highways
Government of the Northwest Territories
Box 1320
Yellowknife, NWT
XIA 2L9

Dear Mr. Barber:

Keewatin Port Facilities Study

Attached is our final report for the above project. In the report we describe current maritime activities in the Keewatin Region, current port facilities and the deficiencies and requirements. We then use this information as a basis to develop a Master Plan for the development of port facilities in the Region.

The attached report describes the course of this work and the recommended plan. An Executive Summary is also included.

This work was undertaken by IBI Group in association with Stevenson Hluchan Associates Limited. It benefited from the guidance of a Steering Committee made up of:

- G. Barber, Public Works and Highways;
- J. Bunge, Public Works and Highways;
- J. Stevens, Public Works and Highways;
- R. Matson, Transport Canada;
- I. Marr, Transport Canada;
- A. Kathan, Department of Fisheries and Oceans;
- H. Wirth, Indian and Northern Affairs.

We would like to thank you and your colleagues for the extensive cooperation and assistance that we received during the course of the project.

Yours truly,

L.S. Sirns
Director

LSS:jh

240 Richmond Street West, 5th Floor, Toronto, Ontario M5V 1 W1 (41 6) 596-1930, FAX (416) 596-0644

NORTHWEST TERRITORIES
PUBLIC WORKS AND HIGHWAYS

KEEWATIN PORT FACILITY STUDY

FINAL REPORT

161 Group
in association with
Stevenson Hluchan Associates Limited

March, 1989

KEEWATIN PORT FACILITIES STUDY

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INTRODUCTION

This study was funded by the Government of the Northwest Territories, with the assistance of Transport Canada, Fisheries and Oceans, and Indian and Northern Affairs, to determine the overall requirements for port facilities in the Keewatin Region to serve goods, people, renewable resource movements and recreational traffic. It was also intended to develop a relative priortization of the various elements of the overall plan produced. The study area encompassed five communities on the west coast of Hudson Bay and one on Southampton Island. The specific communities are Eskimo Point (Arviat), Whale Cove, Rankin Inlet, Chesterfield Inlet, Baker Lake and Coral Harbour.

CURRENT MARINE ACTIVITY

Basic materials for the communities are brought in by Northern Transportation Company Limited (NTCL). The NTCL community resupply operation employs a tug and four barges operating out of the railhead at Churchill, Manitoba. On each trip two barges are moved by the tug and the other two barges remain in Churchill to be loaded for the next trip. At the destination port bulk fuel is pumped out through a floater hose to shore based tanks. Then the lightened barge is beached, ramps are placed. from the barge to the shore and the cargo is handled by NTCL crews to the consignees within the community. Typically ten or so voyages are made per season. Total volume is growing and exceeded 29,000 tonnes in 1988. Typically one or two voyages are made to each community. Rankin Inlet receives the highest level of service, with four trips and a total of 11,400 metric tonnes of cargo in 1988.

Other marine activity in the area includes:

- commercial fishing;
- subsistence and recreational fishing by the local inhabitants;

- local trips by outfitters carrying tourists;
- private cargo carrying from Churchill and between communities, usually in Peterhead vessels approximately 14 to 15 metres in length;
- larger equipment movements such as the barges carrying construction equipment landed in 1988 for the Rankin Inlet airport project;
- a cruise ship which visited several of the communities in 1988 which is expected to return in future years.

The activities of all of these operators are constrained by the lack of port facilities. In most communities NTCL uses a gravel pushout (maintained by GNWT Government Services) on a beach. The pushout usually has a flat face or a community wharf is available for use by smaller vessels; these are usable only at high tide. This presents problems with respect to the costs and convenience of operation and, in certain circumstances, causes problems of security and safety.

FUTURE ECONOMIC ACTIVITY IN THE REGION

The population of the Region is growing implying increases in resupply volumes, in other cargo movements and in fishing operations. Cargo carried by NTCL is projected to increase to between 37,000 and 42,000 tonnes by 2005. Other specific changes that are occurring include:

- the Department of National Defence is reconfiguring the airport at Rankin Inlet to be a Forward Operating Location (FOL). While military aircraft will not be stationed there permanently, a base will be developed to accommodate squadrons for protracted exercises or in emergencies;
- there is a considerable amount of activity in mineral exploration. Decisions are reported to be close on the development of several mines in the area. The

most imminent appears to be the proposed uranium mine close to Baker Lake;

- an upgrading of the fisheries is generally desired. A study is being undertaken by GNWT Department of Economic Development and Tourism this year.

PORT FACILITY PROPOSALS

In each of the six communities within the study area, four cases or levels of facilities were analyzed:

1. Facilities capable of accommodating primarily NTCL barges under all water conditions;
2. Facilities capable of accommodating Peterhead type vessels under all water conditions;
3. The above two capabilities, but with tidal water depth restrictions;
4. Improvements to existing pushout facilities.

It was found not to be possible at acceptable levels of costs . to develop Case 1 facilities in Whale Cove, Chesterfield Inlet and Coral Harbour. In Baker Lake such a facility is not required because the lack of tide makes NTCL operations much simpler in this location. Because of shallow water a Case 2 facility was not practical at Eskimo Point but a Case 3 facility could be constructed which would handle NTCL and smaller vessels at most stages of the tide. An improvement plan for each port was developed.

MASTER PLAN

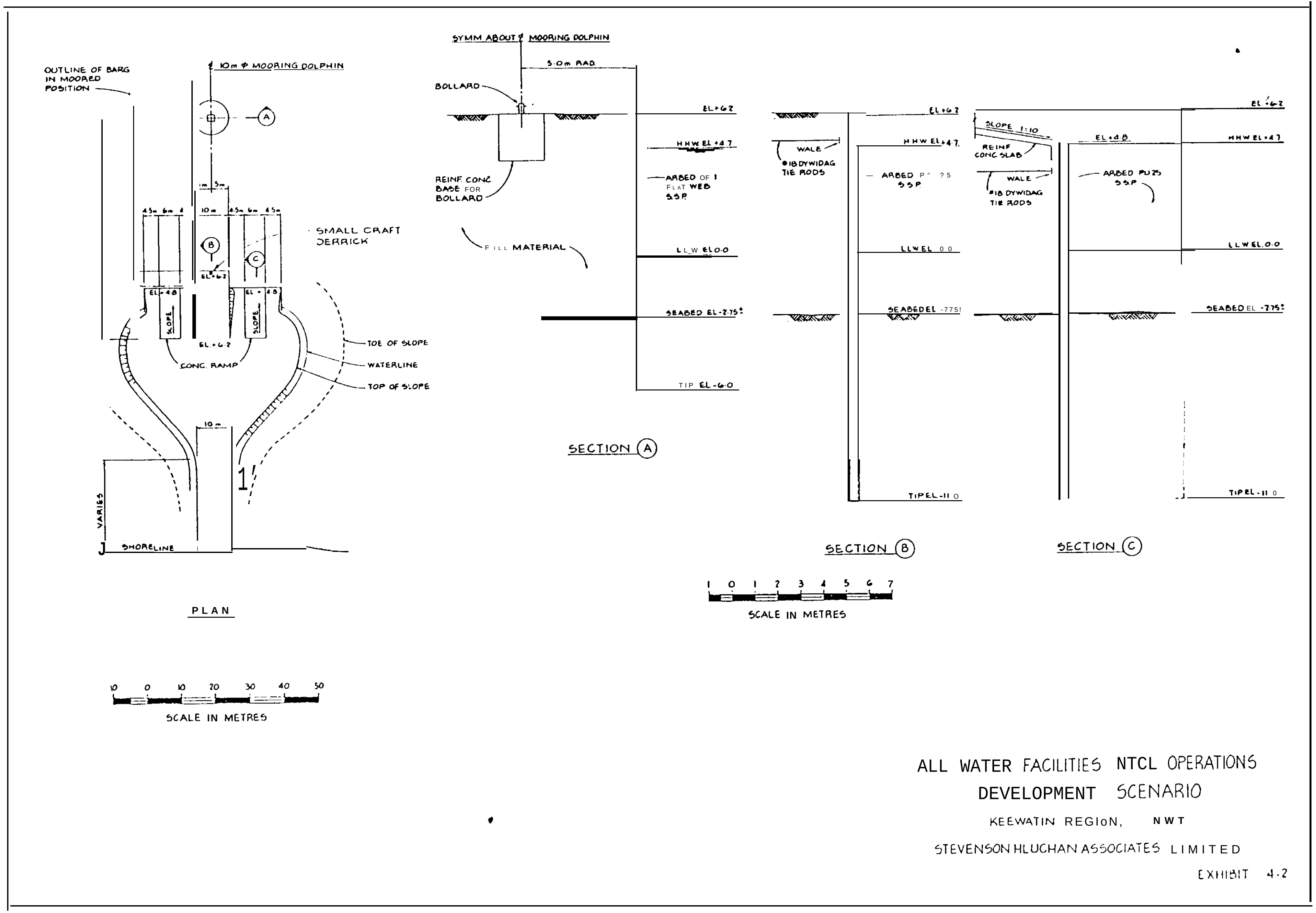
Based on proposals for each port a master plan for port facility development in the Keewatin Region was developed, using the following criteria to rank projects:

- capital costs of facilities;
- ongoing operating requirements;
- cost savings to NTCL;
- cost savings to other operators;
- security and safety;
- stimulation of economic activity.

Using these criteria an overall plan was developed. The elements of this master plan, in the order of relative priority, are as follows:

1. Construction of a major facility on Melvin Bay adjacent to Rankin Inlet which can handle the NTCL tug and barges at all stages of the tide and at which the barges can be tied up and left by the tug. Exhibit S.1 (included as Exhibit 4.2 in the main body of the report) shows the conceptual design of the facility. This has an estimated capital cost of $2.1 million.
2. Construction of a new pushout and community wharf at Eskimo Point **(Arviat).** This has an estimated cost of $420,000. Because of shallow water the existing pushout and landing at Eskimo Point will have to be replaced in any case.
3. Repairs to the existing community wharf facility at Baker Lake. It is suggested that a floating section be added which would make it usable by smaller vessels. A floating portion would have to be positioned in such a way as not to interfere with NTCL operations. Capital costs are estimated at $75,000.

EXHIBIT S.1



OUTLINE OF BARG IN MOORED POSITION
10m Φ MOORING DOLPHIN
SMALL CRAFT DERRICK
EL+4.8
EL+6.2
SLOPE
CONC. RAMP
TOE OF SLOPE
WATERLINE
TOP OF SLOPE
10m
VARIES
SHORELINE
PLAN
SCALE IN METRES
SYMM ABOUT ℄ MOORING DOLPHIN
5.0m RAD.
BOLLARD
REINF. CONC BASE FOR BOLLARD
FILL MATERIAL
EL+6.2
HHW EL+4.7
ARBED OF 1 FLAT WEB S.S.P.
LLW EL0.0
SEABED EL-2.75±
TIP EL-6.0
SECTION (A)
WALE
#18 DYWIDAG TIE RODS
SEABED EL
TIP EL-11.0
SECTION (B)
SLOPE 1:10
REINF CONC SLAB
EL+4.8
ARBED PU25 S.S.P.
LLW EL.0.0
SEABED EL -2.75±
SECTION (C)
SCALE IN METRES
ALL WATER FACILITIES NTCL OPERATIONS
DEVELOPMENT SCENARIO
KEEWATIN REGION, NWT
STEVENSON HLUCHAN ASSOCIATES LIMITED
EXHIBIT 4.2

4. The development of a floating wharf at Coral Harbour to accommodate private cargo carrying vessels and fishing vessels. The capital costs are estimated at $215,000.

5. The development of a similar floating wharf facility at Whale Cove at a cost of $490,000.

The benefits of implementing such a program would include:

- cost savings and capacity and flexibility improvements for NTCL through the availability of a wharf in Rankin Inlet where the tug and barges can be tied up;
- increases in local employment at Rankin Inlet through use of local labour to make deliveries;
- stimulation of local private entrepreneurs who would be encouraged to carry cargo in smaller vessels by the provision of better wharfing facilities for Peterhead size vessels in Eskimo Point, Whale Cove, Rankin Inlet, Baker Lake and Coral Harbour;
- assistance to the fishing industry by providing better mooring facilities for fishing vessels landing product and for vessels transporting product to Churchill;
- stimulation of the tourism industry through facilitating the visits of cruise ships to the area and by making local recreational travel easier.

SOURCES OF FUNDING

Several territorial and federal government departments have programs which are potentially applicable to the development of port facilities in this area. The following sharing of responsibilities is suggested:

- the proposed Rankin Inlet facility is a major port facility of the type that in most other parts of Canada would be provided by Transport Canada. It is possible that Transport Canada might either construct this facility directly or provide funds to the Government of the Northwest Territories to construct it;

- the changes to the facilities in Eskimo Point (Arviat) are basically a replacement for the facilities already developed by the Government of the Northwest Territories who would be responsible for moving and/or replacing the pushout for NTCL. It would also seem appropriate for the Department of Fisheries and Oceans or the Department of Indian and Northern Affairs to consider the possibility of assistance for portion to be used by fishermen;
- the facilities proposedat Whale Cove and Coral Harbour are primarily for the use of local fishing vessels and it would seem appropriate that the Department of Fisheries and Oceans would take the major responsibility;
- the repairs to the present wharf facility in Baker Lake should be the responsibility of the Government of the Northwest Territories, the builder of the wharf.

1. INTRODUCTION

1.1 STUDY AREA

There are six communities on the west and north coasts of Hudson Bay within the Keewatin Region of the Northwest Territories. Exhibit 1.1 shows the locations of these communities and adjacent areas. The study area for this project was defined to include the Hudson Bay communities. The communities and their 1988 populations are as follows:

Eskimo Point (Arviat)	1,255
Whale Cove	222
Rankin Inlet	1,444
Chesterfield Inlet	312
Baker Lake	1,066
Coral Harbour	501
Total	4,800

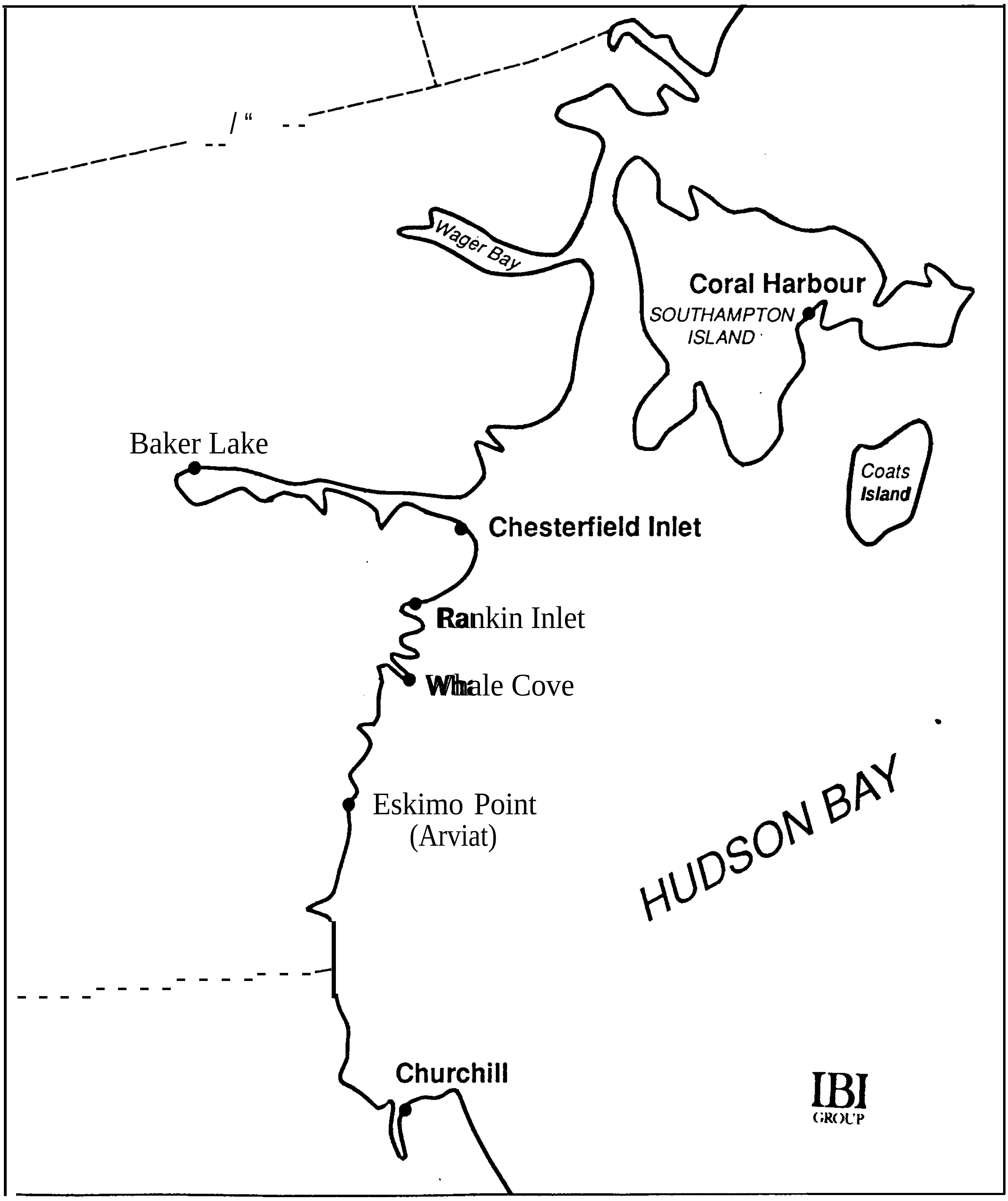
The first community listed, Eskimo Point, intends to resume officially the use of its Inuktitut name, Arviat, in June of 1989.

Transportation to these communities is completely supplied by the marine and air modes and of course most bulk materials move by the marine mode. Northern Transportation Company Limited (NTCL) operates a tug and barge service from Churchill, Manitoba, to supply these communities. In addition to the NTCL operation, other marine activity in the area includes:

- a ship chartered by Hudson Bay Company which normally visits Coral Harbour each year;
- special shipments, usually from Eastern Canada, by tug and barge associated with mineral developments or with construction activity;
- local freight movements from Churchill using vessels in the 14-15 metre range;
- commercial fishing in several communities;
- recreational or subsistence fishing;

EXHIBIT 1.1

STUDY AREA



- tourism.

In addition the area is visited by float planes during the summer open water season. Most of these float planes are either associated with mineral exploration or with recreational fishing by tourists.

Port facilities in the area are currently rather rudimentary. As described later in this report in most cases they consist of a pushout constructed with sand or gravel to make beaching of barges and other craft easier. In some communities a small wharf accessible only at high tide is also available.

1.2 STUDY BACKGROUND

NTCL and several of the communities have requested improved port facilities, in most cases a wharf that can be accessed at all stages of the tide. To assess the requirements for such facilities, this study was therefore commissioned by a joint territorial/federal committee made up of. representatives of:

- Department of Public Works and Highways of the Government of the Northwest Territories;
- Transport Canada;
- Department of Fisheries and Oceans;
- Department of Indian and Northern Affairs.

1.3 OBJECTIVE

The objective of this study is to establish the overal 1 requirements for wharfing and moorage facilities at ports on the Keewatin Coast for goods, people, and renewable resource movements as well as for recreational traffic. In addition, the requirements at each community are to be given a relative priority.

1.4 CONTENT OF THIS REPORT

This report describes the conduct and the results of the project which included:

- site visits;
- analysis of population trends and potential changes in economic activity;
- forecasts of future marine activity;
- analysis of alternative types of port facilities which could be implemented in the various ports;
- an evaluation of the possibilities;
- the development of an overall master plan for port facilities in the area;
- an investigation of governmental programs that might be available to fund facility development.

Chapter 2 describes current marine activity in the study area and Chapter 3 examines future developments which may affect the need for marine facilities. Chapter 4 describes alternative methods of meeting the needs in the various ports. Chapter 5 provides the overall evaluation of alternatives and develops priorities. Chapter 6 explores the programs of the different governments and departments that might be responsible for implementation of elements of the master plan.

2. MARINE ACTIVITY

As described previously, there is a variety of types of marine activity at present in the area. Most important of these is the NTCL resupply operation. In this section first the NTCL operation is described and then other marine activity is summarized for each community.

2.1 NTCL RESUPPLY OPERATION

Northern Transportation Company Limited (NTCL) is the major commercial operator in the area. It brings in dry cargo and bulk fuels to supply all the communities within the study area. The southern terminal for this operation is Churchill, Manitoba. Cargo and fuel is brought to Churchill by the railway line.

For all of the communities in this study area except for Coral Harbour, the NTCL operation is the only major means of resupply. All fuel and most of the dry cargo requirements of each of these communities are met by NTCL. There are a few local vessels which carry cargo from Churchill during the summer months. All other resupply requirements have to be met by air shipment.

Four barges and one tug are used for the operation. In addition a Ports Canada harbour tug is available for moving barges within the Port of Churchill. The barges are 64m (210 feet) in length and 17m (56 feet) wide with a moulded depth of 4.0m (13 feet). They have a maximum load capacity of approximately 1,700 metric tonnes for both bulk fuel and deck cargo.

The mode of operation is generally as follows:

- the tug leaves Churchill with two barges and proceeds to one of the northern communities. The barge is loaded with bulk fuel in under-deck tanks and with dry cargo on the deck;

- when the tug and barge reaches one of the northern communities, a floater hose is transferred ashore and attached to a pipeline connection to one of the local tank farms. The bulk fuel is pumped ashore;

- after the bulk fuel is pumped out and the barge is riding higher, it is beached on the next high tide. This is usually done in a location where a ramp or pushout has been constructed on the beach;

- a ramp is placed from the barge to the shore. Forklifts carried on the barge unload the dry cargo to the beach. The material is then delivered directly to the consignees in the community, either using the forklifts or using highboy trailers. Some highway trailers are also carried on the barge and delivered directly to consignees;

- at the next suitable high tide the barge is refloated;

- the tug and barges then proceed to another community or return to Churchill for reloading;

- by the time the tug returns to Churchill, the two other barges are usually loaded. The tug therefore drops off the two empty barges and leaves again on another trip, usually within 24 hours, with the two loaded barges.

This system is flexible and requires relatively little investment at the destination end (the northern communities). It does suffer, however, from some disadvantages:

- the pushouts must be repaired as they are eroded by wave and ice action. Depending upon the exposure of the particular location, this may have to be done every year or once every two or three years;

- unloading often has to wait for the right stage of the tide, causing delays and reducing productivity;

- unloading can also be delayed by the weather, again reducing productivity;

0 the unloading operation is carried out almost completely by NTCL crews. These are crews from the tug and crews flown in from Churchill to assist. There is therefore little local employment spin-off from the operation.

Exhibit 2.1 shows the tonnages carried over the last 11 years. It can be seen that the bulk fuel predominates in terms of tonnage carried, representing almost 75% of the total in 1988. The tonnage has increased considerably in the last three years, averaging approximately 28,000 tonnes per year. Previous to this time the average was just over 20,000 tonnes per year. The increased volume over the last. three years can probably be explained by the high level of construction activity in the area and increases in air services (which require fuel which is brought in by the resupply operation). Exhibit 2.2 shows the same information on tonnage by port in a graphic form.

The most important destination is Rankin Inlet which receives approximately 36% of the total volume. It can be seen from Exhibit 2.3 that the proportion of cargo going to Rankin Inlet has been increasing. The second most important destination is Baker Lake followed by Eskimo Point (Arviat) with Whale Cove, Chesterfield Inlet and Coral Harbour representing lesser volumes. The 1986 trip to Wager Bay was a one time event; building supplies for a lodge were landed.

Exhibit 2.3 shows the sailing pattern over the last four years. There were between 9 and 12 sailings each year. Most of these sail ings were to a single destination where both barges were unloaded. In a few cases there were two destinations visited on a particular sailing. The navigation season is generally from the middle of July to the end of September.

Exhibit 2.4 summarizes the number of trips and the number of calls made to each community by year. Rankin Inlet is the destination for the greatest number of calls, generally three or four per year. The

Exhibit 2.1
NTCL Keewatin Tonnage
(metric tonnes)

DRY CARGO

DESTINATION	1978	1979	1980	1981	1982	YEAR 1983	1984	1985	1986	1987	1988	AVERAGE (1978-1988)
Eskimo Point (Arviat)	1,306	688	504	558	273	559	790	755	1,610	1,479	1,012	867
Whale Cove	454	42	174	152	70	96	241	470	427	125	323	234
Rankin Inlet	1,111	1,297	1,885	2,123	1,103	840	2,006	1,377	2,528	2,980	2.575	1,802
Chesterfield inlet	272	157	239	227	312	426	779	365	611	675	321	399
Baker Lake	1,766	2,203	1,887	1,487	462	652	1,854	1,694	1,973	1,968	2,204	1,650
Cora lHarbour	683	1,438	920	749	343	383	1,231	499	701	828	569	759
Wager Bay									91	0	0	18
SUBTOTAL	5,592	5,825	5,609	5, 296	2,563	2,956	6,901	5,160	7, 942	8,055	7,004	5,718
Southbound	469	243	1,111	485	1,031	934	523	552	286	417	373	584
TOTAL TONNAGE	6,061	6,068	6,720	5,781	3,594	3,890	7,424	5,712	8,227	8,472	7,377	6,302

BULK FUEL

DESTINATION	1978	1979	1980	1981	1982	YEAR 1983	1984	1985	1986	1987	1988	AVERAGE (1978-1988)
Eskimo Point (Arviat)	3,251	3,671	1,865	2,505	1,826	2,995	3,092	2,560	3,285	2,905	3,524	2.862
Whale Cove	874	926	1,214	1,038	225	515	954	801	778	904	692	'811
Rankin Inlet	5,652	4,966	4,967	4,647	4,648	6,422	6,128	5,513	8,402	8,008	8,840	6,1W
Chesterfield Inlet	1,296	1,272	1,300	726	649	743	1,100	1,050	1,385	1,184	1,080	1,071
Baker Lake	3,886	4,584	3,150	2,558	3,059	3,496	3,622	4,312	3,507	4,013	5,775	3,815
Coral Harbour	1,920	1,812	2,333	2,013	1,655	1,532	1,991	2,068	1,719	1,851	1,762	1, 87B
Wager Bay										0	0	0
SUBTOTAL	16,879	17,231	14,829	13,487	12,062	15,703	16,887	16,304	19,07?	18,863	21,674	16,636
Southbound	0	0	0	0	0	0	187	0	234	60		44
TOTAL TONNAGE	16,879	17,231	14,829	13,487	12,062	15,703	17,074	16,304	19,311	18,923	21,67:	16,680

TOTAL

DESTINATION	1978	1979	1980	1981	1982	YEAR 1983	1984	1985	1986	1987	1988	AVERAGE (1978-1988)
Eskimo Point (Arviat)	4,557	4,359	2,369	3,063	2,099	3,554	3,882	3,315	4,895	4,384	4,537	3,729
Whale Cove	1,328	968	1,388	1,190	295	611	1,195	1,271	1,206	1,029	1,015	1,045
Rankin Inlet	6,763	6,263	6,852	6,770	5,751	7,262	8,134	6,890	10,931	10,988	11,414	8,002
Chesterfield Inlet	1,568	1,429	1,539	953	961	1,169	1,879	1,415	1,996	1,859	1,402	1,470
Baker Lake	5,652	6,787	5,037	4,045	3,521	4,148	5,476	6,006	5,480	5,980	7,980	5,465
Coral Harbour	2,603	3,250	3,253	2,762	1,998	1,915	3,222	2,567	2,420	2,679	2,331	2,636
Wager Bay	0	0	0	0	0	0		0	91	0	0	8
SUBTOTAL	22,471	23, 056	20,438	18,783	14,625	18,659	23,74	21,464	27,019	26,918	28,678	22,354
Southbound	469	243	1,111	485	1,031	934	710	552	520	477	373	628
TOTAL TONNAGE	22,940	23,299	21,549	19,268	15,656	19,593	24,498	22,016	27,539	27,395	29,051	22,982

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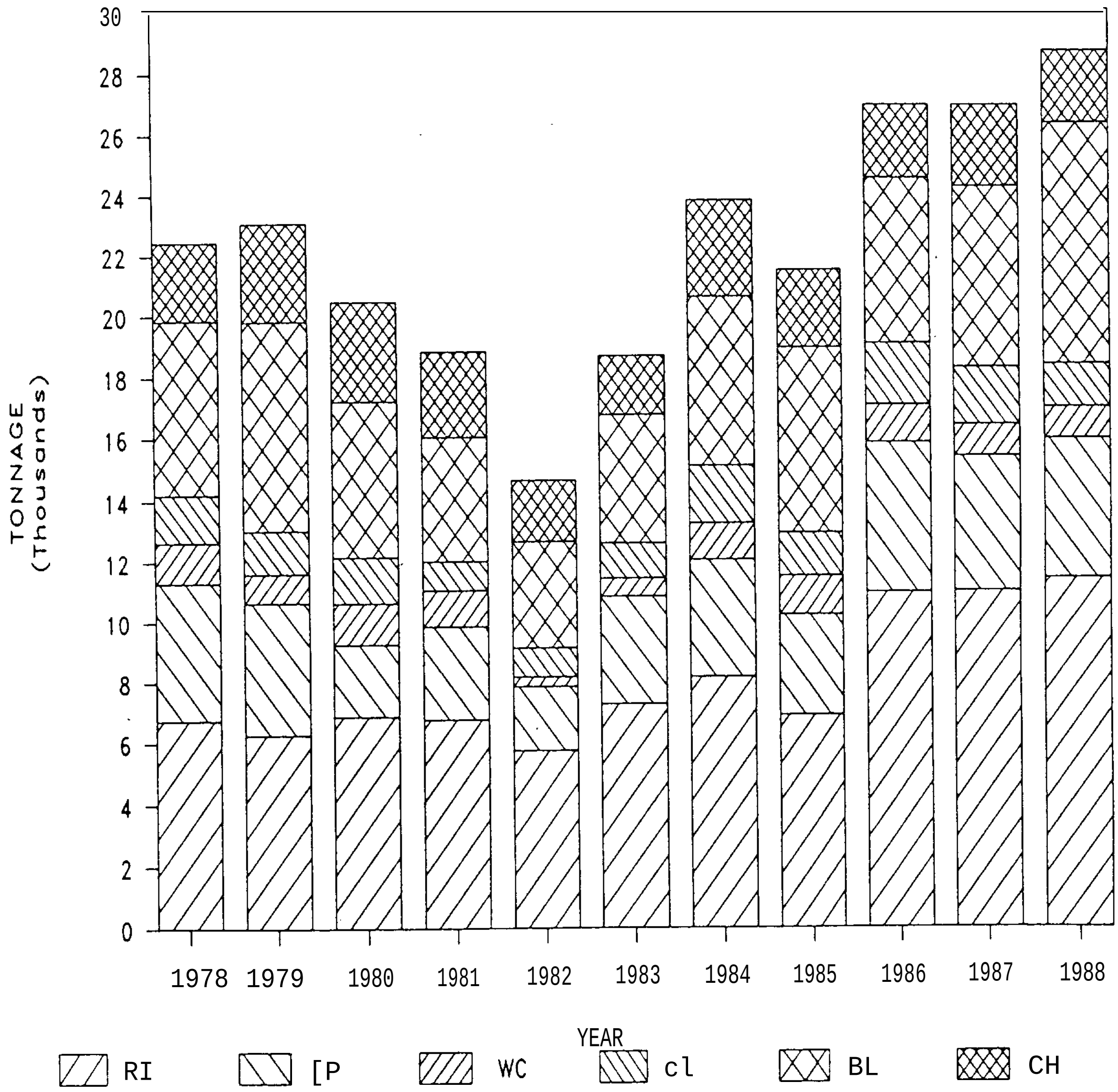
EXHIBIT 2.2

NTCL TONNAGES BY COMMUNITY



Rankin Inlet Eskimo Point Whale Cove Chesterfield Inlet Baker Lake Coral Harbour

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GROUP

EXHIBIT 2.3
NTCL SAILING PATTERN

Trip No.	Depart. from Churchill	First Stop	Arrival	Departure	Unloading Time (days)	Second Stop	Arrival	Departure	Unloading Time (days)	Return to Churchill	Days
1988											
1	July 16	Eskimo Point (Arviat)	July 20	July 24	4					July25	9
2	July 26	Whale Cove	July 27	July 29	2					July 30	4
3	July 31	Rankin Inlet	Aug. 1	Aug. 4	3					Aug. 6	7
4	Aug. 6	Baker Lake	Aug. 9	Aug. 12	3					Aug. 15	9
5	Aug. 15	Coral Harbour	Aug. 18	Aug. 21	3					Aug. 24	9
6	Aug. 24	Chesterfield Inlet	Aug. 26	Aug. 28	2	Baker Lake	Aug.30	Aug. 3		Sept. 3	10
7	Sept. 4	Rankin Inlet	Sept. 6	Sept. 9	3					Sept. 11	7
8	Sept. 11	Baker Lake	Sept. 15	Sept. 18	3					Sept. 21	10
9	Sept. 21	Rankin Inlet	Sept. 23	Sept. 26	3					Sept. 28	7
1987											
1	July 14	Eskimo Point (Arviat)	July 15	July 20	5					July 20	6
2	July 22	Whale Cove	July 23	July 25	2	Rankin Inlet	July 25	July 27	2	July 29	7
3	July 29	Rankin Inlet	July 30	Aug. 3	4					Aug. 5	7
4	Aug. 5	Baker Lake	Aug. 8	Aug. 11	3					Aug. 14	9
5	Aug. 18	Coral Harbour	Aug. 21	Aug. 24	3					Aug. 26	8
6	Aug. 26	Chesterfield Inlet	Aug. 28	Aug. 31	3					Sept. 2	7
7	Sept. 2	Rankin Inlet	Sept. 4	Sept. 7	3					Sept. 9	7
8	Sept. 11	Baker Lake	Sept. 14	Sept. 18	4					Sept. 21	10
9	Sept. 21	Rankin Inlet	Sept. 23	Sept. 25	2					Sept. 26	5
10	Sept. 26	Eskimo Point (Arviat)	Sept. 27	Sept. 28	1					Sept. 29	3
1986											
1	July 7	Eskimo Point (Arviat)	July 8	July 12	4					July 14	7
2	July 15	Whale Cove	July 16	July 19	3					July 20	5
3	July 20	Rankin Inlet	July 22	July 23	1					July 25	5
4	July 26	Rankin Inlet	July 28	July 31	3					Aug. 1	6
5	Aug. 3	Baker Lake	Aug. 6	Aug. 9	3					Aug. 11	8
6	Aug. 12	Coral Harbour	Aug. 15	Aug. 19	4					Aug. 21	9
7	Aug. 22	Chesterfield Inlet	Aug. 24	Aug. 27	3					Sept. 4	6
8	Aug. 29	Rankin Inlet	Aug. 30	Sept. 2	3					Sept. 4	6
9	Sept. 5	Baker Lake	Sept. 10	Sept. 13	3					Sept. 15	10
10	Sept. 15	Eskimo Point (Arviat)	Sept. 16	Sept. 18	2					Sept. 19	4
11	Sept. 19	Rankin Inlet	Sept. 21	Sept. 23	2	Wager Bay	Sept. 25	Sept. 26		Sept. 29	10
12	Oct. 1	Rankin Inlet	Oct. 3	Oct. 5	2					Oct. 6	5
1985											
1	July 17	Eskimo Point (Arviat)	July 18	July 21	3					July 23	6
2	July 23	Rankin Inlet	July 26	July 29	3					July 31	8
3	Aug. 1	Whale Cove	Aug. 2	Aug. 4	2					Aug. 6	5
4	Aug. 6	Baker Lake	Aug. 10	Aug. 12	2					Aug. 14	8
5	Aug. 14	Baker Lake	Aug. 17	Aug. 19	2					Aug. 22	8
6	Aug. 22	Coral Harbour	Aug. 24	Sept. 1	8					Sept. 4	13
7	Sept. 4	Chesterfield Inlet	Sept. 5	Sept. 7	2					Sept. 9	5
8	Sept. 9	Rankin Inlet	Sept. 11	Sept. 13	2	Baker Lake	Sept. 5	Sept. 16	1	Sept. 19	10
9	Sept. 19	Eskimo Point (Arviat)	Sept. 20	Sept. 21	1	Whale Cove	Sept. 21	Sept. 22	1	Sept. 23	4
10	Sept. 23	Rankin Inlet	Sept. 26	Sept. 28	2					Sept. 29	6

EXHIBIT 2.4
SUMMARY OF NTCL OPERATIONS

		Number of Calls							
Year	Number of Trips	Eskimo Point (Arviat)	Whale Cove	Rankin Inlet	Chesterfield Inlet	Baker Lake	Coral Harbour	Wager Bay	Total Calls
1988	9	1	1	3	1	3	1	-	o
1987	10	2	1	4	1	2	1	-	1
1986	12	2	1	5	1	2	1	1	13
1985	10	2	2	3	1	3	1	-	12
1984	9	2	1	3	2	2	2	-	12
1983	9	2	3	3	1	2	1	-	2
1982	8	1	1	3	1	2	1	-	9
1981	9	2	1	4	1	2	1	-	11
Average	9.5	1.8	1.4	3.5	1.1	2.3	1.1	0.1	1 .3

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next busiest is Baker Lake with two or three. The other destinations receive one or two.

NTCL staff have stated that the lack of wharves north of Churchill represents a potential safety and flexibility problem. Once the tug has left Churchill, there is no safe place to tie up a barge in case of emergencies such as inclement weather, possible cargo spills, engine problems, etc. In addition wharfage facilities would materially improve the productivity of operations if the crews did not have to wait for a particular stage of the tide or for fair weather.

2.2 MARINE ACTIVITY BY PORT

In addition to the NTCL operations there are several other types of marine activity. These and the current facilities are described in the sections below.

Eskimo Point (Arviat)

Eskimo Point has a population of 1,200. The port is served by one or two NTCL voyages per year. In addition there are a number of smaller vessels resident in the area usually of 22 foot length or smaller. size used for fishing. There is a small fish plant which does not export from the area. Other vessels, mostly of the Peterhead design and manned by residents from other ports in Keewatin, bring cargo from Churchill.

There is a pushout which NTCL uses adjacent to the fish plant. Imbedded in this pushout is an old barge that was placed there to give a little more stability. The fishermen also use the same area to land their catch although there is another location further south also used by local vessels.

The Peterhead boats coming from Churchill use the same area. They can only come in at high tide and have to leave again before low tide. Often this requires them to take two tides to unload. There are probably seven or eight trips a year of these itinerant vessels but there might be more if a wharf were available.

The harbour has problems with shoals and lack of water depth in the area of the pushout. The bottom is sand and gravel with a few boulders mixed in. The harbour is relatively sheltered during low tide conditions but can be exposed to significant wave action during the periods of high water. Winds can make navigation difficult. There are few currents. The only ice action is the result of tidal movements with little rafting of the ice. The tidal range is relatively large, about 3.8m.

The local population is growing. There is also a considerable amount of mineral exploration activity to the west. If any of these explorations develop into an operating mine, there may be increased demand for traffic to this port. There is some local tourism. Last year (1988) a cruise ship passed through Hudson Bay and visited this community; passengers had to be landed in rubber dinghies because of the lack of a suitable wharf.

The pushout is in a difficult location because of shallow water; however, it generally requires repairs only approximately every two years or so, costing perhaps $3,000 to $5,000 per occasion.

A wharf would make things much easier for the local fishermen, for the entrepreneurs carrying cargoes from Churchill (in the Peterhead vessels), for any tourist operations that might develop and of course for NTCL. There is a considerable amount of local construction equipment, mainly earth and material moving equipment, available although these are usually fairly heavily committed during the summer. The local people did indicate, however, that an important spinoff of any wharf construction activity should be the local employment provided.

Whale Cove

Whale Cove is a smaller community (1988 population of 222), almost completely Inuit. It generally receives only one NTCL voyage per year. There is a considerable amount of local fishing activity including some commercial operations. The vessels used are a mixture of Peterheads, longliners and larger canoes. The local operators have noted that there have been problems associated with the lack of a wharf which have included damage to vessels, spoilage of fish waiting for tides and loss of product due to difficult transfer procedures.

In addition to the NTCL resupply, there are a number of trips by private operations bringing cargo from Churchill. Hamlet officials suggested that there are at least eight trips per year.

The location of the pushout in the harbour is relatively well sheltered. The first work on the pushout for the last five years was done in 1988. The average cost of maintaining the pushout is probably only $1,000 per year.

Rankin Inlet

Rankin Inlet is the largest community in the Keewatin Region with a current population approaching 1,500. It is the largest centre for governmental operations in the region as well as being the seat of the Regional Council. Current marine activity includes:

- three or four calls per year by NTCL;
- local fishermen and mariners who own perhaps ten of the larger craft and many smaller vessels;
- private freighters (maybe up to six trips per year) carrying cargo mainly from Churchill;

- a visit by the cruise ship that visited Hudson Bay in 1988 which is expected to return in future years.

The NTCL operation uses a makeshift wharf that was developed in the harbour, Johnston Cove, using an abandoned barge. This landing area has two problems:

- it is located exactly in the area where the local fishermen moor their vessels. When the tug and barges are in the harbour these vessels have to be moved and there is a considerable amount of congestion;

- there is a considerable amount of shallow water in the harbour and there is a sand bar at the edge of the harbour which appears to be growing and in the future may restrict access.

For 1989 it is planned to use a new landing site located one kilometre southwest of the edge of the Town and two kilometres from the existing pushout. This site is called Itivia (Mover the hill" in Inuktitut) and is located on a body of water described on the navigation charts as Melvin Bay. Melvin Bay is a well sheltered inlet off of Rankin Inlet itself. It is regarded as a superior landing site in that it has deep water close to the shore and a large, well protected anchorage area.

The site at Melvin Bay is quite remote from the tank farm, however, and fuel landed here would have to be pumped a considerable distance over land. A new pipeline might be constructed when the Town's tank farm is modernized, currently set at approximately five years from now. The existing tank farm adjacent to Johnston Cove was modernized in 1988 and changes will not be required for some time. In the meantime NTCL will probably continue to pump out fuel in Johnston Bay and then move the barges around the point to unload the dry cargo in Melvin Bay. In 1988 a tug and barge from Eastern Canada landed construction equipment at this location to be used for airport expansion. A rough road exists to Melvin Bay. This was developed in 1988 on the path of an earlier road used when Melvin Bay was used as a winter landing strip. The longer distance from the community means that NTCL will have to incur more truck-hours for local delivery.

Currently there is not a good location for float plane activity in Rankin Inlet. Formerly, these planes used a small lake to the northwest of Town but this is now used as a reservoir for the community's drinking water and is no longer suitable for float plane operations. Float planes now have to use a lake seven or eight miles to the northwest. Melvin Bay could be a suitable place for float plane operations if there were a wharf or a suitable beach for loading and unloading of passengers and equipment. These float planes are generally used for mining exploration activity.

Chesterfield Inlet

Chesterfield Inlet is a small community of just over 300 persons. It is generally served by one NTCL call per year.

The only local marine activity is fishermen in small craft although the local fish plant does have a 8.5m aluminum pickup boat. In addition, DFO has a 10.7m barge. There was a longliner operating in the area but it has since relocated. There was also a large Peterhead fishing vessel located here but it has been sold. Almost all the fishing activity is done by smaller craft. These vessels are landed on beaches and the vessels can be pulled up onto the shore by hand or with the assistance of trucks. This is done either in front of the fish plant or by the Hudson Bay store.

The port does have some Peterhead vessels coming from Churchill, Rankin Inlet and points south, perhaps three per year. Many of these are only calling for provisions although they have had Peterheads bringing cargoes in. In these cases they have had to unload the cargo onto smaller craft which is a very inconvenient way of unloading.

The NTCL operations take place at a pushout adjacent to the Hudson Bay store. Because the harbour is exposed to the southeast, however, the NTCL operation is more complicated here than at other locations. A common pattern of events is as follows:

- the NTCL tug arrives with two barges;
- it takes the barges around to a sheltered anchorage in the west (about five miles by small vessel but about 20 miles around for the tug and barge);
- one of the barges is anchored there;
- the tug then returns to the Harbour with one barge and pumps the fuel out and then beaches the barge for the unloading of the dry cargo;
- the empty barge is then taken around to the anchorage, left there and the second barge moved around to the Town;
- unloading takes place and then the tow is reunited.

A new community wharf was constructed at the southeast end of the harbour last year. It was constructed too late to see any activity in 1988. It is made up of rock gabions on the inward face, that is the northwest side. It is about 600 metres from the community and a new road had to be constructed. Although the bottom of the harbour is reported to be mainly sand and gravel, at the new wharf there is bedrock on the bottom. The NTCL barge operation can not use the community wharf because it is too small and does not have a place for the ramps from the barge.

There are unused fishing quotas at Chesterfield Inlet. The GNWT has had an application for a processing and packing vessel in this community but they have deferred action on this until an overall fishing strategy for the Keewatin is developed. The population is static. The cruise ship that visited Hudson Bay in 1988 did not call at Chesterfield Inlet.

Baker Lake

Baker Lake is a larger community with over 1,000 inhabitants. It generally receives two or three calls by NTCL each year. The community is located on Baker Lake, approximately 300 kms. inland from Hudson Bay but connected to it by a channel. Because the Lake is primarily freshwater, the NTCL operations at this location are not affected by tides. Bulk fuel can be pumped ashore and dry cargo unloaded at the same time although the present locations of the tank farms do not permit this for all of the bulk fuel unloading.

The current marine transportation activities in Baker Lake include:

- NTCL which is the only user of the wharf;
- resident vessels which include one longliner and many smaller vessels which are active in fishing and hunting. These vessels are usually beached on the property of the owner. The longliner is normally kept anchored in front of the owner's house;
- float planes which normally use the beach in front of the Hudson Bay store;
- some freighter boats although these seldom visit Baker Lake.

Previous to the construction of the existing wharf there was a pushout which was constructed by sinking an old barge and covering it with gravel. The present wharf was built in the fall of 1987. It was built mostly by DPW staff using equipment owned by the Hamlet. Gravel was hauled from pits north of the community. It was damaged in the spring of 1988. The steel sheeting on the front face was removed by the ice; the current configuration therefore is of reinforced sides but with a gravel outside face. The sides are reinforced with large boulders on the outside edges and therefore the wharf is not too useful for smaller vessels. NTCL captains, however, report that the current configuration is very suitable for their operations.

There is no tidal movement at the western end of the Lake although there are traces of salt water. Usually the Lake freezes over to a depth of approximately three metres of ice. There is a considerable amount of ice movement in the Spring, particularly when the river breaks up. The Lake can get choppy with waves up to 1.5 metres but this is uncommon. Navigation is difficult in the narrower sections of the passage from Hudson Bay into Baker Lake. The main problem is the depth of water. Large vessels such as the NTCL tug and barge usually wait for high tide.

The existing location of the wharf is fairly good for navigation but, according to Hamlet staff, there are better sites to the east of the Town. The proposed uranium mine in the area (described in the next chapter) has been looking at a harbour site 10 or 12 km to the east of the Town. Apparently, the company proposes to build a winter road from the mine to the dock. Materials would be stockpiled at the dock during the navigation season and then moved to the mine site after freeze-up.

The community had previously talked about constructing a floating, L-shaped wharf for float planes. This would be necessary to protect the aircraft from inclement weather originating from the southeast which can cause Lake to become choppy.

There were previously three fuel tank farms in the area, operated by the GNWT Government Services, the electric power generating company and Transport Canada. The Transport Canada tank farm has been replaced by a new one constructed by a private operator. The electric power generating tank farm was consolidated in with the Town tank farm. Thus two have recently been decommissioned but there are two continuing, Transport Canada's and the Hamlet's.

Coral Harbour

Coral Harbour is the only one of the six communities in the study area not located on the mainland. It is located on Southampton Island on the north side of Hudson Bay. There is a small harbour immediately adjacent to the community. A wooden wharf constructed there is accessible at high tide. However, NTCL does not usually use this wharf as the harbour is very constricted and is difficult to navigate into during periods of high wind. NTCL therefore generally uses a pushout constructed on an open beach, called Snafu Beach, approximately five kilometres to the west of the community. This site is difficult to maintain as it is subject to severe wave action. In the past it has happened that the pushout has had to be repaired halfway through an unloading period. In 1988 the Territorial Department of Public Works spent almost $12,000 maintaining the barge pushout.

The current NTCL operation is usually as follows:

- fuel is pumped off to the Transport Canada aviation fuel tanks at Snafu Beach. These tanks are connected to the airport by a pipeline;
- the barge is then beached at Snafu and the dry cargo unloaded. This dry cargo is carried by forklift and lowboy trailer to town (a distance of about three miles);
- then the barge is taken around and fuel is pumped ashore to the tank farm in town.

The Town tank farm also supports the electric power generating station with fuel carried by tanker from the tank farm to the generating station. There are plans to consolidate the two tank farms, probably at or adjacent to the current tank farm. Fuel will be carried to the airport by tanker truck where holding tanks would be available for approximately one day’s fuel.

Currently there is one NTCL voyage per year. NTCL normally flies in its own crew. Forklifts and other equipment from the barges is used to carry the material into Town. The barge can be unloaded in 48 hours if there is no weather interruption but often it takes much longer.

In addition to the NTCL voyage there is usually one Hudson Bay company chartered vessel voyage per year. This is a conventional ship and traffic is lightered to shore. Sometimes the lighters come into the wharf in the harbour and sometimes they use Snafu Beach.

The local people mention that Snafu Beach is very exposed and weather can interrupt unloading. On the other hand, the Harbour is very difficult to enter but once the vessel is in the Harbour it provides quite a bit of shelter.

In addition there are quite a few local fishing vessels including six Peterhead types and a large 15m processing vessel. The latter usually carries "its fish directly to the processing plant in Rankin Inlet. In addition there are many other small vessels in Town. These vessels normally come in at high tide. The large tidal range is approximately 3.6m.

Tourism is seen as a growth industry. Coral Harbour was visited by the cruise ship in 1988 and is expected to be on the permanent itinerary. There was some concern expressed by local entrepreneurs that the ship may have to bypass the town if the tide is not right to accommodate the dinghies at the hamlet's wharf.

2.3 TOTAL FISHING ACTIVITY

Although a very high proportion of the population of Keewatin (about 2,400 persons or one-ha"lf the population) participates in subsistence or recreational fishing, there are considerably fewer persons engaged in commercial fishing. Exhibit 2.5 presents information on the number of commercial fishing licences and the commercial and domestic (recreational/subsi stence) fi sh harvests by community in 1987-88. There were a total of 231 licensed commercial fishermen in the six study communities in that year. The commercial harvest totalled approximately 33,000 kg., representing about 73% of the total fish harvest. The total value of fish landed and marketed in 1986/87 was $112,000. However, as shown in Exhibit 2.6, the federal Department of Fisheries and Oceans estimated the value of all the Keewatin fish and marine mammals harvested in 1987-88 to be close to $1 million.

At present the main fishing activity in the Keewatin area is harvesting arctic char." These are fish that live in the rivers but feed in Hudson Bay. The main summer fishery involves catching them as they return to the rivers. As shown in Exhibit 2.5, the major areas of char fishing activity in the Keewatin are Eskimo Point, Whale Cove and Rankin Inlet. There is also char fishing on inland lakes through holes in the ice during the winter months.

There may be some potential for an off-shore fishery but this has not yet been proved. There are also some marine mammals which are currently harvested for local use. At Eskimo Point, Rankin Inlet and Whale Cove, each local community catches 30-70 beluga whales in the season. Coral Harbour inhabitants harvest both beluga whales and walrus.

The DFO sets commercial fishing quotas but not all the quotas are used up now. For the Keewatin region as a whole, the annual commercial quota for arctic char in all Schedule 5 waters (waters for which fish assessments have been done) totals about 180,000 kg. Thus,

EXHIBIT 2.5

1987-88 KEEWATIN FISH HARVEST STATISTICS*

Community	Commercial Fishing Licences	Commercial Harvest (kg)	Domestic Harvest (kg)	Total Harvest (kg)
Baker Lake	18	0	500	500
Chesterfield Inlet	22	2,603	600	3,203
Coral Harbour	7	4,268	94	4,362
Eskimo Point (Arviat)	121	9,505	7,548	17,053
Rankin Inlet	23	3,786	2,012	5,798
Whale Cove	40	12,518	1.500	14.018
TOTAL	231	32,680	12,254	44,934

* Almost 100% of the total harvest was arctic char with less than one percent arctic cod

SOURCE: Department of Fisheries and Oceans

EXHIBIT 2.6

APPROXIMATE VALUE OF KEEWATIN FISHERIES, 1987-88*

Species	Estimated Value ($)
Char	303,200
Narwhal	30,355
Beluga Whale	341,834
Walrus	54,026
Ring Seal	173,345
Harp Seal	17,574
Bearded Seal	76,990
TOTAL	997,324

* For total harvest, based upon replacement values used by Department of Economic Development, GNWT

SOURCE: Department of Fisheries and Oceans only about 18% of the potentially available commercial fish resource was used in 1987-88. There is considerable fish supply to support an expansion of the commercial fishing industry in the Keewatin, although it should be noted that many of the lakes are remote and difficult to access and the commercial harvests from waters closer to the communities are generally higher relative to the quotas (30%-50% of quotas). The viability of expanding the commercial fishery also depends on market and cost factors.

Whale Cove and Chesterfield Inlet have sporadically exported frozen char to Churchill but the Rankin Inlet fish plant is the only one which consistently ships out fish. All of the product currently moves by air although various people have discussed the possibility of moving some by boat to Churchill as a backhaul; these are usually operators who are now making freight runs from Churchill and would like a backhaul cargo.

As there are no large wharfs in any of the communities, the fishermen typically come in on the high tide. This produces awkward hours, particularly for the fish processing plant in Rankin Inlet. All-water wharves to accommodate Peterhead and longliner vessels would make the fishery more attractive by encouraging the consolidation of fish movements to the fish plants in larger vessels. Such a collector boat system would reduce unit transportation costs, as well as spoilage since the larger vessels can sail in worse weather conditions than small craft and would experience less delay in delivering the fish. As mentioned previously a collector boat system has recently been introduced in Coral Harbour where a 50-foot fish processing vessel is used to carry consolidated fish loads to Rankin Inlet.

The Department of Economic Development of Northwest Territories is commencing a study of a fishing development strategy for the Keewatin District. This study will be completed in the summer of 1989. It will analyze, amongst other things, infrastructure requirements for the development of the fishery.

3. FUTURE ACTIVITY

The need for port facilities is determined both by present deficiencies and by potential future requirements. In this chapter we examine changes in economic activity in the area which may take place over the next decade.

3.1 DEPARTMENT OF NATIONAL DEFENSE PROGRAMS

As part of its strategy for North American air defense, the Department of National Defence (DND) is developing five Forward Operating Locations (FOL's) for military aircraft in the North. One of the sites selected is in the study area at Rankin Inlet. The concept is that the Rankin Inlet airport runway facilities will be expanded to accept air force planes and ground facilities will be developed to support operations. No aircraft would, however, be permanently stationed here. For exercises or in emergencies, aircraft would be flown in. At the present time, it is not anticipated that a permanent staff will be located at Rankin Inlet. Personnel will be brought in on an as-required basis.

The logistics of this operation have not been completely worked out by DND. It is anticipated, however, that once the FOL is operational that approximately 2,000 tonnes of aviation fuel will be required in an average year.

The first construction contracts have already been let. Construction equipment was landed, by barge at the Itivia site on Melvin Bay, in the fall of 1988. This first contractor is based in Eastern Canada and moved the equipment directly from there. The Department expects to award other contracts by May of 1990. More construction equipment is scheduled to come in 1990 and prefabricated buildings during the 1991 construction season. Most of the material required during construction is expected to come by the NTCL resupply operation. NTCL is the designated carrier to supply this operation.

The operation of this FOL, as currently contemplated, will not have a large impact on the requirements for marine facilities. However, the expansion of the Rankin Inlet airport in terms of runway widths and particularly length may have a greater effect. For example, the 727 aircraft which are now operated by First Air into Rankin Inlet today cannot be fully loaded because of the lack of runway length. Better airport facilities are expected to reinforce the role of Rankin Inlet as the central location in Keewatin District. More efficient 'aircraft operation may take some volumes of resupply away from NTCL to the port but in the long run the reinforcement of Rankin Inlet's role will probably increase the demand for marine movement.

3.2 MINERAL EXPLORATION AND DEVELOPMENT

There is a considerable amount of mineral exploration activity in the Keewatin District. In 1987 there were 17 exploration projects with a total expenditure of $21 million. Several developments are close to a go ahead decision. The four projects that appear to be closest to fruition are described below.

Urangesellschaft Canada Limited, Baker Lake

This is a uranium mine which is proposed to be located approximately 80 kms. west of Baker Lake. The company, West German in origin but with a Canadian office, is currently in the midst of a feasibility study and will decide at the end of the feasibility study whether to pursue the project or not. The feasibility study is expected to be finished in the summer of 1989. In addition environmental hearings of the project are expected to start soon. These will last until mid-1990. Only at this time will the company have a definitive response to their proposals.

The company has, however, developed an operational plan. During the production phase they expect to fly the product out. They will require, however, marine resupply of fuel and materials. They expect to ship this directly from Eastern Canada by chartered tug and barge although the fuel may possibly be moved by a small tanker with a transfer into smaller craft and closer to the narrows between Baker Lake and Hudson Bay. The materials would be landed at a new wharf to be constructed approximately 10 or 12 kilometres east of the Baker Lake town site. They would be moved to the mine over a winter road. The volume of materials movement is expected to be approximately 25,000 tonnes per year, half of which will be fuel.

At the mine site itself there are expected to be-approximately 250 workers. As many as possible would be local people but the company does expect that a high proportion will be from other parts of Canada. Only short term accommodation will be provided at the mine site and workers will be flown in and flown out.

The same mode of supply through a new wharf on Baker Lake will be used during the development phase of the project. They expect to move in approximately 25,000 tonnes of construction equipment and materials over two to three years.

Noble Peak Resources Limited

The Noble Peak project is a gold mine in the greenstone area west of the Hudson Bay coast, directly west of Whale Cove. A decision to proceed to development has not yet been made and, according to the company, will probably require another year and one half of exploration and proving.

The company expects that the exploitation of this mine will require the construction of at least a winter road from Rankin Inlet or Eskimo Point (Arviat). The product of the mine will be concentrated ore which will be moved south, probably by sea. In addition large volumes of supplies are expected to be brought in by the marine mode. The company feels that they will probably be chartering ships to carry these volumes directly to and from Eastern Canada.

At the mine site they are contemplating a fly in/fly out type of operation with few permanent residences, at least during the initial phases.

During the construction phase materials will be coming in, possibly by NTCL through Rankin Inlet.

Borealis Exploration Limited

Borealis expects to develop a small gold mine in the Fat Lake area west of Whale Cove. The company has not made a firm commitment to this project but has invested a considerable amount in exploration and proving. At the present time, they are supplying this site by small fixed wing aircraft from Churchill. In the winter they carry heavier materials by Hercules Aircraft to a temporary runway on a frozen lake.

In the long term, with development of the mine, they would like to use the marine mode to carry supplies into the mine site. This would include fuel, equipment and supplies. This would probably require a winter road from one of the communities on the shore of Hudson Bay, the nearest of which is Whale Cove.

They expect to have a total employment of 80 to 100 people on site. There would only be limited permanent accommodation at the mine site; the remainder of the workers would fly in and fly out. They expected that some of these workers would be recruited from or relocated to Rankin Inlet from Whale Cove or Eskimo Point while many of the others would continue to maintain their family accommodation outside of the Northwest Territories.

During the construction phase a winter road would be used to carry materials in.

Cullaton Lake

Operations at the Cullaton Lake gold mine were suspended in November of 1985. The owner, Corona Corporation, has continued to monitor conditions at the mine site particularly the status of buildings and equipment. The company insists that the mine is not abandoned but do not have a date for the resumption of operations.

3.3 TOURISM

At present tourism is not well developed in the Keewatin. As mentioned previously one cruise ship did visit the Region in 1988 and is expected to return in future years. In addition, there are some tour operators active in Rankin Inlet and Coral Harbour; typically these take small groups of tourists out in boats to spot wildlife or to fish.

The development of better wharfing facilities would assist in the development of the tourism industry.

3.4 EXPECTED POPULATION GROWTH

Exhibit 3.1 shows projected populations for each of the six Keewatin communities, as estimated by the GNWT Bureau of Statistics. The total population of the six communities is forecast to grow at a fairly rapid rate through natural increase (the forecasts assume zero net migration). The total population is expected to grow from the current level of 4,800 persons to about 7,100 persons in 2005, for an average annual compound growth rate of 2.3%. The communities are expected to experience fairly similar growth rates, but with slightly higher growth rates in Eskimo Point (Arviat) and Chesterfield Inlet. Rankin Inlet and Eskimo Point (Arviat) are expected to continue to be the largest

EXHIBIT 3.1
KEEWATIN POPULATION PROJECTIONS

COMMUNITY	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	AVERAGE COMPOUND GROWTH RATE
Eskimo Point(Arviat)	1,255	1,290	1,327	1,365	1,405	1,446	1,488	1,530	1,573	1,617	1,661	1,705	1,749	1,794	1,840	1,885	1,929	1,973	2.7%
Whale Cove	222	229	235	240	246	251	257	262	267	273	278	284	290	296	301	307	314	320	2.2%
Rankin Inlet	1,444	1,480	1,515	1,550	1,585	1,620	1,655	1,690	1,724	1,757	1,791	1,825	1,857	1,890	1,923	1,957	1,990	2,023	2. o%
Chesterfield Inlet	312	322	332	343	354	366	377	388	400	411	422	433	444	455	466	476	487	498	2.8%
Baker Lake	1,066	1,095	1,124	1,153	1,183	1,212	1,241	1,269	1,296	1,324	1,351	1,378	1,403	1,429	1,454	1,480	1,506	1,532	2.2%
Coral Harbour	501	514	528	541	555	568	582	597	612	627	642	657	674	691	708	724	741	759	2.596
TOTAL	4,800	4,930	5,061	5,192	5,328	5,463	5,600	5,736	5,872	6,009	6,145	6,282	6,417	6,555	6,692	6,829	6,967	7,105	
'Annual Growth		130	131	131	136	135	137	136	136	137	136	137	135	138	137	137	138	138	
% GROWTH		2.7%	2.7%	2.6%	2.6%	2.5%	2.5%	2.4%	2.4%	2.3%	2.3%	2.2%	2.1%	2.2%	2.1%	2.0%	2.0%	2.0%	2.3%

Source: GNWT Bureau of Statistics

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communities in the area with populations of close to 2,000 by the Year 2005.

This expected significant growth in population in the six communities implies growing resupply freight volumes in the future, as investigated in the following section.

3.5 FORECAST OF NTCL ACTIVITIES

As discussed in Chapter 2, the total volume of freight (dry cargo and bulk fuel) carried by NTCL to the six study communities jumped significantly in 1986 and has been growing since then, reaching 29,000 tonnes in 1988. Expected continuing population growth (described in the previous section) in the six Keewatin communities served by NTCL will result in increased general cargo and bulk fuel volumes to these communities in the future, independent of additional volumes that may be generated by new economic activities such as new mines and defense facilities (discussed in Chapter 3).

Exhibits 3.2 and 3.3 respectively present medium and high forecasts of NTCL volumes to each community up to the Year 2005. These volumes were calculated by multiplying the projected populations of each community (given in Exhibit 3.1) by tonnes/capita freight generation rates as given in the Exhibits. For the medium forecast, the tonnes/capita rates used are those obtained by dividing the average 1978-88 annual NTCL volume to each community by the 1984 population of the community. The resulting tonnes/capita rates represent average levels over ten years which smooth out the effects of peaks and valleys in economic activity over time. The tonnes/capita rates used in the high forecast of Exhibit 3.3, on the other hand, were the actual values for

Exhibit 3.2
Projected NTCL Keewatin Tonnage - Medium Forecast

DRY CARW

OEST I NAT ION	1988 (Ac tual)	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	999	2000	2001	2002	2003	2004	2005	TONNES /CAPITA
Eskimo Point(Arviat)	1 ,116	983	1,011	1,040	1,070	1,101	1,133	1,165	1, 198	1,232	1,265	1,299	1,332	1,366	1,401	1,436	1,469	1,503	0.76
Wha 1 e Cove	356	260	267	273	279	285	2,%	298	303	310	316	323	329	336	342	349	357	364	1.14
Rankin In[et	2,838	2,153	2,204	2,255	2,306	2,356	599	2,458	2,508	2,556	2,605	2,655	2,701	2,749	2,797	2,847	2,8%	2,943	1.45
Chesterfield Inlet	354	511	527	545	562	581	2,019	616	635	653	670	687	705	722	740	756	773		1.59
Baker Lake	2,430	1,782	1,829	1,876	1,925	1,972	1,022	2,065	2,109	2,154	2,198	2,242	2,283	2,325	2,366	2,408	2,451	2,471	1.63
Corn l Harbour	627	903	927	950	975	997		1,048	1,075	1,101	1,127	1,154	1,184	1,213	1,243	1,271	1,301	1,333	1.76
SUB-TOTAL	7,721	6,591	6,765	6,938	7,117	7.294	7,473	7,651	7,828	8,006	8,182	8,359	0,534	8,713	8,890	9,067	9,246	9.425	1.34

8ULK FUEL

OEST INATION	1988 (Actual)	1989	1990	1991	1992	1993	1994	1995	1996	1 W7	1998	1999	2000	2001	2002	2003	2004	2005	TONNES /CAPITA
Eskimo Point(Arviat)	3,885	3,244	3,337	3,433	3,533	3,636	3,742	3,848	3,956	4,066	4,177	4,288	4,398	4,511	4,627	4,740	4,851	4,962	2.51
Whale Cove	763	902	925	945	968	988	1,012	1,031	1,051	1,075	1,094	1,118	1,142	1,165	1,185	1,209	1,236	1,260	3.%
Rankin Inlet	9, 744	7,405	7,580	7,755	7,931	I3,106	8,281	8,456	8,626	8,791	8,961	9,131	9,292	9,457	9,622	9,792	9,937	10,122	5.00
Chesterfield Inlet	1, 191	1,374	1,417	1,464	1,511	1,562	1,609	1,656	1,707	1,754	1,801	1,848	1,895	1,942	1,989	2,032	2,079	2,126	4.27
Baker Lake	6,366	4,119	4,229	4,338	4,451	4,560	4,669	4,774	4,876	4,981	5,083	5,184	5,278	5,376	5,470	5,568	5,666	5,763	3.76
Coral Harbour	1,942	2,234	2,295	2,352	2,412	2.469	2,530	2,595	2,660	2,725	2,791	2,856	2,930	3,004	3,077	3,147	3,221	3,299	4.35
SUE-TOTAL	23,891	19,279	19,783	20,286	20,806	21,321	21,842	22,360	22,876	23,393	23,907	24,425	24, i35	25,455	25,971	26,487	27,009	27,532	3.89

TOTAL

DESTINATION	1988 (Actual)	1989	1990	1991	1992	1993	1994	1995	1996	1 w?	1998	1999	2000	2001	2002	2003	2004	2005	TONNES /CAPI TA
Eskimo Point(Arviat)	5,001	4, 227	4,348	4,472	4,603	4,738	4,873	5,013	5,154	5,298	5,442	5,586	5,730	5,878	6,029	6,176	6,320	6,464	3.28
Whale Cove	1,119	1, 162	1,192	1,218	1.248	1,273	1,304	1,329	1,355	1,385	1,410	1,441	1,471	1,502	1,527	1 #557	1,593	1,623	5.07
Rankin Inlet	12,582	9,558	9,784	10,010	10,236	10,462	10,688	10,914	11,134	11,347	11,567	11,786	11,993	12,206	12,419	12,639	12,852	13,065	6.46
Chesterfield Inlet	1,545	1,886	1,944	2,009	2,073	2.143	2,208	2.272	2,343	2,407	2,471	2,536	2,600	2,665	2,729	2,788	2,852	2,916	5.86
Baker Lake	8,796	5,901	6,058	6,214	6,376	6,532	6,688	6,839	6.985	7,135	7,281	7,426	7,561	7,701	7,836	7,976	8,116	8,256	5.39
Coral Harbour	2,569	3,137	3,222	3,302	3,387	3,466	3,552	3,643	3,735	3,826	3,918	4,009	4,113	4,217	4,321	4,418	4,522	4,632	6.10
			0																
TOTAL	31.612	25.870	26.548	27.224	27.923	28,615	29,315	30,011	30,704	31 ,3W	32,089	32,785	33,469	34,168	34,860	35,554	36,255	36,957	5.22

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Exhibit 3.3
Projected NTCL **Keewatin** Tonnage - High Forecast

DRY CARGO

DESTINATION	1988 (Actual)	1989	1990	1991	1992	YEAR 1993	1 994	1995	1996	1997	1 998	1999		2001	2002		2004	2005	TONNES /CAPITA
Eskimo Point(Arviat)	1,012	1,041	1,071	1,101	1,133	1,167	1,200	1,234	1,269	1,304	1,340	1,375	1,411	1,447	1,484	1,521	1,556	1,592	0.81
Whale Cove	323	333	342	349	358	365	374	381	388	397	404	413	422	431	438	447	457	466	1.45
Rankin Inlet	2,575	2,639	2,701	2,764	2,826	2,888	2,951	3,013	3,074	3,133	3,193	3,254	3,311	3,370	3,429	3,489	3,548	3,607	1.78
Chesterfield Inlet	321	331	342	353	364	377	388	399	412	423	434	446	457	468	480	490	501	513	1.03
Baker Lake	2,204	2,264	2,324	2,384	2,446	2,506	2,566	2,624	2,680	2,738	2,794	2,850	2,901	2,955	3,007	3,061	3,114	3,168	2.07
Coral Harbour	569	584	599	614	630	645	661	678	695	712	729	746	765	785	804	822	841	862	1.14
SUE-TOTAL	7,004	7,192	7, 3?9	7*566	7,758	7,948	8,140	8,330	8,518	8,707	8,895	9,084	9,267	9,456	9,641	9,829	10,018	10,207	1.46

8ULK FUEL

DESTINATION	1988 (Actual)	1989	1990	1991	1992	YEAR 1993	1 994	1995	996		1 998	1999	2000	2001	2002	2003	2004	2005	TONNES /CAPITA
Eskimo Point(Arviat)	3,524	3,623	3,727	3,833	3,946	4,061	4,179	4,297	4,417	4,541	4,665	4,788	4,912	5,038	5,167	5,294	5,417	5,541	2.81
Whale Cove	692	714	733	748	767	783	801	817	832	851	867	886	904	923	939	957	979	998	3.12
Rankin Inlet	8,840	9,060	9,274	9,489	9,703	9,917	10,131	10,346	10,556	10,759	10,964	11,172	11,368	11,570	11,772	11,980	12,182	12,384	6.12
Chesterfield Inlet	1,080	1,115	1,150	1,188	1,226	1,267	1,306	1,344	1,385	1,423	1,461	1,499	1,538	1,576	1,614	1,648	1,686	1,725	3.46
Baker Lake	5,775	5,932	6,089	6,247	6,409	6,566	6,723	6,875	7,021	7,173	7,319	7,465	7,601	7,742	7,877	8,018	8,159	8,300	5.42
Coral Harbour	1,762	1,807	1,857	1,902	1,952	1,997	2,047	2,099	2,152	2,205	2,258	2.310	2,370	2,430	2,490	2,546	2,606	2,669	3.52
SUB - TOTAL	21,674	22,252	22,830	23,407	24,002	24,592	25,187	25,777	26,362	26,949	27.534	28,121	28.693	29.278	29,859	30.443	31,030	31,616	4.52

TOTAL

DESTINATION	1988 (Actual)	1989	1990	1991	1992	YEAR 1993	1 W4	995	1996	1997	1 998	1999	2000	2001	2002	2003	2004	2005	TONNES /CAPITA
Eskimo Point(Arviat)	4,537	4,663	4,797	4,935	5,079	5,227	5,379	5,531	5,686	5,846	6,005	6,164	6,323	6,485	6,652	6,814	6,973	7,132	3.62
Whale Cove	1,015	1,047	1,075	1,097	1,125	1,148	1,175	1,198	1,221	1,248	1,271	1,299	1,326	1,354	1,376	1,404	1,436	1,463	2.57
Rankin Inlet	11,414	11,699	11,976	12,252	12,529	12,806	13,082	13,359	13,628	13,888	14,157	14,426	14,679	14,940	15,201	15,469	15,730	15,991	7.90
Chesterfield Inlet	1,402	1,447	1,491	1,541	1,590	1,644	1,694	1,743	1,797	1,846	1,896	1,945	1,995	2,044	2,093	2,138	2,188	2,237	4.49
Baker Lake	7,980	8,197	8,414	8,631	8,855	9,073	9,290	9,499	9,701	9,911	10,113	10,315	10,502	10,697	10,884	11,079	11,273	11,468	7.26
Coral Harbour	2,331	2,391	2,456	2,517	2,582	2,642	2,707	2,777	2,847	2,917	2,986	3,056	3,135	3,214	3,294	3,368	3,447	3,531	4.65
TOTAL	28,678	29,444	30,209	30,973	31,760	32,540	33,327	34,107	34,880	35.656	36,428	37,205	37,960	38,734	39,500	40,273	41,048	41,823	5.97

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strong economic activity (e.g. mineral exploration but not the development of a major mine) in the area.

The medium and high forecasts of NTCL cargo predict total volumes of 37,000 and 41,800 tonnes respectively by the Year 2005. At these levels, NTCL would likely experience some capacity problems with its given mode of operation, i.e. it may not be possible to serve all the communities' needs with a two-barge operation within the short navigation season. This is based upon the following analysis of the capacity of the NTCL resupply operation as currently organized.

At present, 10 or 12 trips per year are made. Assuming each barge's practical capacity is 1,700 tonnes and that two barges are carried on each trip, this works out to a capacity per year of between 34,000 and 41,000 tonnes. As can be seen from the foregoing, the demand estimates bracket the range of these capacities. If NTCL is to meet the high demand estimate, then some changes in operating procedures will be required. This could include the purchase of another tug, possibly carrying more than two barges on a trip or improved wharfing facilities to reduce delays for weather and increase the speed of unloading.

In addition, it might be desirable at some time in the future . to increase the area of operations of NTCL to include additional destinations such as Repulse Bay. With the increasing demand being experienced in the study area, this also may necessitate changes in the pattern of NTCL operations.

3.6 FISHING STRATEGY STUDY

As described in the previous section commercial fishing is at a relatively low level in Keewatin at the present time. A regional fishing strategy study is in the process of being commissioned. This is scheduled to be completed by the end of October, 1989.

The study will examine opportunities and constraints on the development of the fishing industry, it will also examine infrastructure requirements such as wharves and other facilities that may be required for the future development. It would do this for the various communities within the District.

The study will therefore provide useful information concerning the relative priority of wharf facilities in the various communities; unfortunately this information was not available during the course of this project.

4. PORT FACILITY PROPOSALS

4.1 OVERVIEW OF MARINE OPERATIONS

4.1.1 NTCL Operations

Prior to opening of the resupply season, the operators make an inspection of the harbour and wharf facilities within each of the resupply ports. The inspection team generally includes the Master of the tug Keewatin, the NTCL General Manager and representatives of the NWT and Federal Governments. The operators make requests and suggestions required to upgrade or repair the facilities for receiving the tug and barges. Generally the NWT Government will issue a work order to the local authority to make the necessary improvements. These improvements generally entail removal of ice transported rocks and debris from the landing area and replacement of gravel and sand materials that have been washed away or lost during the winter.

The resupply season starts in July, usually during the second or third week. The first shipment is to the settlement of Eskimo Point (Arviat), 289 kilometres north of Churchill, on the west coast of Hudson Bay. The actual date of sailing is carefully chosen, dependent on ice conditions and forecasts of conditions along the coast. The tug and barges require at least 20 km of clear water between the shore and the main ice pack in Hudson Bay. This considerable distance is to allow free passage of the vessels at least 16 km offshore, which clears the shoals and shallows. The remaining four kilometres allow for vessel navigation and shifting ice conditions. Conditions at or near the resupply settlements usually govern the early barge service. By mid August, however, all of the ports are clear of ice and the Bay ice no longer is of concern.

Marine cargo destined for the resupply ports generally falls within one of the four following categories:

- general cargo on pallets;
- cargo containerized or on trailers;
- heavy equipment and vehicles; and
- bulk fuels.

At most of the resupply points, a small motorboat from the tug Keewatin is used to mark the appropriate channel for safe and efficient entry and berthing in the harbour. These markers are left in for the season but are carried off by the ice during the winter. In general, the fuel or a portion of the fuel cargo is offloaded first by mooring the barge close to the pipeline header and pumping the cargo through the barge's floating pipeline. Motorboats are used to handle the floating pipeline. This procedure lessens the barge's draft thus enabling it to be beached closer inshore for the offloading of the dry cargo.

The barges are then berthed, grounded on the beaches, just prior to high tide at the various beach landing sites. These sites usually consist of gravel pushouts which form a pier with the barge berthed bow to and held in position by shore anchors. In some locations old landing craft have been used to stabilize the pushout. The dry cargo unloading operation begins while the second barge is positioned and the fuel cargo is pumped off via floating pipeline.

At the pushout, a ramp carried by the barge is placed from the barge to the shore. NTCL forklifts are utilized to unload the cargo onto the beach from where NTCL tractors and trailers (also carried on the barge) are used to distribute the cargo to its final destination.

4.1.2 Other Itinerant Operations

Most other itinerant vessels using the ports in the area are of the Peterhead type, used both for fishing and for cargo carrying, approximately 14m in length. These vessels utilize the same facilities as the NTCL operations where practical. To unload directly onto the shore, the unloading operations must be conducted during periods of high water conditions when sufficient water depths are available alongside the pushout or submerged landing craft pierhead structure. Such operations are reported to generally require two tidal cycles to discharge completely the transported cargo with the vessel waiting offshore during periods of low tidal conditions.

At locations where direct transfer to the shore is not possible, the cargo is loaded into small craft which are then beached and the cargo manhandled to a waiting vehicle.

Cargo carried via the Peterheads is in the break bulk form such that it can be handled manually. Assistance in removing the cargo from the vessel is achieved by means of a vessel mounted hand derrick.

4.2 RESUPPLY PORTS

A description of the marine related facilities that exist in each of the resupply ports is presented in this section while a detailed description of the various harbour features can be found in Appendix A.

4.2.1 Eskimo Point (Arviat)

Eskimo Point (Arviat) is located at 61° 07' N; 94° 04' W on the west coast of Hudson Bay approximately 289 km north of the Port of Churchill. The hydrographic chart and aerial photograph for this community are presented in Exhibits A-1 and A-2 respectively of Appendix

A. The marine related facilities consist of a barge landing site and petroleum storage facilities.

Barge Landing Site

The barge landing site is an old gravel-filled landing barge located at the end of a 32 metre long gravel pushout which is situated in the centre of town. Annual maintenance requirements are minimal and generally consist of the removal of any boulders that have been deposited in the landing area and the levelling of the pushout's top surface. Occasional restoration of the pushout is required.

Petroleum Storage Facilities

Three petroleum storage tanks exist approximately 150 m inshore from the pushout facility while aviation fuel is stored in storage tanks situated some 1.5 km away at the hamlet's airport. Both storage facilities are connected to the shoreline by pipeline with their header connections located immediately east of the existing pushout.

Land Transport Infrastructure

The hamlet's main road runs parallel to the shore line. The area's flat topography would enable relatively easy connection to be made between this main roadway and the shoreline at presently inaccessible locations.

Cargo Handling Operations

Typical NTCL resupply and Peterhead itinerant operations are carried out at Eskimo Point.

Future Development Plans

GNWT's 1989-90 budget allows for the provision of a small craft wharf at Eskimo Point. Consideration is also being given to the relocation of the pushout facility to the hamlet's eastern extremity so that advantage can be taken of the deeper water that exists closer to the shoreline at this location; however, the contemplated site is presently zoned for residential use. A change to this zoning designation will be required before this proposed relocation can proceed.

4.2.2 Whale Cove

Whale Cove is located on the west coast of Hudson Bay at 62° 10′ N; 92° 36′ W approximately 408 km north of Churchill. Exhibits A-4 and A-5 of Appendix A present the relevant hydrographic chart and aerial photograph respectively. The marine related facilities consist of a barge landing site and petroleum storage facilities.

Barge Landing Site

The barge landing facility consists of a dirt and gravel pushout located approximately 400 metres east of the centre of town . within a small, well sheltered cove. Annual maintenance operations generally consist of clearing ice-carried rocks and boulders from the landing area with only occasional rebuilding of the pushout required (estimated to be required once every 4 years).

Petroleum Storage Facilities

Petroleum storage facilities are located on the western side of the Cove with the connection header also located on this side.

Land Transport Infrastructure

A roadway runs along the relatively flat foreshore of the head of Whale Cove. Outside this foreshore area the terrain becomes very rugged and would not be conducive to easy road development.

Cargo Handling Operations

Typical NTCL and Peterhead operations are carried out at Whale Cove.

Future Development Plans

No future development plans have been identified.

4.2.3 Rankin Inlet

Rankin Inlet is located at 62° 49′ N; 92° 05′ W on the west coast of Hudson Bay at the head of a large inlet of the same name. It lies approximately 515 km north of the Port of Churchill and possesses marine related facilities in both Johnston Cove situated immediately adjacent to the townsite and in nearby Melvin Bay. The relevant hydrographic charts are presented in Exhibits A-6 and A-7 of Appendix A while the aerial photography is presented in Exhibit A-8.

In the past Johnston Cove has been used for all marine operations. In 1988 a pushout approximately 10 m long was constructed in Melvin Bay to unload a barge carrying the construction equipment to be used in the upcoming extension of the Rankin Inlet landing strip. NTCL is planning to use the Melvin Bay site in 1989.

Cargo Wharf

The town's cargo wharf in Johnston Cove is comprised of a 61 metre long by 9 metre wide gravel approachway with a pierhead approximately 24 m wide. The pierhead area has been formed from three rock filled former Transport Canada landing barges. Two deadman anchors used for mooring are located on either side of the approachway while a stern shore anchor is available on the adjoining beach which runs parallel to the approachway. A relatively large storage area is available adjacent to the wharf for the storage of cargo prior to delivery. Alongside water depths are reported to be less than one metre. Maintenance activity is generally restricted to the replacement of fill material washed out from the abandoned barge hulls.

Petroleum Storage Facilities

A recently reconstructed petroleum storage tank farm exists on top of the headland forming the southern side of Johnston Cove. Receiving pipelines run down the relatively steep slope of this headland to the water's edge where deep water is available. To unload, the fuel carrying barge secures itself against the rock face and pumps the petroleum products ashore via a floating pipeline.

Land Transport Infrastructure

The Johnston Cove wharf structure is located immediately adjacent to the town site and is connected directly to the hamlet's main road system over level ground.

The Melvin Bay site is situated approximately 1.5 km from the town centre and is connected by a rudimentary roadway originally created some 20 years ago to serve the former settlement of Ativia and the now discontinued winter airstrip operations. This latter roadway traverses relatively rugged terrain, possesses a moderate slope and was upgraded in

1988 to facilitate movement of the construction equipment offloaded at this site. Additional gravel build-up in places could be expected to be required to convert it into a functional roadway.

Cargo Handling Operations

Typical NTCL and Peterhead operations are carried out at Rankin Inlet.

Future Development Plans

In the past, the NTCL unloading operations in Johnston Cove have caused inconvenience to local boat owners as these vessels are normally moored in the lee of Esker Island which necessitates their relocation during resupply operations. In 1989, NTCL plan to relocate their resupply operations to the recently constructed pushout at Melvin Bay in order to relieve this congestion.

NTCL have strongly requested that suitable berthing facilities be constructed at Melvin Bay, capable of accommodating two of their resupply barges during all water conditions.

4.2.4 Chesterfield Inlet

The community of Chesterfield Inlet is located at 63° 20′ N; 90° 42′ W immediately to the south of Chesterfield Inlet and some 562 km north of Churchill. Exhibits A-9 and A-10 of Appendix A present the relevant hydrographic charts while Exhibit A-n presents the aerial photograph. The marine related facilities consist of a barge landing site, a small craft wharf and petroleum storage facilities.

Barge Landing Site

A landing beach site exists immediately to the east of the Hudson's Bay Company store. A small ramp constructed of the beach gravel is available at this site to accommodate the ramp that is placed to span from the barge to the shoreline. Maintenance requirements are minimal and usually consist of the removal of boulders left by the winter ice. Limited storage area exists adjacent to the landing site; it is sufficient to marshal several trailers and some dry cargo before distribution to the consignees.

Small Craft Wharf

A small craft wharf facility was constructed in the summer of 1988 at a slight protrusion that exists on the inlet's eastern shoreline. This structure is constructed of rock filled plastic coated wire gabions and provides an approximate berthing face of 15 m on its northwest side. The seaward side is protected by sloping rock rip-rap. Timber facing is scheduled to be installed during 1989. The facility is situated some 600-700 metres from the townsite and is connected to it by a roadway constructed especially for this facility. Vessels can utilize this facility only during high water conditions as the sea bottom is exposed . at other times.

Petroleum Storage Facilities

Petroleum storage facilities exist at the Northern Canada Power Company (NCPC) power plant located on the inlet's western shoreline some 500 metres from the town site. A POL tank farm is situated on the rock outcrop just east of the beach landing site. Both facilities are provided with receiving pipelines that extend to the shoreline.

Land Transport Infrastructure

The barge landing site is situated close to the town centre and is thus connected to the town's road network. A new roadway extension, although somewhat rudimentary, has been provided to the recently constructed small craft facility.

Particular Cargo Handling Operations

As the NTCL resupply operation at Chesterfield Inlet involves the use of two barges, the lack of suitable sheltered area in Chesterfield Anchorage makes it necessary for one of the barges to be left anchored in a sheltered anchorage situated on the southern shore of Chesterfield Inlet. After securing the anchored barge, the tug and remaining barge returns to the townsite where the fuel is pumped out after which the barge is beached approximately one hour before high tide. The emptied barge is then returned to the anchorage area where it is left while the other barge is offloaded.

Prior to the construction of the small craft facility, Peterhead cargo would be unloaded into a smaller boat for transport to the beach. Commencing in the summer of 1989, this traffic can be accommodated at the newly constructed small craft facility. As only high water access is provided, it will probably be necessary for the Peterhead to wait out one period of low water conditions in order to complete unloading operations.

Future Development Plans

No future development plans other than the completion of the small craft facility have been identified.

4.2.5 Baker Lake

The community of Baker Lake is situated at 64° 18' N; 96° 03' W, almost 300 km inland from Hudson Bay and some 760 km by water from Churchill. The marine related facilities consist of a barge landing facility along with petroleum storage facilities. The relevant hydrographic chart is presented in Exhibit A-13 of Appendix Awhile Exhibit A-14 contains the area's aerial photograph.

Barge Landing Facility

A wharf facility was constructed in the fall of 1987 with the dock face comprised of gravel filled steel bins. The resultant structure protrudes some 45 metres from the shoreline and is approximately 20 metres wide. A dock face of some 20 metres is provided on the lake side; however, large boulders have been placed in front of the structure. The western side of the structure has been designated to be utilized as a float plane landing dock. The lake side face of this structure was damaged during the 1988 spring break-up by rafting ice.

Petroleum Storage Facilities

A total of four petroleum storage tank farms exist in the town; two of them are no longer operational with their volume handled by the town's tank farm located on the hamlet's eastern limit. This tank farm has a pipeline header meeting the shoreline some 800 metres to the east of the landing facility. The airport's aviation fuel is handled by a small privately owned tank farm situated on the lake's western shore close to the airport. Both facilities can be supplied by floating pipelines.

Land Transport Infrastructure

The hamlet's main road runs parallel to the lakeshore and connects to the new barge landing facility.

Cargo Handling Operations

NTCL standard operations of first pumping the petroleum products ashore followed by the unloading of dry cargo are carried out at this location.

The lack of suitable water depth in front of the new docking structure will not allow its utilization by visiting Peterhead vessels. As such, small craft must be utilized to transport their cargo to the beach area.

Future Development Plans

The development of the proposed uranium mine would require docking facilities to be located some 10 to 12 km east of the Baker Lake settlement; this proposed development has yet to advance past the feasibility study stage. An environmental assessment is being held this year. Officers of the proponent firm have said that if a new wharf is constructed for mine operations, it possibly could also be used by NTCL and other operators.

4.2.6 Coral Harbour

Coral Harbour is situated at 64" 8' N; 83° 10' W on the southern shore of Southampton Island approximately 848 km north-northwest of Churchill. The marine related facilities are a barge landing site at Snafu Beach, a small craft facility at Coral Harbour and petroleum storage facilities. The relevant hydrographic charts are presented in

Exhibits A-16 and A-17 of Appendix Awhile Exhibit A-18 contains the area's aerial photograph.

Barge Landing Site

The facilities used for the resupply operation are located at Snafu Beach in Munn Bay, some 4.5 km due west of the Coral Harbour settlement. The landing facility at Snafu Beach consists of an old gravel filled Transport Canada landing barge at the head of a gravel approach that extends some 30 metres from the shoreline. Two shore anchors are situated on either side of the pushout and approximately 0.9 metres of water is available alongside the submerged barge. Considerable maintenance is required every year (reported to cost approximately $12,000 to $15,000 annually) to replace washed out sections of the pushout. Occasionally it is necessary to restore the pushout while the resupply operations are being carried out. As the site is exposed to wave action, NTCL unloading operations often have to be suspended until the weather clears.

Small Craft Facility

A small wooden rock filled type of structure exists on the west side of the cove situated immediately to the east of the hamlet. The face of this facility has been sloped to allow the ice build-up to ride up over the structure rather than forcing it to sustain full loading effects. The structure and indeed the entire cove is dry during periods of low tide.

Petroleum Storage Facilities

Transport Canada aviation fuel tanks are located at Snafu Beach while those belonging to GNWT and NPC are situated adjacent to the town site. Both tank farms have pipeline headers extending to the shoreline for connection to floating hoses.

Land Transport Infrastructure

A 4.5 km long roadway connects Snafu Beach to the Hamlet of Coral Harbour. A pipeline connects the Transport Canada tank farm at Snafa Beach to the airport.

Cargo Handling Operations

The NTCL barge first unloads its fuel at the Transport Canada tank farm located at Snafu Beach and then it berths bow-to the end of the landing facility about 1 hour prior to high water in order to offload its dry cargo. This offloaded dry cargo is then transported by forklift and lowboy trailer the 4.5 km to the townsite. Afterwards the' barge is taken around to the townsite where the fuel is pumped ashore to the town's tank farm. It is reported that the barge can be unloaded within 48 hours if there is no weather interruption but often it takes much longer.

The NTCL barge has unloaded in the past at the town site; however, the harbour is very difficult to enter and leave. Once inside the harbour area, well protected conditions prevail and unloading operations can be carried out with minimal interruption.

The Peterheads that enter Coral Harbour must wait for high water conditions to offload their cargo at the small craft facility.

Future Development Plans

Plans exist to consolidate the existing petroleum storage facilities, probably at or adjacent to the current town tank farm. Aviation fuel would be trucked to the airport.

Although commitments have not been made, the local residents have proposed a plan to develop a wharf site to the east of the town site. The proposal would see a causeway built from the mainland to an island (a reported distance of some 300 metres) with a wharf being built out from the island to deep water. The causeway would also act as a breakwater.

4.3 DESIGN PARAMETERS

4.3.1 Design Vessels

The tug, the M.V. Keewatin, is powered by 3375 bhp and is capable of achieving a speed of 10 knots. Its overall length is 37.0 m, its breadth 11.6 m, its molded depth 3.65 m while its running draft is 2.0 m. It was constructed in 1974.

Four barges each capable of transporting both dry and liquid cargos, are utilized in the resupply operations. These barges are 64.0 m long, 17.1 m wide, have a molded depth of 3.96 m and have a flat bottom. The load area approximates 50 m X 14.6 m with two of the barges possessing partly covered decks while the other two are open deck craft. Each barge is capable of transporting up to 1,700 tonnes of cargo and possesses a light draft of 0.75 m and a fully loaded draft of 2.3 m. Generally each tow consists of one covered and one open barge. The unloading ramps currently utilized are 10.7 metres long.

The design vessel for the Peterhead type of craft has been taken to be the Qairulik, viewed while it was beached for the winter at Rankin Inlet. This vessel is of wooden construction approximately 14.0 m long, 4.5 mwide and has a draft of 1.25 m. It has a shaped hull such that it must be properly supported when out of the water.

The following parameters are proposed for the design of the dock structures when vessels are to be accommodated during all water conditions:

		NTCL Operations	Peterhead Operations
1.	Berth length	75 m	15 m
2.	Elevation of Dock above High High Water	1.5 m	1.0 m
3.	Water Depth Below Low Low Water	2.75 m	1.75 m
4.	Surcharge Loading	2.5 t/m^2	0.5 t/m^2
5.	Berthing Energy	2.0 t-m	0.5 t-m
6.	Bollard Forces	30 t	2.0 t
7.	Wind Loading	0.5 KPa	0.5 KPa
8.	Design Life	40 yrs.	40 yrs.

4.3.2 Unloading Ramps

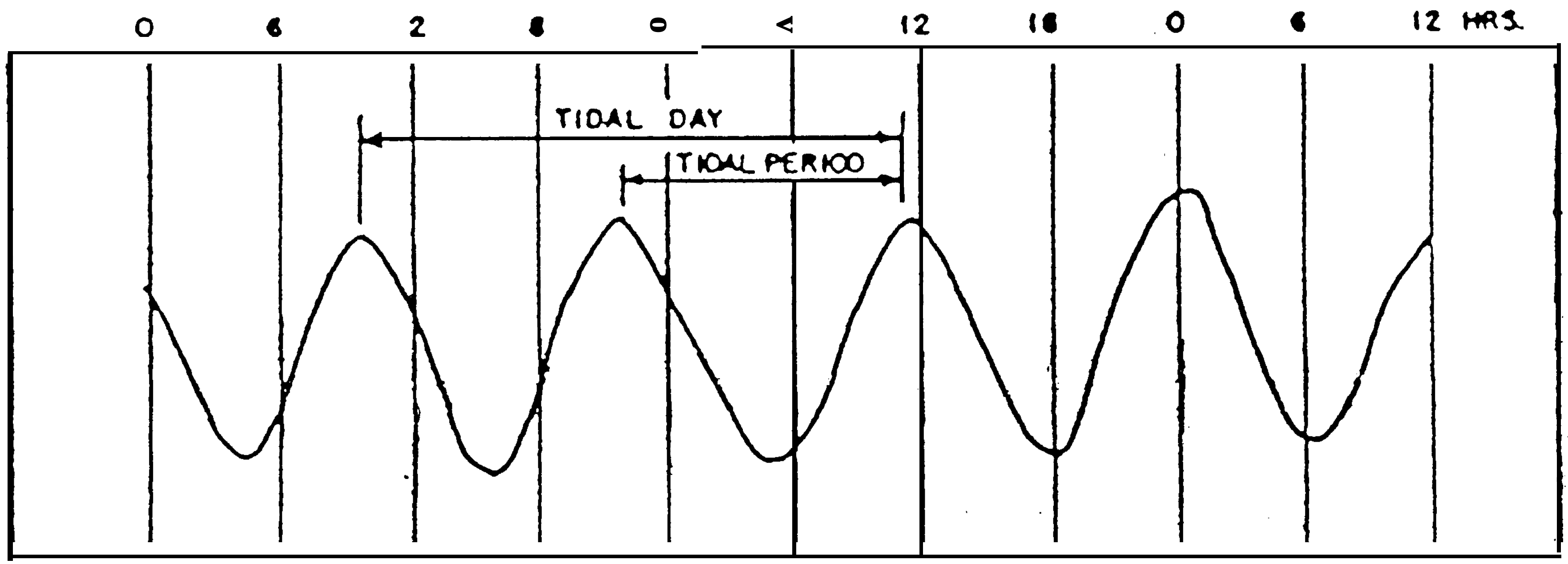
Ideally the change in gradient upwards and downwards for loading/unloading ramps should be no greater than 1:10 in order to allow for the use of small wheel cargo handling equipment although the unloading equipment presently utilized should enable the use of a maximum ramp gradient of 1:7. Heavy, wheel mounted cargos would have to wait for appropriate water levels such that the required gradient is available.

4.3.3 Intermediate Water Levels

In light of the current low utilization of the existing facilities and that forecast till the year 2005, it could be more practical at certain locations to provide facilities that are able to accommodate visiting vessels only during certain portions of the tidal cycle. To approximate the portion of each tidal cycle during which the facilities cannot be utilized, use can be made of the curve presented in Exhibit 4.1 which approximates the tidal cycle for a typical semi-diurnal tide. By comparing the high and low water levels experienced at each of the study ports to the presented curve, the extent of time when a particular least depth of water is available can be approximated. For the itinerant traffic, the necessity to leave the structure during periods of low water could be advantageous as it will prevent such vessels from being stationed at the facility for extended periods of time thus preventing its use by other vessels.

EXHIBIT 4.1

APPROXIMATION OF SEMI-DIURNAL TIDAL CYCLE



4.4 CONTRACTOR AND EQUIPMENT AVAILABILITY

A number of small general contractors exist within the Keewatin Region; however, their marine construction experience must be considered to be very limited.

Available equipment is generally that required for earth moving operations such as caterpillars, front end loaders, dump trucks and graders. An old American crane is located in Baker Lake which was utilized in the 1987 construction of the Hamlet's new wharf facility while a hydraulic lift is available in Rankin inlet. Discussions with a Rankin Inlet equipment supplier identified a willingness to purchase a high lift crane that could be utilized in marine facility construction as a number of other uses in the local community could be envisaged for such a piece of equipment. Also a 6m by 15m (approximate dimensions) landing craft is available in Rankin Inlet although it is in need of upgrading.

4.5 AVAILABLE TYPES OF FACILITY CONSTRUCTION

There are a number of different types of structures commonly utilized in the provision of marine facilities which can generally be categorized as being either open-type pile supported, gravity type or floating structures. A brief outline of the various structural concepts followed by an evaluation of the appropriateness of their usage in the Keewatin Region is presented in Appendix B.

4.6 ALTERNATIVE PORT FACILITY DEVELOPMENTS

Five of the six study ports (Baker Lake being the exception) possess reasonably similar physical characteristics; the location of Baker Lake on an inland body of water with its resultant lack of tidal variation differentiates it from the other study ports. On this basis, typical facility developments have been created for different development scenarios and these typical developments have then been applied to the various study sites with modifications to account for any differing physical characteristics. The four development scenarios or cases evaluated are as follows:

1. Facilities capable of accommodating primarily NTCL barges under all water conditions;

2. Facilities capable of accommodating Peterhead-type vessels under all water conditions;

3. The above two capabilities, but with tidal water depth restrictions;

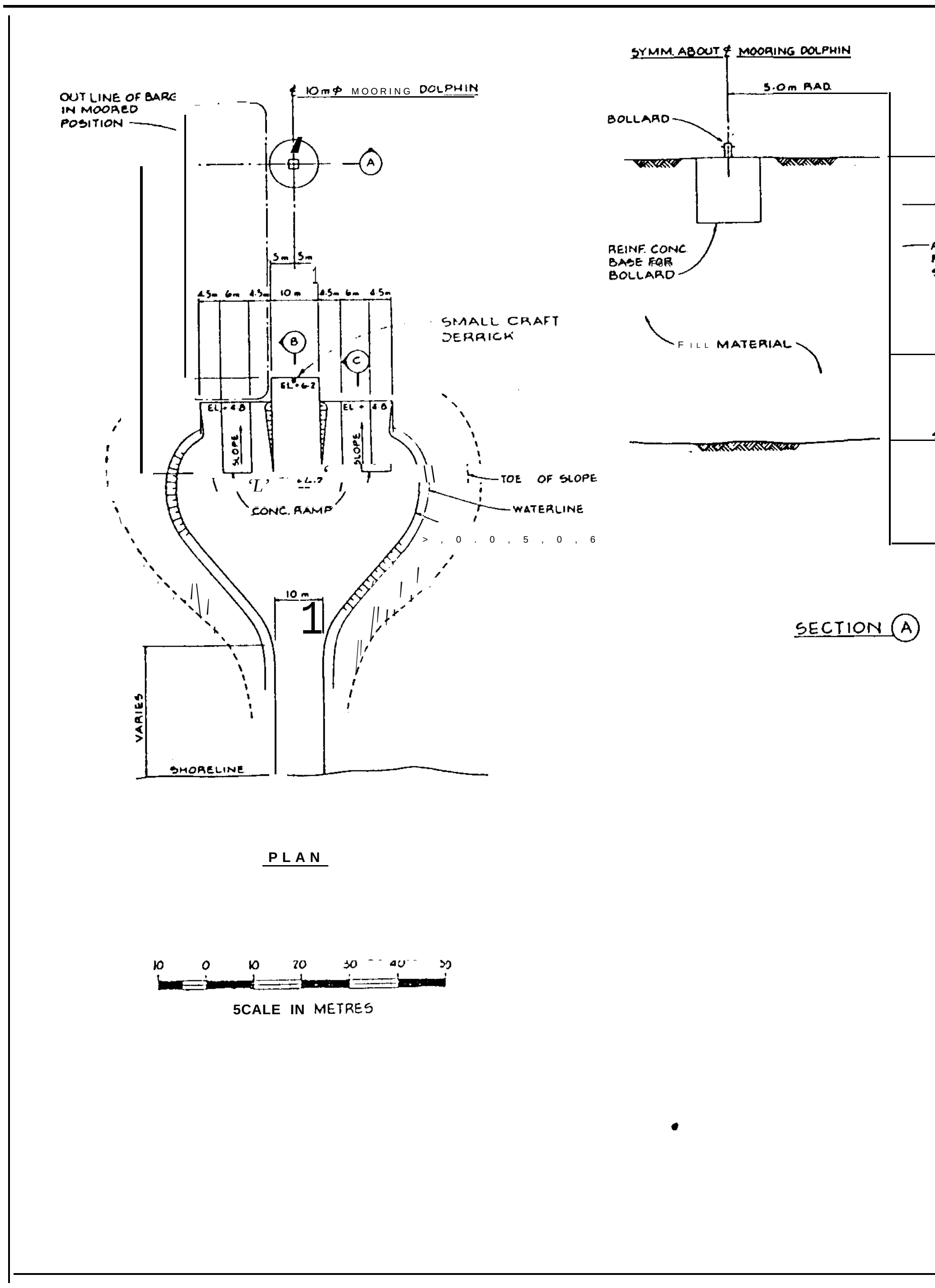
4. Improvements to existing pushout facilities.

These development scenarios have been assessed for the various study ports based mainly on information contained on Canadian Hydrographic Service charts. The assessment is therefore preliminary and has not been supported by subsurface exploration or site-specific water depth soundings and topographic mapping, all of which would be essential for final design. The results of these detailed investigations could alter the choice of structural arrangement and the associated cost estimates.

4.6.1 All Water Facilities - NTCL Operations (Case 1)

The facilities provided under this alternative are basically directed towards accommodating the NTCL barges at Rankin Inlet, the most likely location for such facilities because of its size, location and harbour characteristics. The proposed facility layout is illustrated in Exhibit 4.2. This development scenario provides two unloading ramps, a 10 m diameter mooring dolphin situated approximately 50 m from the ramp face and a mooring protrusion separating the two ramps. The facility is positioned such that required water depths are available without the aid of dredging operations.

EXHIBIT 4.2



OUT LINE OF BARG
IN MOORED
POSITION
10mΦ MOORING DOLPHIN
5m 5m
4.5m 6m 4.5m 10m 4.5m 6m 4.5m
SMALL CRAFT
DERRICK
EL +4.8
EL +6.2
SLOPE
TOE OF SLOPE
WATERLINE
CONC. RAMP
10m
VARIES
SHORELINE
PLAN
SCALE IN METRES
SYMM. ABOUT ¢ MOORING DOLPHIN
5.0m RAD.
BOLLARD
REINF. CONC
BASE FOR
BOLLARD
FILL MATERIAL
SECTION (A)

Although the minimum development would provide for the unloading of a single barge at a time, the incremental cost of providing facilities capable of simultaneously accommodating two barges is only that associated with providing the second ramp. Therefore the facility has been designed and costed on the basis of providing mooring for two barges. The facility layout is such that the barge's length is accommodated by overhanging past the mooring dolphin. The proposed facility could be expanded to provide a solid berthing pier should such a structure be required at some future date.

A 10 m wide slope protected pushout is provided to enable access to the facility and a 6 m wide concrete access slab is available down the ramp slope to facilitate vehicle movement.

The main variation between sites is expected to be the distance the associated pushout must protrude to connect the ramp face to the shoreline. At Rankin Inlet this distance would approximate 60 metres.

Ramp Design

At Rankin Inlet the large tidal levels have been identified to range-from 0.0 m to 4.7 m, while the mean tidal levels range from 0.9 m to 3.8m. The freeboard of the barge itself will range from 1.7 m when fully loaded to 3.2 m when unloaded. As such, the elevation of the top of the barge deck relative to low low water (L.L.W. = 0.0 m) can be expected to vary from 1.7 m (L.L.W. + fully loaded barge) to 7.9 m (high high water (H.H.W.) + unloaded barge conditions). For mean tidal conditions, this range becomes 2.6 m to 7.0 m. These ranges could also be reduced by approximately 1.5 m (0.75 m at each end of the range) by controlling the rate and timing relative to the tidal cycle of the fuel offloading operations, i.e. the fuel could be utilized as ballast. The various elevations relevant to the ramp design are outlined as follows:

	Elevation (m)		Deck of Barge
	7.9	. . . .	H.H.W. + Unloaded Barge
	7.15	. . . .	H.H.W. + Partially Unloaded Barge
	(7.0	. . . .	M.H.W. + Unloaded Barge
	(6.25	. . . .	M.H.W. + Partially Unloaded Barge
A	(4.8	. . . .	Face of Ramp Elevation
	(3.35	. . . .	M.L.W. + Partially Unloaded Barge
	(2.6	. . . .	M.L.W. + Loaded Barge
	2.45	. . . .	L.L.W. + Partially Unloaded Barge
	1.7	. . . .	L.L.W. + Loaded Barge

A = ramp design range.

As such, the top of the ramp elevation should be established at elevation + 4.8 m which would require fuel unloading restrictions only during periods of greater than normal tidal conditions or when a ramp gradient less than 1:7 is desirable at the outer tidal ranges.

The gradient of the shore based ramp should be established at 1:10 which would require it to extend back approximately 14 m. The ramp connecting the barge to the shore will have to accommodate a vertical variation of 2.3 m; therefore, new 16.1 m long ramps would have to be provided to replace the current 10.7 m long ramps. Such ramps would have to be of light weight construction to enable ease of handling and would require "flaps" at both ends to accommodate gradient changes. These ramps should be capable of being secured to the barge when in use.

Mooring Facilities Design

The proposed facility layout and typical sections are illustrated on Exhibit 4.2. Steel sheet piling (SSP) type of construction has been utilized as it is considered to be the most appropriate for the proposed facilities and would represent the most economical solution. The SSP tip elevation for the mooring protrusion and ramp construction has been determined by increasing the penetration depth required for normal loading conditions by 50% to provide an approximation of the additional resistance that will be required to resist the upward forces exerted by the ice during the winter months. The mooring dolphin piling penetration has been established at 3.25 m to prevent seepage, scour damage and to provide stability from ice forces, berthing loads, etc.

A fundamental premise of the proposed design is the minimization of any protrusions on the structure's outside face which would restrict the vertical movement of both the ice and the resupply barge. Therefore, the use of permanent fenders and a protruding capping beam is not proposed. Truck tires transported by the barge and hung over its side should provide adequate fendering protection. It will be necessary to ensure that the top of the fill material is flush with or slightly higher than the top of the SSP so that any overriding ice buildup cannot catch onto the SSP edge and thus cause damage.

Should the detailed geotechnical investigation indicate the presence of a significant number of boulders in the site's sub-bottom material, difficulty could be expected in the achievement of the required penetration depths. In this case, use would have to be made of cellular steel' sheet pile bulkhead-type of structures or the pile and plank type of construction with pre-drilled holes.

The costs associated with the proposed development at Rankin Inlet are estimated to be as follows:

Mobilization/Demobilization	$250,000
Mooring Dolphin	250,000
Shore Based Facilities	750,000
Shore Connection	250,000
Sub-total	1,500,000
Engineering & Surveys (15%)	225,000
Contingency (25%)	375,000
Total	$2,100,000

This cost could be reduced by approximately $275,000 should it be decided to provide only one unloading ramp.

Peterhead Usage

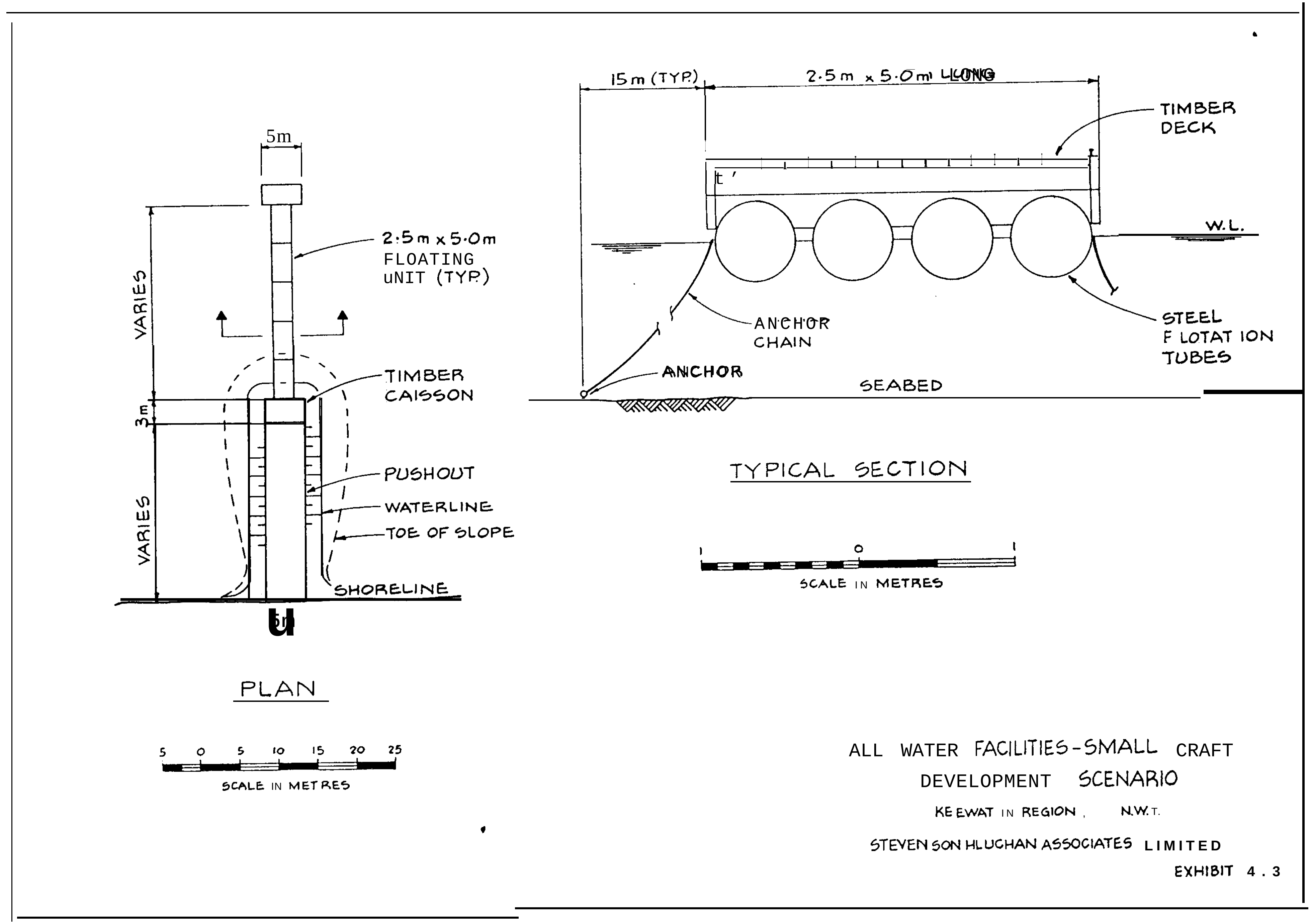
When the facilities are not being utilized by the NTCL re-supply operations, Peterheads and other small craft could be accommodated along the outside of the mooring protrusion existing between the two offloading ramps; however, the top of dock elevation would be considerably greater than the vessel's deck elevation during low water conditions. To facilitate unloading operations, a hand operated derrick could be placed at the dock face.

4.6.2 All Water Facilities - Small Craft (Case 2)

The facilities provided under this alternative are basically directed towards utilization by the Peterheads as they are expected to be the largest of the visiting small craft. Due to the tidal range experienced at the various study sites, the berthing structure itself should be floating such that significant differences in elevation do not exist between the berthing face and the visiting vessel, thus enabling the transported cargo to be easily transferred to and from the vessel. The proposed facility is illustrated on Exhibit 4.3.

Such a floating structure should make use of fairly robust flotation units capable of not only withstanding seasonal skidding onto and off the nearby beach area but also increasing the structure's stability during periods of wave action. It is proposed that the floating units utilized in both the accessway and landing area be comprised of 2.5 metres wide by 5 metres long units, and that the flotation units consist of4 - 508 mm diameter closed end steel piling. The structures would have to be anchored approximately every 15 metres to provide suitable resistance to wind and wave action. The anchoring system should be comprised of chain and a small vessel anchor so that the

EXHIBIT 4.3


5m
2:5m x 5·0m FLOATING UNIT (TYP.)
VARIES
TIMBER CAISSON
3m
PUSHOUT
WATERLINE
TOE OF SLOPE
VARIES
SHORELINE
5m
PLAN
5 0 5 10 15 20 25
SCALE IN METRES
15m (TYP.)
2·5m x 5·0m LONG
TIMBER DECK
W.L.
STEEL FLOTATION TUBES
ANCHOR CHAIN
ANCHOR
SEABED
TYPICAL SECTION
1 0 1
SCALE IN METRES
ALL WATER FACILITIES-SMALL CRAFT
DEVELOPMENT SCENARIO
KEEWATIN REGION, N.W.T.
STEVENSON HLUCHAN ASSOCIATES LIMITED
EXHIBIT 4.3

entire system could be removed at the end of each navigation season. These anchors would have to be situated approximately 15 metres on either side of the structure to allow for the tidal cycle's vertical movement. The anchoring system should be marked with flotation units so that visiting vessels do not run afoul on them.

Anchors placed such a distance to the side of the floating structures will result in considerable slack being available for lateral movement during periods of low tide. The final design would have to incorporate a means of taking up this "slack". This could be as simple as having heavy weights on the anchor cables.

The outermost unit should be placed sideways to provide 5 m of berthing face. These floating structures would not be substantial enough to support regular vehicles; therefore, wheeled push buggies should be available to facilitate the transfer of cargo to/from waiting land-based vehicles.

A 5 mwide slope protected pushout should be extended until a water depth of 1.5 m is encountered during high tidal conditions. After this point, the provision of the identified floating structures will prove to be more economical. A rock filled timber caisson, constructed of 12''x12° pressure treated timbers, should be provided at the end of the pushout to facilitate the transition from the solid to floating types of structure. A prefabricated metal retaining wall, as manufactured by Armco, could be expected to provide a more economical initial cost structure but is not considered to be suitable to withstand the severe ice conditions that will be encountered. A wheeled ramp would be provided to connect the floating structure to the timber caisson.

Floating structures are not capable of withstanding significant wave action and must be located within sheltered water areas. The suitability of utilizing this type of structure must be ascertained separately for each proposed location.

The cost associated with providing the timber caisson is estimated to approach $75,000, while the cost of the floating structures is estimated to be $1200 per square metre of surface area.

4.6.3 Restricted Water Depth Facilities (Case 3)

NTCL Barge Facilities

Facilities similar to those outlined beforehand in Section 4.6.1 - will still be required, even when restricted water conditions are encountered; however, the resultant shallower water depths would mean that the ramp face need not be placed as far from the shoreline as that required for the all water condition version. Also, shorter SSP lengths will be required; however, resultant initial cost savings could be expected to be minor. Any savings will be gained mainly from lower pushout construction costs. Because of the expected lack of savings this alternative has not been considered further.

Peterhead Facilities

The pushout and timber caisson requirements outlined in Section 4.6.2 will be the same regardless of the eventual water depths provided . for, with the only variable being the extent of floating structure provided except when the use of floating structures is not appropriate in which case longer pushouts and greater timber caisson structures would be required.

4.6.4 Improvements to Existing Facilities (Case 4)

Existing facilities consist mainly of gravel pushouts without specific slope protection works. In locations where erosion of the pushout material has presented a problem, rock rip-rap should be placed on the sloped surfaces. Some of this material could be expected to be dislodged by the winter’s ice and would have to be replaced as required.

In locations where suitably sized rock is not readily available for the rip-rap material, investigations should be made into the use of gravel filled, high strength synthetic fabric bags, capable of resisting the tearing action associated with the ice movements. These bags should be as large as can be moved and placed by the community's available equipment. Although it would be preferable to fill the bags in place with concrete, such action could be expected to be very expensive.

4.7 STUDY SITE APPLICATION

In this section the application of each of the evaluated cases to the specific study sites is analyzed.

4.7.1 Eskimo Point (Arviat)

Case 1

Full NTCL berthing facilities could be provided to the east of the present townsite, where deep water conditions exist approximately 125 metres from the existing shoreline. This is the location at which consideration is presently being given to relocate the existing pushout facility. At this location a 100 metre long pushout will be required to connect the ramp island to the shoreline. The cost of providing such a slope protected pushout is estimated to approach $350,000, which indicates that the overall facility cost would approach $2,300,000. The facility should also be provided with breakwater protection to reduce the effects of adverse wave action during periods of high tidal conditions. At this location a new access roadway will have to be constructed.

Case 2

The exposed conditions experienced at Eskimo Point (Arviat) will make the use of floating structures impractical without the provision of extensive breakwater protection.

Case 3

The location proposed for the full NTCL berthing facilities would also be the best available for a small craft facility. Protection from adverse wave action will be as good as available at this location as the facility will be situated within the lee of significant tidal flat protrusions which will reduce the effects of adverse wave action during periods of low tidal conditions. At this location the pushout should extend approximately 75 m, such that 4.0 m of water are available at high tide which would enable the facility to be utlized for approximately 15 hours per day. Associated costs are estimated to approximate $420,000. The main cost components are as follows:

Slope Protected Pushout	$200,000
Timber Caisson	100,000
Sub-Total	$300,000
Engineering & Survey (15%)	45,000
Contingency (25%)	75,000
Total	$420,000

This facility will also facilitate NTCL operations.

Case 4

Annual maintenance requirements for the existing pushout facility are minimal and do not warrant the provision of slope protection. Should the pushout be relocated to the deeper water location, slope protection should be provided only if significant material erosion is experienced or if the pushout is extended further from the shoreline.

4.7.2 Whale Cove

Case 1

The protected cove, within which resupply operations are currently carried out, provides a low water depth of only some 1.5 m while a low water depth of 2.75 m is required for the identified facility. In order to provide the deeper water conditions without undertaking dredging operations,it will be necessary to locate the facility outside the protected area where it is totally exposed to the southeast. To protect the considerable investment associated with the provision of full NTCL facilities at such a location, it would be necessary to also provide breakwater protection. Such a breakwater would have to be built in very deep water and would involve an initial cost much greater than that associated with the marine facilities themselves. Should it become desirable to provide such facilities, consideration should be given to locating them within the protected cove area and dredging a berthing basin at the facilities themselves which would dictate that the operations would have to wait for high water conditions for the barges to approach and leave the facilities. The feasibility of such a development would be highly dependent upon the seabed material characteristics and would require full subsurface investigation information.

Case 2

Water depths within the protected cove area are reported to approximate 1.5 m at low tide which is marginally less than the required 1.75 m. The best location for the proposal facility would be in the northeast corner of the cove in the lee of the southerly extending land prolongation; however, it would be necessary to create a new access roadway over fairly rugged terrain. As such, the optimal location is expected to be found in the general proximity of the current NTCL beach landing site. At this location, the facility pushout component could be expected to extend some 50 metres, which would be supplemented by a further 50 metres of floating dock structures. Associated costs are estimated to approach $490,000, which is comprised of the following main cost components:

Slope Protected Pushout	$ 125,000
Timber Caisson	75,000
Floating Structures	150,000
Sub-Total	350,000
Engineering & Surveys (15%)	50,000
Contingency (25%)	90,000
Total	$490,000

Case 4

Annual maintenance requirements for the existing pushout facility are minimal and do not warrant the expense of providing slope protection.

4.7.3 Rankin Inlet

Case 1

The provision of full NTCL berthing facilities at Melvin Bay have been outlined previously in Section 4.6.1. In order to optimize the use of such facilities, it will be necessary to upgrade the existing access roadway which for budgeting purposes could be expected to cost in the range of $25,000.

Case 2

The proposed floating structures should be provided within the protected area of Johnston Cove, where the floating structures could be connected to the existing pierhead structure. Although a detailed investigation of the condition of the submerged landing craft has not been performed, it may be possible to "plug" the holes by replacing any lost fill with large sized stones. If not, then repairs should be made to the structure to prevent future fill loss. At this location approximately 50 metres of floating dock structure would be required, which would involve an associated cost of some $225,000, including engineering and survey charges and a contingency allowance.

Case 4

The NTCL barge landing operation is scheduled for relocation to Melvin Bay, where a beach landing site with a gravel ramp will be provided. This ramp will be situated close to the high water mark and, as such, it is considered unlikely that significant material erosion problems will be encountered, which indicates that slope protection need not be supplied unless warranted by actual experience.

At the existing Johnston Cove facility, the previously outlined repairs should be performed at the pierhead.

4'.7.4 Chesterfield Inlet

Case 1

Water depths within Chesterfield Anchorage are very shallow and the shallows extend a substantial distance from the hamlet's shoreline, which indicates that, if ever required, full NTCL berthing facilities should be provided to the leeward of the small land protrusion, where the existing small craft structure is found. To provide such facilities with naturally available water depths, it would be necessary to place the structures beyond the protection afforded by the nearby land protrusion. Available hydrographic charts indicate that the seabed in the vicinity of this land protrusion can be expected to be comprised of bedrock and that significant littoral transport is unlikely to occur which would indicate that the most appropriate location for such structures would likely be found close to the shoreline, with the seabed material excavated to provide the required water depths. The hard bottom material will dictate the use of cellular structures as outlined in Appendix B in place of the indicated SSP bulkhead form of construction. Alternatively, the pile and plank with pre-drilled holes type of construction could be employed. The excavation of the seabed material will be very expensive, which could be expected to favour limiting the facility's ability to accommodate a single barge at a time.

Case 2

Again, such facilities should be provided to the leeward of the small existing land protrusion, which will require the excavation of the sea bottom. The extent of this excavation could be limited with the floating platform stationed directly in front of the existing facility. The associated anchoring system would be much simplified in this application as the platform can be attached directly to the existing structure by means of guy wires. The cost associated with such a development could be expected to approach $730,000, comprised of the following main cost components:

Seabed Excavation	$500,000
Floating Structure	25,000
Sub-Total	525,000
Engineering & Surveys (15%)	80,000
Contingency (25%)	$130,000
Total	$730,000

Case 4

The existing beach landing site and shore based ramp requires minimal annual maintenance expenditure; therefore, further improvements other than possibly making the ramp higher and larger, thus enabling gentler slope gradients, are not warranted.

It has yet to be seen how the recently constructed small craft facility will be affected by the area's ice conditions. Remedial measures may be required based on this experience.

4.7.5 Baker Lake

Case 1

NTCL resupply operations currently utilize the recently constructed wharf facility and, although sections of the wharf have failed, it has not adversely affected their operations. The lack of tidal variation and significant current at this location indicates that the present method of securing the barge's aft end by anchors is adequate and that a specific mooring dolphin and ramp structures need not be provided. Therefore, it is considered that the presently available facilities are adequate and need not be improved upon.

Case 2

The presence of large boulders alongside the existing structure's outermost faces (presumably placed there for structural reasons) prevents the utilization of the remaining useable wharf sections. A single floating unit could be placed in front of and connected to the existing structure to service the visiting small craft. This however would interfere with current NTCL operations unless the floating unit can be located on the western part of the dock.

The lack of tidal variation would enable the much closer placement of the anchoring system than previously outlined and even the attachment of the platform to the existing structure by means of guy wires. The costs associated with such a facility could be expected to approach $75,000, which is comprised of the following main cost components:

Floating Structure	$25,000
Engineering & Surveys*	20,000
Contingency*	$30,000
Total	$75,000

* Amounts have been increased to reflect the fact that percentage values will be higher when consideration is given to a single unit.

Case 4

Stone rip-rap should be placed at the failed sections of the existing structure to prevent further erosion of the fill material. Alternatively, this structure could be rebuilt to provide the small craft docking face instead of the floating structure outlined above in the Case 2 scenario.

During our site visit, it was noted that in places the bin wall protruded above the backfill material. In these areas fill should be placed flush with the bin wall so that edges are not available for piled up ice chunks to catch onto and thus cause damage.

4.7.6 Coral Harbour

Case 1

Should it become desirable to provide the outlined NTCL full berthing facility, a location other than those presently utilized will have to be identified. The Snafu Beach area is overly exposed, while the barges experience difficulty approaching the sheltered cove around which the Hamlet of Coral Harbour is built.

Case 2

Floating structures could be extended from the existing timber wharf structure located at the townsite to access the cove's deeper water conditions; however, water depths are not sufficient to enable uninterrupted use of the facility. It appears as though some 50 metres of such structures would be required, the cost of which could be expected to approach $215,000. This estimate is comprised of the following cost components:

Floating Structure	$150,000
Engineering & Surveys (15%)	25,000
Contingency (25%)	40,000
Total	$215,000

Case 4

Considerable expenditure is incurred each year to restore the pushout facility at Snafu Beach prior to the arrival of the NTCL resupply barges. Also, on occasion, the resupply operations are interrupted when the pushout is eroded due to wave action. It is therefore recommended that consideration be given to placing some of the larger sized stones produced from the recent reservoir excavation works on the sides of a reconstructed pushout to prevent, or at least limit, the extent of erosion experienced. The loss of some of these stones through ice action could be expected each winter and would require prompt replacement before any erosion action progresses too far.

4.8 SUMMARY

Exhibit 4.4 provides a summary of the capital costs developed in this chapter. It was concluded that Case 1 type facilities could not be developed within the existing harbours in Eskimo Point, Whale Cove,

EXHIBIT 4.4

SUMMARY OF CAPITAL COST ESTIMATES

	Case 1: NTCL Barges at All Tidal Conditions	Case 2: Peterhead Vessels At All Tidal Conditions	Case 3: Peterhead Vessels: Tidal Restrictions
Eskimo Point (Arviat)	$2,300,000	Very High	$420,000
Whale Cove	Very High	$490,000	Not Costed
Rankin Inlet	$2,100,000	$225,000	Not Costed
Chesterfield Inlet	Very High	$730,000	Not Costed
Baker Lake	Not Costed	$75,000	Not Applicable
Coral Harbour	Very High	$215,000	Not Costed

Chesterfield Inlet and Coral Harbour; extensive port facilities would first be required to provide the necessary wave protection. We have therefore not costed these. A Case 1 facility is not seen as needed in Baker Lake because of lack of tidal conditions and because the current facility provides good service to NTCL. Case 4, improvements to existing pushouts was not costed as in most cases these are fairly minor and already included in ongoing maintenance programs.

Case 2 facilities, needed for accommodation of Peterhead type vessels at all water conditions, show' a very broad range of costs ranging from $75,000 at Baker Lake to $730,000 at Chesterfield Inlet and even more at Eskimo Point (Arviat).

5. DEVELOPMENT OF MASTER PLAN

In this chapter, the material presented in the previous four chapters of the report is used as a basis to develop an overall master plan for port development in the Keewatin district. This is done by first defining criteria to select and prioritize the alternative investments and then applying these criteria to the various proposals developed.

5.1 EVALUATION CRITERIA

The criteria used for the selection and prioritization of the alternatives are as follows:

1. Capital Cost of Facility - the major factor determining the practical feasibility of developing a port facility is its capital costs. Given the financial constraints at the present. time on the Government of the Northwest Territories and the Federal Government, a large number of projects cannot be undertaken at the same time. The facility developments will have to be carefully chosen to maximize the potential benefits of the limited budgets.

2. Ongoing Operating Requirements - any new marine facility will entail ongoing requirements for maintenance, repair and operational supervision. This has a cost implication but also, given the dispersed nature of the population of the Keewatin, has an implication in terms of the requirements for supervision be it by the new Territorial Department of Transportation, Transport Canada or the Department of Fisheries and Oceans. The existing pushouts are maintained by the local hamlets on the direction of the Territorial Department of Government Services. This occurs because the hamlets usually have the necessary equipment and labour forces available to do maintenance operations. A more complex system of infrastructure may require that the higher government levels will have to directly provide maintenance and operational staff on site at some of these locations.

3. costs Savings to NTCL - as described previously in this report one potential benefit of better port facilities is to increase productivity and reduce costs for NTCL. This could be accomplished through several mechanisms, by reducing waits for tide conditions, by reducing waits for favorable weather and by permitting alternate modes of operation such as leaving a barge to be unloaded in one port while the tug goes onto another port with the other barge. While in the short term this cost saving may be small, in the longer term the reduction of delays anticipated through this may permit major expansion to the NTCL operation without a corresponding increase in the amount of equipment required.

4. Cost Savings to Other Operators - at the present time other marine operators in the area must wait for favorable tide and weather conditions to enter all of the ports except for Baker Lake where there is no tide. In addition, unloading operations have to be completed on one tide or the vessel must leave the wharf and return on the next tide. This increases costs and reduces the flexibility of both fishing and cargo handling.

5. Security and Safety - at present there is no facility to which the barge or a longliner/Peterhead type of vessel can be tied up to during periods of emergency north of Churchill, giving rise to safety concerns. If there are mechanical or other problems on board the vessel, the only safe refuge that can be established is an anchorage. While this may provide safety in terms of the integrity of the vessel, it makes repairs and/or transfer of personnel much more difficult. Given the lack of Coast Guard and other rescue vessels in the area, this consideration is quite important.

6. Stimulation of Economic Activity - the economic development of the area is a very important consideration to the Territorial and Federal Governments. The development of wharfs and other port facilities can contribute to this in a number of ways. Firstly and most simply, if the NTCL barges can be off loaded by local contractors then this operation will increase employment in the area. Secondly, the provision of wharf facilities will make it easier for local entrepreneurs to develop the use of smaller vessels for cargo hauling. Thirdly, the development of the local fishery is retarded by the lack of docking facilities for larger, more modern vessels that can be used at all stages of tide and in all weathers.

Finally, improved wharfing facilities would encourage the development of tourism in the Region.

These criteria have been used in two ways. Firstly, in the next section, various proposals for each of the ports are examined in the light of these criteria; within each port, none, one or two projects are selected for further consideration. Next, each of these projects are evaluated with respect to each other in order to develop overall priorities.

5.2 ANALYSIS BY INDIVIDUAL PORT

In this section the port facilities in the various communities are analyzed and an improvements plan developed for each community.

Eskimo Point (Arviat)

In Eskimo Point vessel access to the existing pushout which is also used by Peterhead and longliner type vessels is difficult because of shoaling which has become progressively worse over the last several years. The consensus of Government Services and study team staff is that the facility should be relocated to the eastern edge of the hamlet. In this location deeper water is closer to shore. At this location a wharf could be constructed that would accept NTCL barges at all tidal conditions but it would require substantial breakwater protection with very high costs. It would be possible to modify the pushout that is going to be required in any case to accommodate Peterhead vessels, although with some tidal constraints on operation. A floating structure is not recommended for this location because of exposure to wave action which may damage the facility.

Providing access for freight vessels and fishing vessels in the size class of the Peterhead vessel is important to this community:

- o this is the fastest growing community in the region;

- this is the fastest growing community in the region;
- it is also closest to Churchill, therefore providing more scope for private initiatives in freight carrying on smaller vessels;
- there is considerable fishing activity in the area but the growth is restricted by the lack of wharfing facilities.

Because of these factors we believe that the only prudent course is to develop a new pushout in Eskimo Point but which has a dock face suitable for Peterhead sizee vessels.

Whale Cove

Whale Cove gets only one or two NTCL deliveries a year. It is therefore very difficult to justify a facility to handle NTCL operations under all tidal conditions. Also as shown in the previous chapters such a facility would be very expensive to develop within the existing harbour.

A wharf that could handle Peterhead size vessels at all tidal stages to date can be developed at an estimated cost of some $490,000. " Therefore this proposal has been carried forward for further evaluation.

Rankin Inlet

In Rankin Inlet there are two major proposals:

- the development of a facility which would handle NTCL and other large barges at all tidal conditions on Melvin Bay;
- the development of a wharf for Peterhead size vessels at all tidal conditions on Johnston Cove.

The first facility would be used primarily by NTCL. It could also be used by other operators of tugs and barges such as the contractors who are expected to be moving large quantities of equipment and materials for the reconstruction of the airport at Rankin Inlet as a Forward Operating Location. Also the facility would be capable of being extended such that regular ocean going vessels can be accommodated should the need develop. Peterhead size vessels could also use the facility. Exhibit 5.1 shows the comparison of these two projects using the criteria developed in the previous section. On the basis of the comments shown on - the exhibit, it was concluded that the facility for NTCL barges was the preferred development option for Rankin Inlet as it would have the greatest impacts for NTCL and possibly also for the independent operators. In the longer term a floating structure could be developed for Johnston Cove if local activity continues to increase in that location.

Chesterfield Inlet

As discussed previously, the development of a major facility for NTCL within the harbour would be very costly. Public Works is just in the process of developing a wharf for other vessels. It was therefore decided that, at this time, no further facilities would be recommended. .

Baker Lake

Baker Lake is in a similar condition. A community wharf has been developed by the government of the Northwest Territories. Some repairs of the facility which was damaged by ice should be undertaken to make the facility useful for smaller craft. At the present time NTCL captains report that the facility works well for the tug and barge operations and that they do not require anything more. Therefore the proposal to add a floating unit to the wharf to make it usable by small craft requires that the floating unit be placed at the western end of the facility so that it does not interfere with NTCL operations.

EXHIBIT 5.1

COMPARISON OF PROJECTS AT RANKIN INLET

Criteria	Facilities	
	Facility for NTCL Barges and Smaller Craft	Wharf to Handle Peterhead Vessels at All Tidal Conditions
Capital Cost	$2.1 million	$0.25 million
Ongoing Operating Requirements	Low	Requires floating structures to be placed and removed at the beginning and end of each navigation season
Cost Savings to NTCL	Substantial	No impact
Cost Savings to Other Operator	Can be used by other tug/barge and Peterhead boats	Only useful for Peterhead size and local vessels
Security and Safety	Provides location to tie up vessels and barges in case of trouble	Only suitable for smaller vessels
Stimulation of Economic Activity	Permits NTCL to contract out local delivery; permits other operators to use larger vessels	Would encourage fishing activity and independent marine activity

IBI
GROUP

The proposals for a uranium mine development in the area would result in the development of a new wharf which could be used by NTCL and other operators. Therefore, at this time, it is not recommended that any other major facilities be put in place.

Coral Harbour

At Coral Harbour it was found not to be desirable to attempt to locate a major facility that could handle NTCL barges within the town harbour itself due to navigation restrictions. Such a facility would have to be constructed outside of the harbour and would be" extremely expensive. Improvements to the wharf utilizing floating section in the existing harbour could, however, be developed to enable longer periods of use by Peterhead vessels and longliner fishing vessels. This is a proposal that is therefore recommended for Coral Harbour.

Members of the, Hamlet Council have suggested a much larger project which would involve the construction of a causeway in a creation of a new sheltered area outside of the present harbour. The relatively high capital costs of this proposal cannot be recommended at this time.

5.3 RANKING OF PROJECTS

In this section the proposed improvement at each port in the study area is given a relative priority. Exhibit 5.2 shows this relative comparison.

The project proposed for Rankin Inlet would result in substantial benefits to NTCL in the short term. (Appendix C to this report includes these estimated benefits.) The facility could also be used by other operators. Given the relative importance of Rankin Inlet, the development of the airport by the Department of National Defence and the traffic that this development is expected to generate and the

EXH

COMPARISON OF PROJEC

Criteria	Eskimo Point: New Pushout and Peterhead Wharf	Whale Cove: Floating Peterhead Wharf
Capital Cost	medium cost, $420,000	medium cost, $490,000
Ongoing Operating Requirement	site demands some ongoing repairs	requires ongoing maintenance operatio
Cost Savings to NTCL		
Cost Savings to Other Operators	reduces tidal delays	removes tidal delays
Security and Safety	some impacts	some impacts
Stimulation of Economic Activity	helps fishing and cargo activity	stimulates fishing an cargo activity
Other Comments	changes required in any case	
Ranking	2	5

potential for commerical development in the area all led the study team to g"ive this project the highest ranking.

The second ranking was given to the development of new facilities at Eskimo Point. In this case it is the development of a new pushout and wharf for smaller vessels. As described earlier in the report some development is requried in any case at Eskimo Point because of the problems associated with the existing facility.

Third priority has been assigned to repairing the existing facility at Baker Lake. Essentially this is to make it useable by small craft. Fourth and fifth priority are given to the projected developments at Coral Harbour and Whale Cove, respectively, for local traffic.

The overall ranking of projects, as developed by the consultant team, is therefore as follows:

1. NTCL facility 'at Rankin Inlet;
2. New pushout and wharf at Eskimo Point (Arviat);
3. Repairs to existing facility at Baker Lake;
4. Floating wharf at Coral Harbour;
5. Floating wharf at Whale Cove.

5.4 POTENTIAL IMPACTS

The potential impacts of implementation of this master plan include:

- cost savings and capacity and flexibility improvements for NTCL through the availability of a wharf in Rankin Inlet where the tug and barges can be tied up;
- possible increases in local employment at Rankin Inlet through use of local labour to make deliveries of materials;

- stimulation of local private entrepreneurs who would be encouraged to carry cargo in smaller vessels by the provision of better wharfing facilities for Peterhead size vessels in Eskimo Point, Whale Cove, Rankin Inlet, Baker Lake and Coral Harbour;

- assistance to the fishing industry by providing better mooring facilities for fishing vessels and for vessels that might transport the cargo to Churchill;

- stimulation of the tourism industry through facilitating the visits of cruise ships to the area and making local recreational travel easier.

6. SOURCES OF FUNDING

The program recommended in Chapter 5, while not extremely large, will require funding additional to the amounts normally spent on marine projects in the Keewatin district. In this chapter potential sources of funding are explored.

6.1 RELEVANT AGENCIES

The main agencies who might become involved in funding capital works in this area include the Government of the Northwest "Territories and three Federal Government departments.

Government of the Northwest Territories

Prior to April 1, 1989, the Department of Public Works and Highways had a limited program to provide small wharfs in support of local fishing, hunting and transportation for use by small boats and float equipped aircraft. This program was responsible for the development of the new community wharfs in Chesterfield Inlet, Coral Harbour and Baker Lake.

A new Department of Transportation will be formed shortly. It will be responsible for planning, and construction design of transportation facilities including the community wharfs.

Transport Canada

Transport Canada through its Marine Group and the Canadian Coast Guard is generally responsible for supplying multi-use commercial port and navigation facilities in Canada. It has generally been responsible for the development of ports including wharfs facilities in most ports across the country. For example, it has been responsible for the development of port facilities in Churchill, Manitoba. In this area of the Northwest Territories, Transport Canada has not played a major role although it was formerly the owner of Northern Transportation Company Limited (NTCL) and continues to provide assistance to that company.

Department of Fisheries and Oceans

One of the branches of this Federal Government Department is the Small Craft Harbours (SCH) branch. THe objective of this branch is:

> "to provide, maintain and manage, consistent with fisheries policy, regional harbour systems to accommodate the commercial fishing fleets, and to assist in the provision, maintenance and management of recreational harbours."

As such this department could be expected to assist in the development of facilities required for commercial fisheries and for recreational uses.

The Department of Indian and Northern Affairs

Generally this department is responsible for federal responsibilities with respect to native peoples and for the promotion of economic development in the North. This includes assisting in mineral resource development and other activities. As discussed in this report there are two major areas of interest to DINA to which port development may contribute:

- the development of commercial fisheries developed largely by native peoples;
- encouragement of development of mineral resources of the area.

The Department, however, does not normally enter into the development of port facilities itself. Instead it provides loans or other types of assistance to individuals, cooperatives or firms. Some of this may be used for funding port facilities.

6.2 POSSIBLE ALLOCATION OF RESPONSIBILITIES

A final decision on responsibilities will depend upon negotiations at the political level between the two levels of government but we suggest the following points for consideration:

- the proposed Rankin Inlet facility is a major port facility of the type that in most other parts of Canada would be provided by Transport Canada. In addition Transport Canada's Marine Group provides relatively few services on the western coast of Hudson Bay and has not provided many services over a long period of time. Therefore it is possible that Transport Canada might either construct this facility directly or provide funds to the Government of the Northwest Territories to construct it;

- the changes to the facilities in Eskimo Point (Arviat) are basically a replacement for the facilities already developed by the Government of the Northwest Territories who would be responsible for moving and/or replacing the pushout for NTCL. However, we also propose providing facilities for local vessels to use this as a wharf and it would seem appropriate for the Department of Fisheries and Oceans or the Department of Northern Affairs to consider the possibility of assistance for at least for this portion of the development;

- the facilities proposed at Whale Cove and Coral Harbour are primarily for the use of local fishing vessels and it would seem appropriate that the Department of Fisheries and Oceans would take the major responsibility;

- the repairs to the present wharf facility in Baker Lake should be the responsibility of the Government of the Northwest Territories as the GNWT constructed the wharf.

The proposed involvement of the Federal Government departments is reflective of their traditional roles in the north and the overall interest of the Federal Government in these areas in order to promote Canadian sovereignty in the north through the development of economic resources and contributions to the well being of the people who live there.

KEEWATIN PORT FACILITIES STUDY

APPENDIX A

DESCRIPTION OF RESUPPLY PORTS

APPENDIX A

DESCRIPTION OF RESUPPLY PORTS

A.1 ESKIMO POINT (ARVIAT)

Eskimo Point (Arviat) is located at 61″ 07′ N; 94″ 04′ W on the west coast of Hudson Bay approximately 156 nautical miles (289 km) north of the Port of Churchill (See Exhibits A.1 and A.2). The hamlet is situated on the north side of a land protrusion bearing the same name with its immediate shoreline consisting of a narrow sandy beach ridge. The surround ng land area is very flat with muskeg covered marshes lying to the south of the community.

Approaches & Bathymetry

The navigation approach to Eskimo Point is considered to be very difficult with the approach area filled with reefs and shoals. Within the inlet area, tidal flats and drying patches extend from both shorelines to almost fill the inner part of the inlet except for a narrow channel generally extending in the east-west direction providing water depths of at least 4.0 metres. This channel generally shoals to 2.9 m approximately 800 m from the hamlet and to 0.9 m or less closer to the hamlet.

The approach is such that the NTCL operators use a motor boat from the tug Keewatin to mark the channel with buoys before bringing the barges in to the landing beach area.

Anchorage

An anchorage providing good protection from northerly winds and free of strong tidal streams is identified to exist in 13 m of water approximately 3.7 km south of the navigation beacon existing on Sentry Island. Shallow draft vessels can find anchorage closer to Eskimo Point but should be prepared to move should easterly winds build up.

EXH BIT A-1A: ESK MO POINT

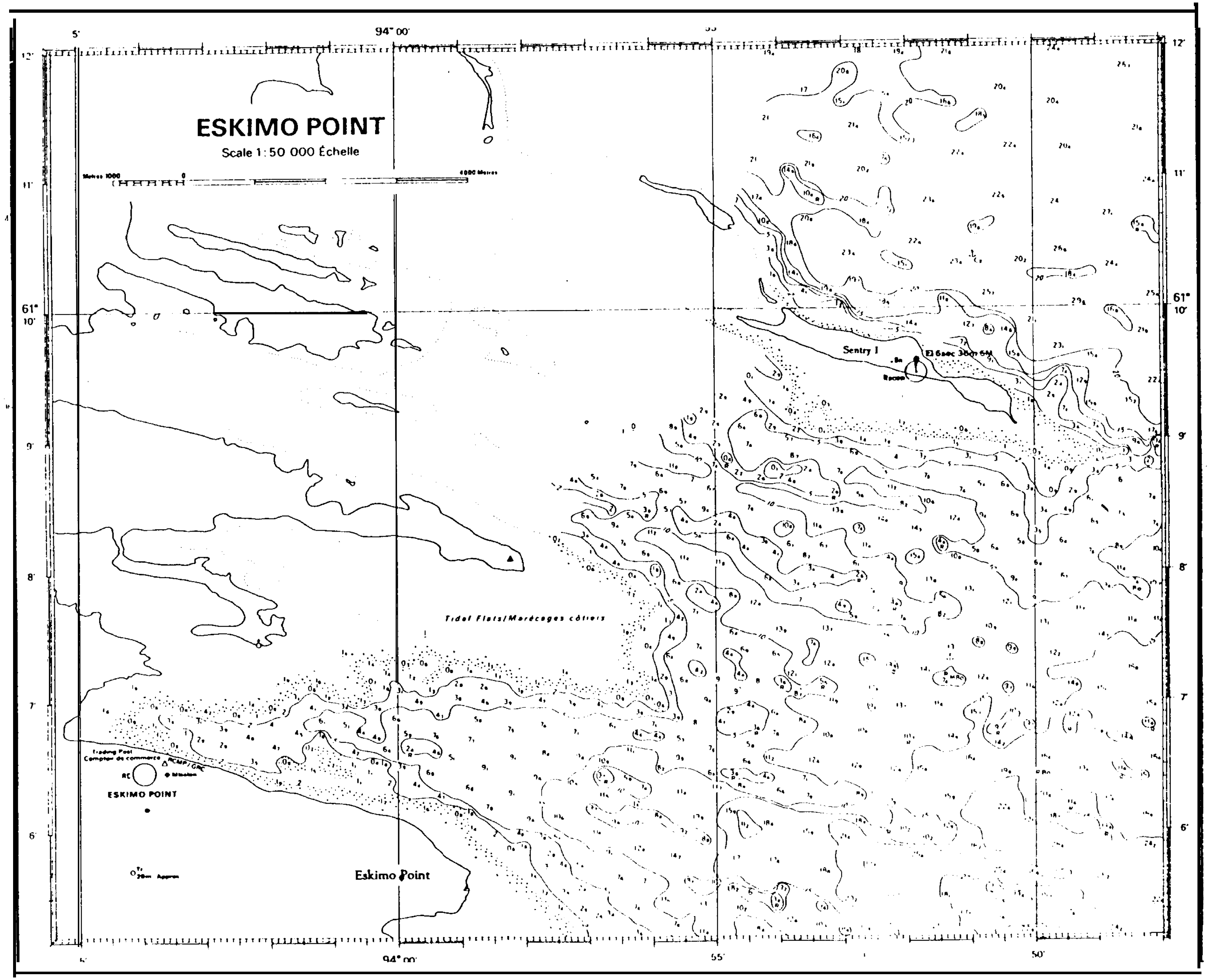


EXHIBIT A-1B: ESKIMO POINT

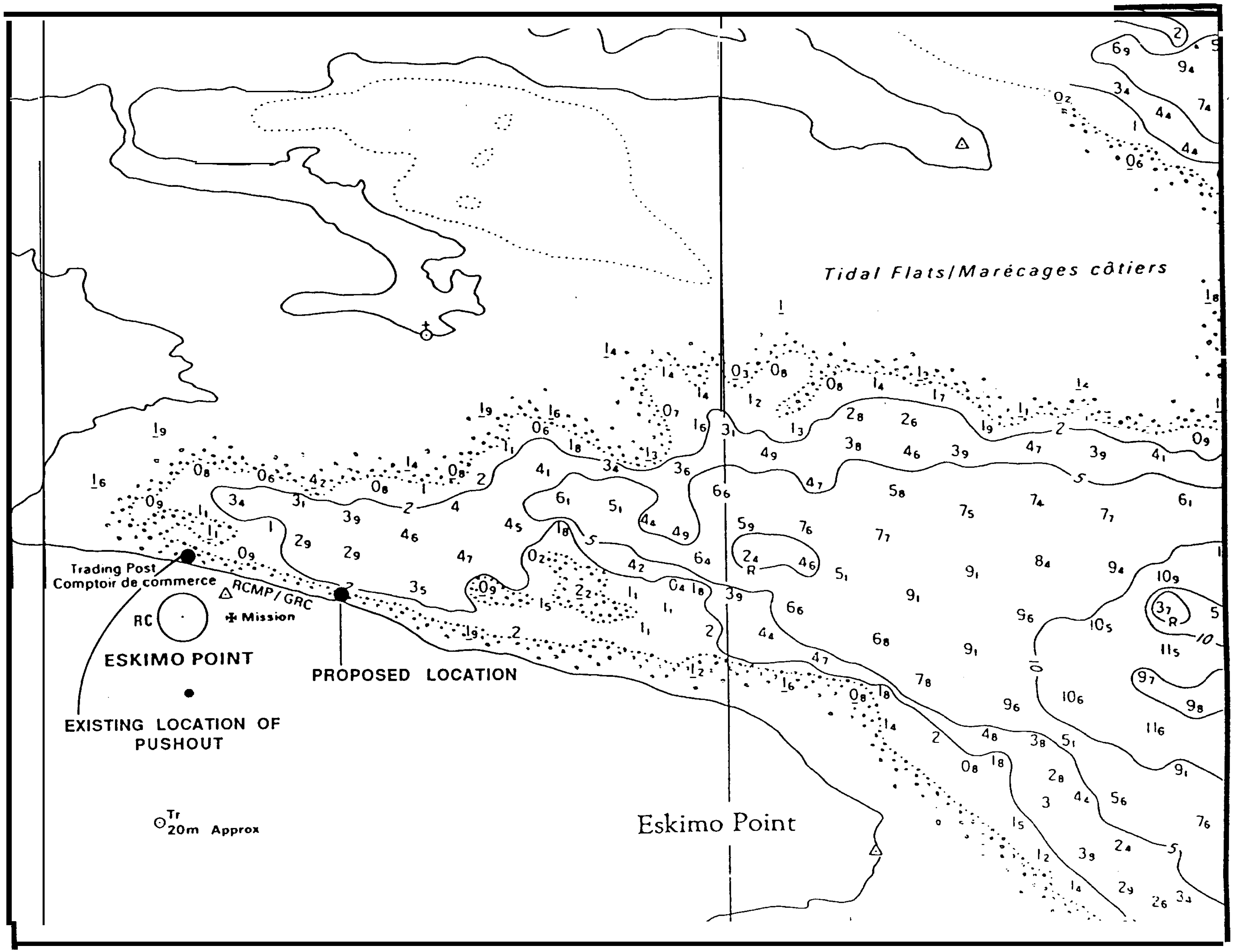
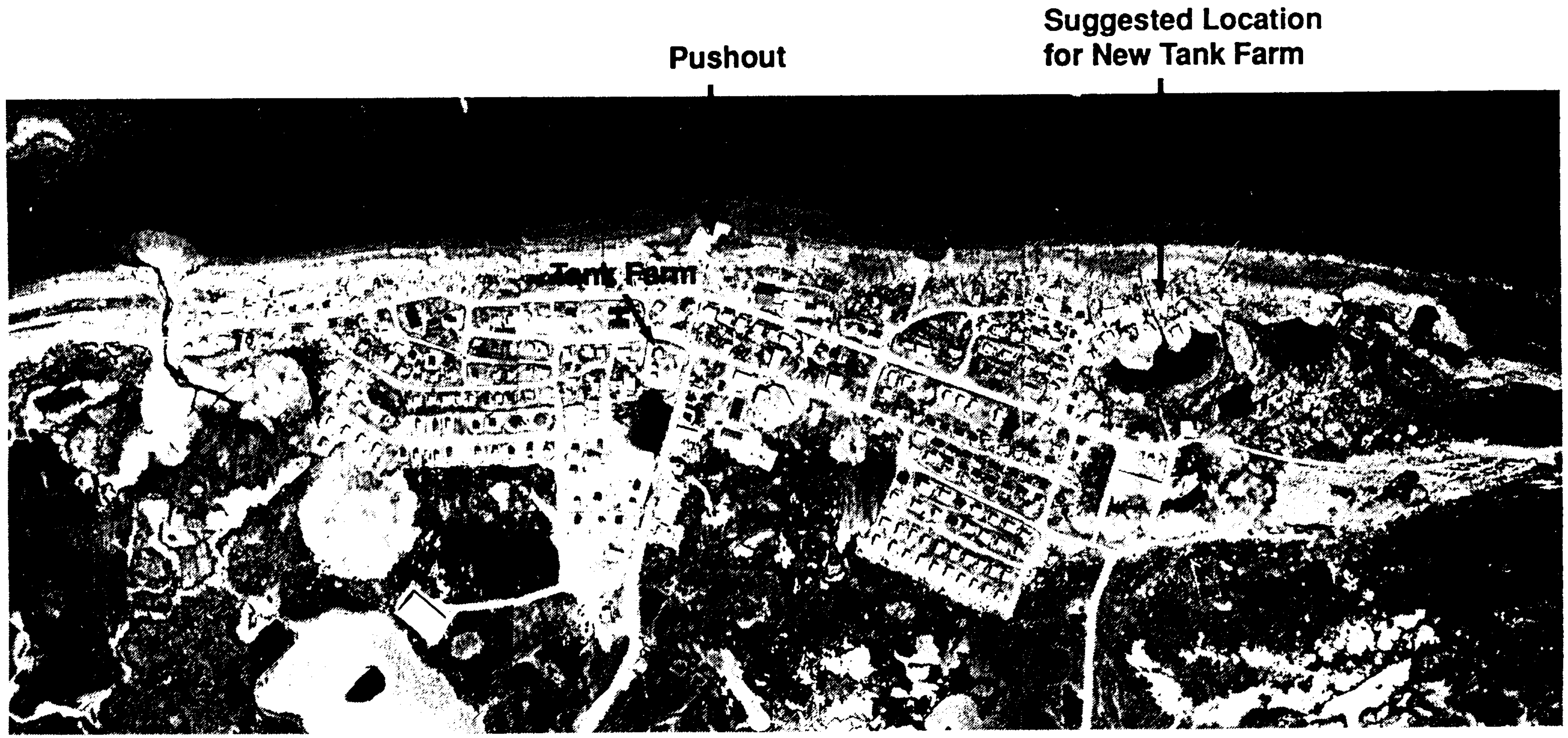


EXHIBIT A-2
ESKIMO POINT AERIAL PHOTO-1986



Tide

The tide is semi-diurnal with a mean tidal range of 2.7 m (0.6 m to 3.3 m) and a large tidal range of 3.8 m (0.0 m to 3.8 m). The mean sea level is 2.1 m.

Currents

Tidal currents incremented by winds are reported to reach 2 knots in the vicinity of Sentry Island on the ebb flow and up to 5 knots on the flood flow. The currents are strongest in the shallow waters lying close to the adjacent shoal.

Winds

Wind conditions could be expected to approximate those recorded at Churchill (See Exhibit A.3). During the navigation season (July - Oct.) the wind direction is such that their percentage frequency indicates reasonable uniformity from all directions with a slight predominance displayed by N and NW winds. Most of the strong winds are also reported to originate from these directions. Strong wind conditions could be expected to make navigation through the approachway difficult.

Waves

Wave effects along the Eskimo Point beach could be expected to be minimal during periods of low tide due to the protection provided by Sentry Island and its connecting shoal and the extensive tidal flats extending from both shorelines of the inlet. During periods of high tide, the tidal flat protection is no longer available which will enable significant wave action to take place along the beach front.

EXHIBIT A-3

WEATHER TABLE-CHURCHILL, MANITOBA

Weather Table — Churchill, Man., 58″45′ N., 94°04′ W. Altitude: 29 m

1

Month	Mean Sea Level Pressure	Air Temperature: Daily Mean	Air Temperature: Mean of Daily Max.	Air Temperature: Mean of Daily Min.	Absolute Extremes: Max	Absolute Extremes: Min.	Mean Relative Humidity	Mean Total	Max. Fall in 24 Hours	Mean Snowfall
	kPa	°C	°C	°C	°C	°C	%	mm	mm	cm
Jan	01.8	27.5	23.6	11.4	0.0	-45.0	70	15.3	12.9	16.9
Feb	101.9	-25.9	-21.7	)00	1.1	-45.4	71	13.1	11.7	14.6
Mar	102.0	-20.4	-15.7	-25.1	5.6	-43.9	74	18.1	11.9	18.6
Apr	101.9	-10.1	-5.4	-14.8	18.2	-1).1	81	22.9	25.4	22.3
May	101 8	-1 5	2.2	-5.1	27.2	-21.7	83	31.9	55.6	19.1
June	101 3	6 1	10.8	1.5	31.1	.9 4	80	43.5	32.5	3.5
July	101 I	11.8	16.8	6.8	33.9	-2.2	77	45.6	52.3	0.0
Aug	101 1	Ill	13.3	7.2	32.8	-2.2	80	58.3	51.1	0.0
Sep	101 2	5.4	8.5	1.1	27 8	-11.7	80	50 9	41 2	6 4
Oct	101)	-1.5	1.3	.4 4	20 b	-24.4	84	41.0	35.8	29.3
Nov	101.5	-12 1	-8.3	-15 9	12	-)6 1	82	38.8	35.1	41.6
Dec	101 7	.21 2	-18.2	.26 1	2 2	-40.0	74	20.9	21.8	22.8
Mean	101.5	-7.2	-3.2	-11.3			78			
Extreme or Total					33.9	-45.4		402.3	55.6	91. $
Period of Record	953-980	1951-1980			1943-1980		1953 1980	951-960	1943-1960	1931 -19s0

Month	Days with: Rain (0.25 mm or more)	Snow (0.25 cm or more)	Frost	Visibility less than ½ mile	Gales (Winds 34 knots or more)	Thunder	Mean Cloud Amount (Tenths)
Jan	•	11	31	2	1	0	5
Feb	0	10	28	2	1	0	5
Mar	•	10	31	1	1	0	5
Apr	1	10	)0	4	1	0	6
May	5	7	29	7	1	·	7
June	9	2	1)	8	1	2	7
July	11	0	I	7	•	2	7
Aug	13	0	·	6	1	2	7
Sep	12	4	8	4	1	I	8
Oct	6	14	26	4	2	o	8
Nov	1	18	10	2	3	0	8
Dec	•	14	31	1	1	0	6
Mean							7
Extreme or Total	58	100	258	48	14	7	
Period of Record			943-980	957-980	957-980	957-980	953-980

Month	Wind Direction, Percentage Frequencies: N/NNE	NE/ENE	E/ESE	SE/SSE	S/SSW	SW/WSW	W/WNW	NW/NNW	CALM	Mean Speed
										knots
Jan	4/2	1/1	2/1	2/2	5/3	5/6	21/21	14/-i	1	13.1
Feb	4/2	2/1	2/1	2/2	6/3	4/4	14/ii	17/7	2	13.0
Mar	6/4	3/4	5/4	3/5	6/3	3/3	9/19	13/9	2	12.0
Apr	9/6	5/5	7/5	5/6	9/3	3/2	4/10	11/9	2	12.2
May	10/8	7/7	7/6	4/5	7/3	3/2	3/6	II/i i	1	12.0
June	9/8	7/9	7/7	5/5	6/3	4/3	4/5	7/9	2	I I I
July	9/6	7/7	5/6	5/5	6/5	6/5	6/7	7/T	2	10.4
Aug	9/6	5/5	4/4	5/6	7/4	5/5	7/7	9/10	2	I I I
Sep	8/5	4/4	5/4	4/5	8/5	5/5	7/i	10/-i i	1	12.8
Oct	6/5	3/3	4/4	5/5	8/4	4/5	8/11	12/i	1	1).4
Nov	5/4	3/3	3/2	3/4	6/5	5/6	13/15	15/9	2	13.8
Dec	4/3	2/2	3/2	3/3	7/4	6/6	17/16	13/i	2	12.3
Mean	7/5	4/4	5/4	4/4	7/4	4/4	10/13	12/9	2	12.3
Period of Record	1955-1980									

Note: kPa . iloPascals • mb . 10 A: Ad, ed nc als based on 5 10 19 years, Ir sive,
fro 951- 0 and any other available dat rom 1931-1950

* Average less than 0.5

T = Trace

Ice

The shelter supplied by Sentry Island and the surrounding shoals could be expected to restrict ice movements to that associated with tidal movements. As such, significant ice rafting is probably not experienced along the town's shoreline which has been confirmed by the local residents.

Bed Material and Littoral Transport

The area's sand and gravel beach indicates that the bed material could be expected to be composed of similar material with interspersed boulders. The presence of extensive tidal flats indicates that there is an abundance of material to be transported should differential bottom elevations be established.

Fog

Fog conditions result during the navigation season when onshore wind conditions prevail over an extended period of time. Records indicate that during this period fog conditions could be expected to occur with an average frequency of 5 days per month with slightly greater. occurrence during the early months (See Exhibit A.3).

Aids to Navigation

Hydrographic chart No. 5398 indicates a flashing light exists on Sentry Island and that beacons formed by wooden poles exist on the north and south entrance headlands to the inlet.

eastern entrance of Wilson Bay (See Exhibits A.4 & A.5). It is located approximately 22o nautical miles (408 km) north of Churchill. Whale Cove is south facing and sheltered from all directions except the S to SSE directions. The hamlet is situated on a large sandy-gravel and relatively flat area with the surrounding area consisting of rocky outcrops and low lying hills. The surrounding coastline is rocky.

Approaches and Bathymetry

The approach to Whale Cove is from the southeast and tracks north of Walrus and Morso Islands. Other approaches could exist but only this one has been surveyed to date. Several shoals lie within the approachway; however, they are charted and normally would not present a problem to approaching vessels. Whale Cove itself provides a deep channel to within 200 metres of the shore at which point the water shallows rapidly. A small well protected cove lies immediately to the east of the hamlet within which a low water depth of some 1.5 m is reported to exist.

Anchorage

Anchorage can be obtained south of the hamlet in Whale Cove but the water is deep and the berth is protected only from northerly winds. Anchorage with excellent protection can be found on the east side of Wilson Bay at about 62° 12′ N; 92″ 37′ W.

Tide

The tide is semi-diurnal with a mean tidal range of 3.0 metres and a large tidal range of 4.0 m.

EXHIBIT A-4A: WHALE COVE

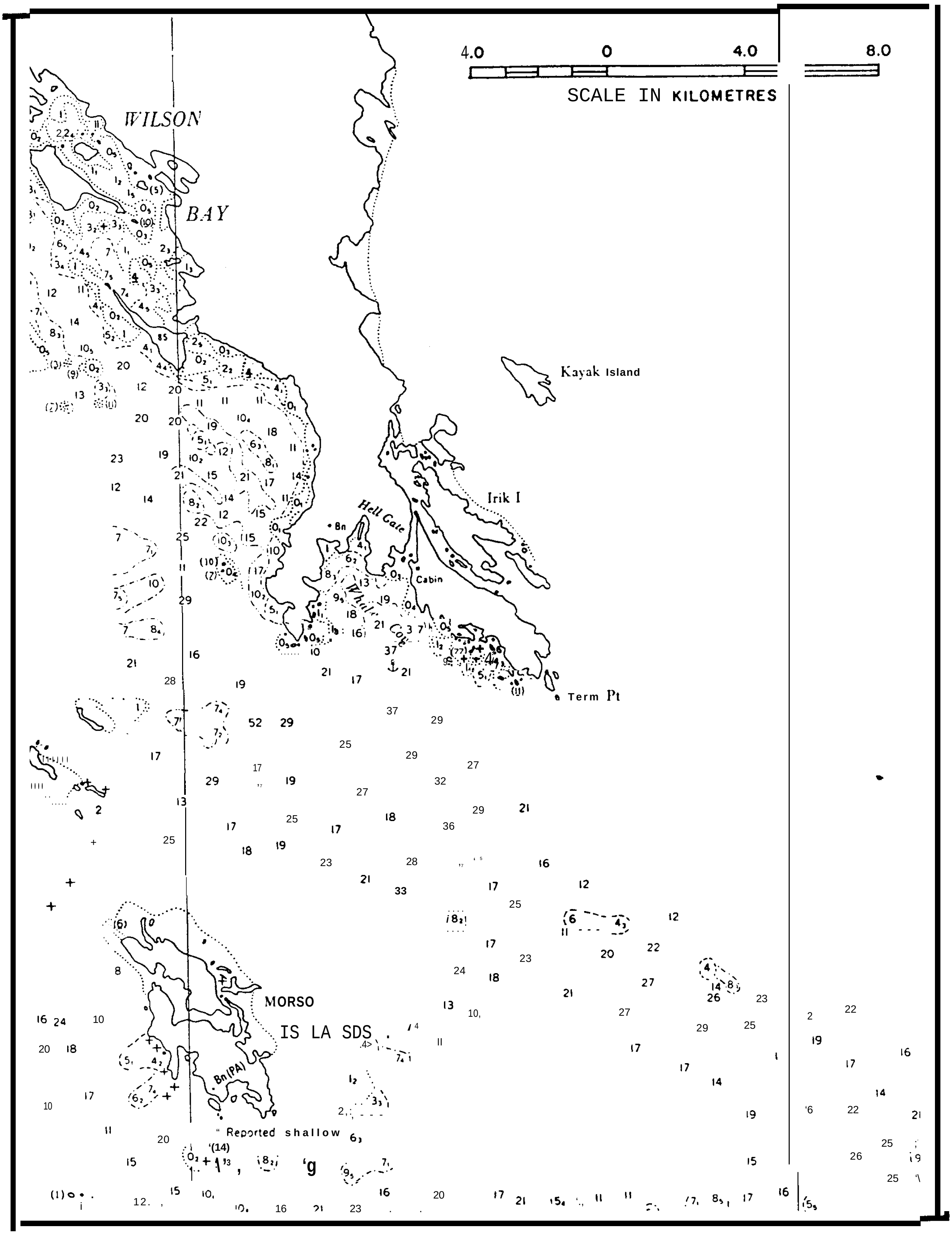


EXHIBIT A-4B: WHALE COVE

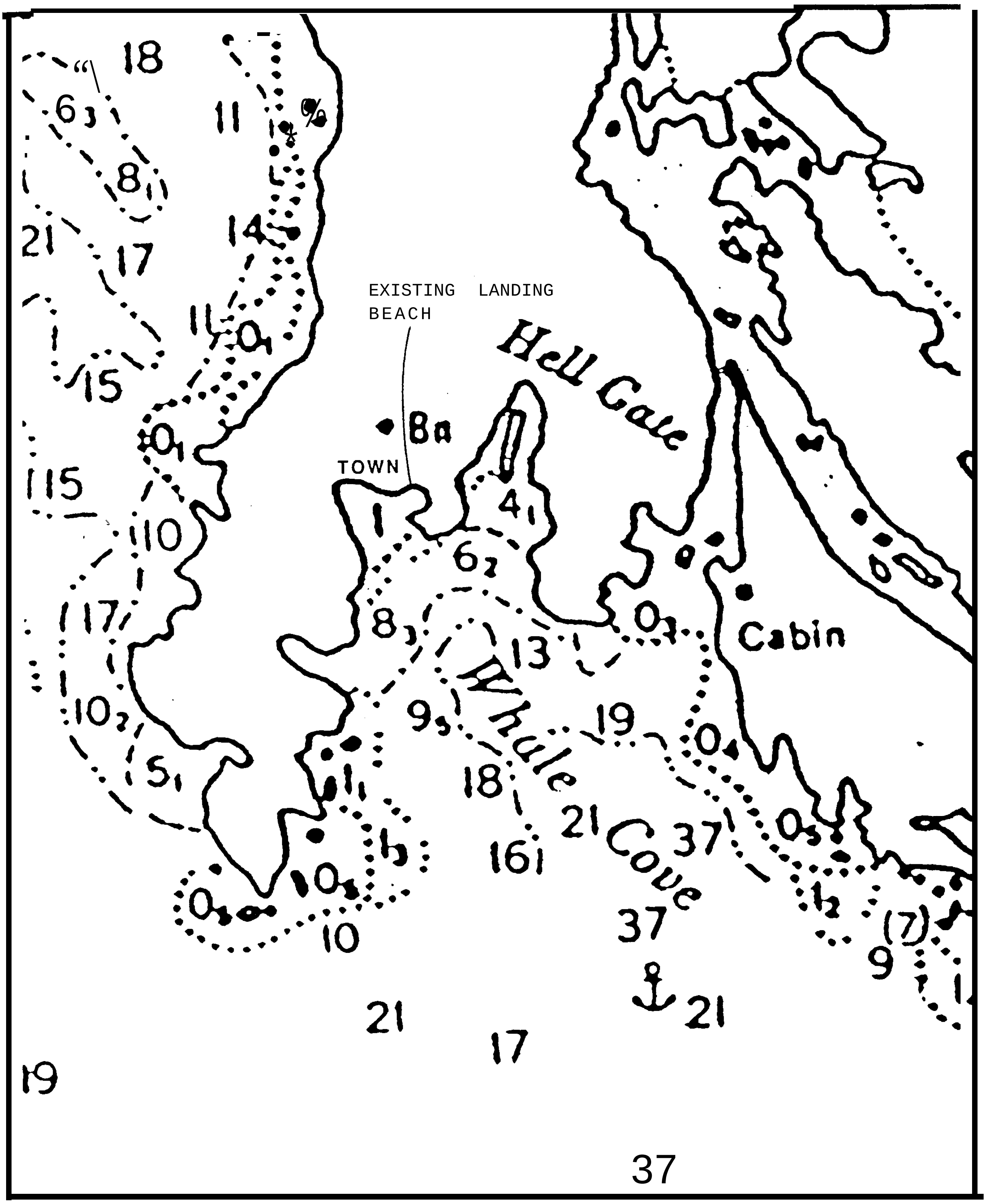
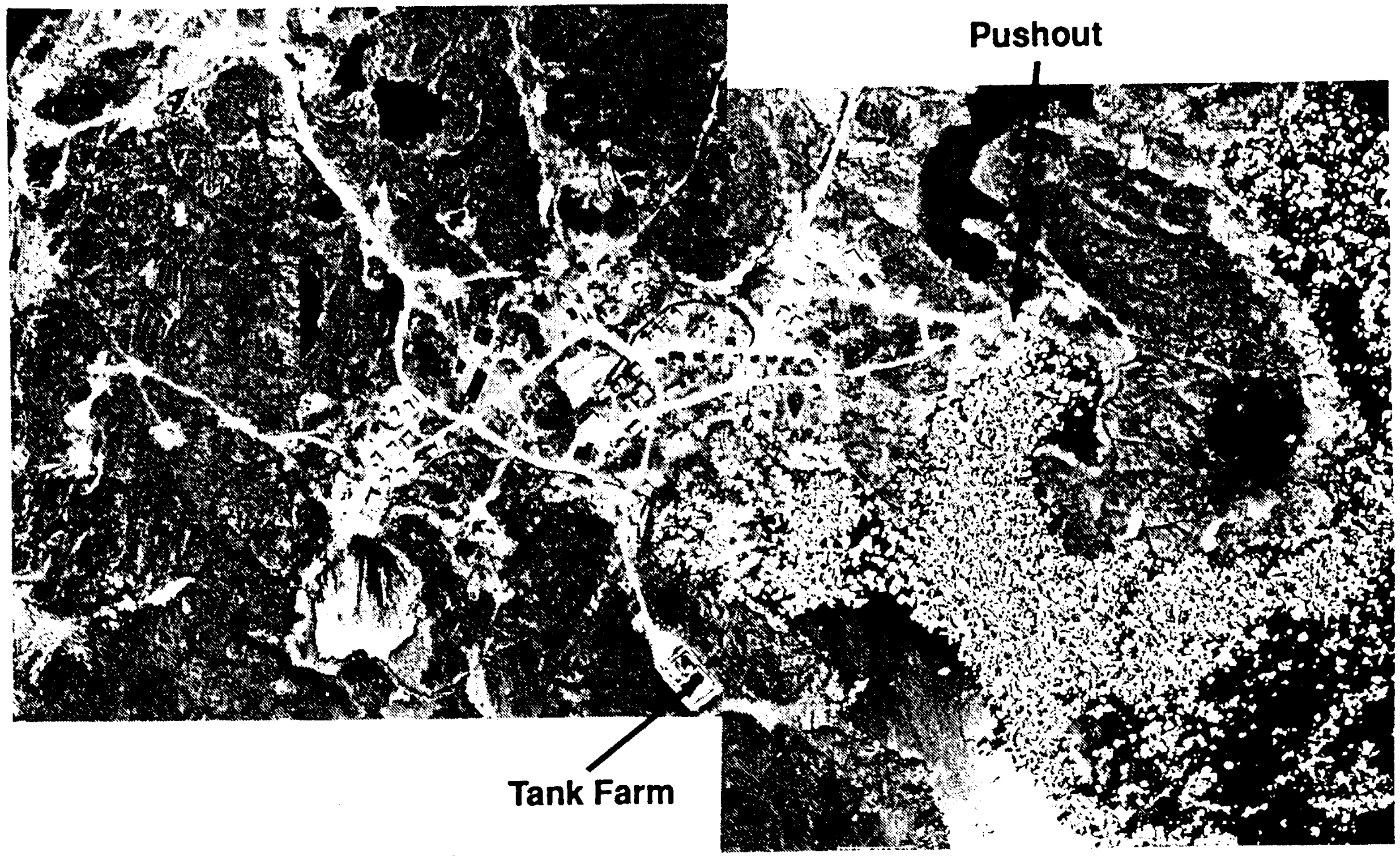


EXHIBIT A-5
WHALE COVE AERIAL PHOTO-1986



Currents-

The Sailing Directions publication does not comment on the existence of tidal streams in the vicinity of Whale Cove, consequently it must be assumed that tidal conditions experienced do not adversely affect marine operations in this area.

Wind

Wind conditions at Whale Cove could be expected to approximate those recorded for Chesterfield Inlet where winds from the North to Northwest quadrant predominate during the shipping season (See Exhibit A.12). Only S to SSE winds could be expected to affect operations within Whale Cove itself. Vessel approach would not be adversely affected by winds originating from the various other directions.

Waves

A significant fetch extends in the S to SSE directions consequently significant wave action could be expected to occur within Whale-Cove along the exposed beach when sustained winds originate from the exposed direction. These waves could be expected to break at the ledge where the water shallows rapidly. Only limited wave action should occur within the small protected cove area.

Ice

Ice rafting could be expected to occur along the shores due to the Cove's S

Bed Material and Littoral Transport

The composition of the Cove's bed material is unknown; however, the fact that the seabed deepens sharply approximately 200 m offshore of the hamlet would indicate that in the inshore area the seabed probably consists of a thin layer of granular material overlying bedrock. Therefore, although littoral transport could be expected to take place in the granular material due to the relatively high tidal conditions, its limited quantity would minimize such effects.

Fog

Fog conditions could be expected to occur during" the navigation season with an average monthly frequency of 5 days with slightly greater occurrence during July and August (See Exhibit A.12).

Aids to Navigation

An aeronautical radio beacon and a radar transponder are located near the settlement to assist navigation.

A.3 RANKIN INLET

Rankin Inlet is located at 62° 49' N; 92° 05' W on the west coast of Hudson Bay on Kudlulik Peninsula at the head of a large inlet of the same name. It lies approximately 278 nautical miles (515 km) north of the Port of Churchill (See Exhibits A.6, A.7 & A.8). The hamlet itself faces onto Prairie Bay which constitutes a northern branch of the inlet.

The general topography of the area consists of low lying hills and rocky terrain with sand and gravel ridges along the coastline.

EXHIBIT A-6: RANKIN INLET

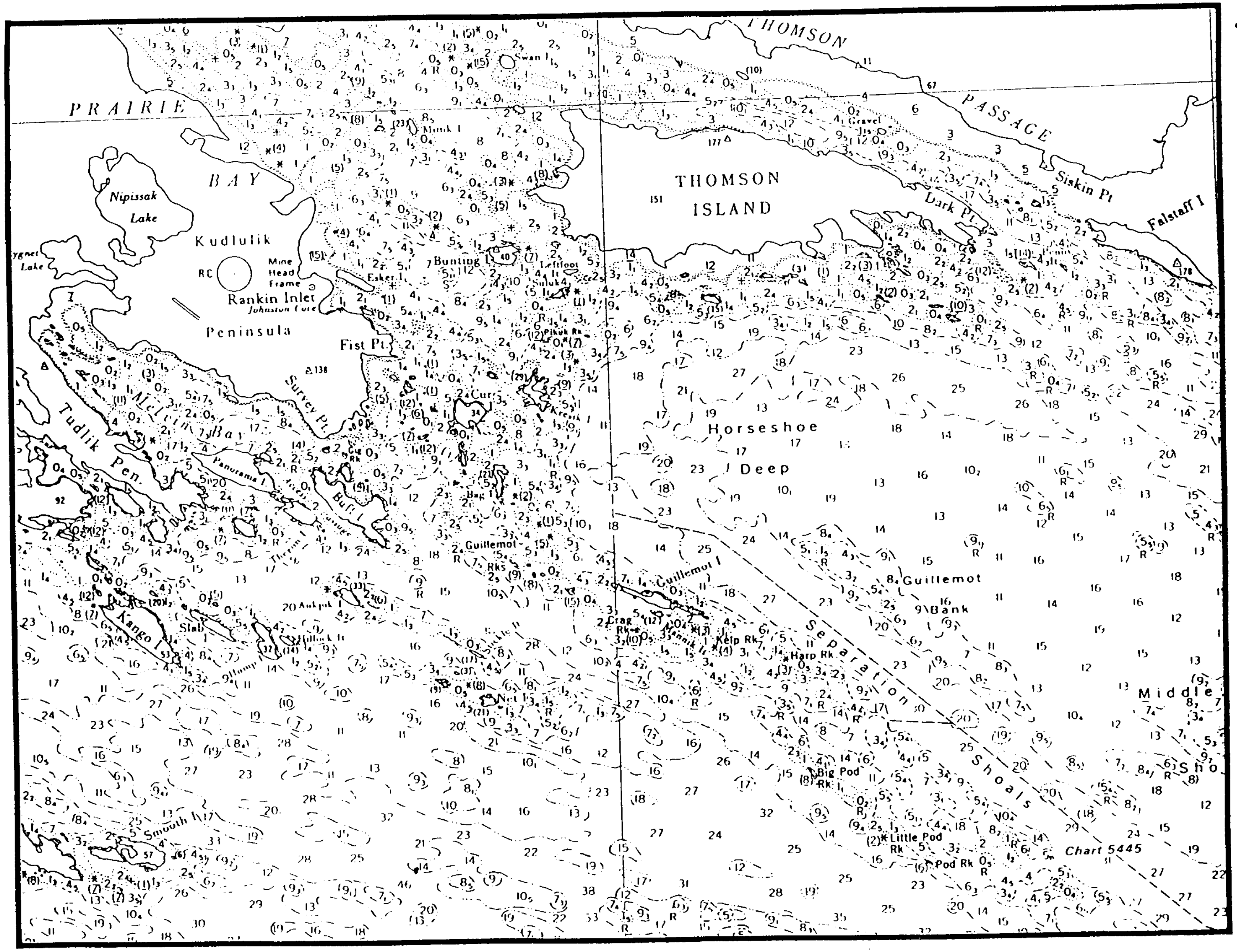


EXHIBIT A-7A: RANKIN INLET HARBOUR

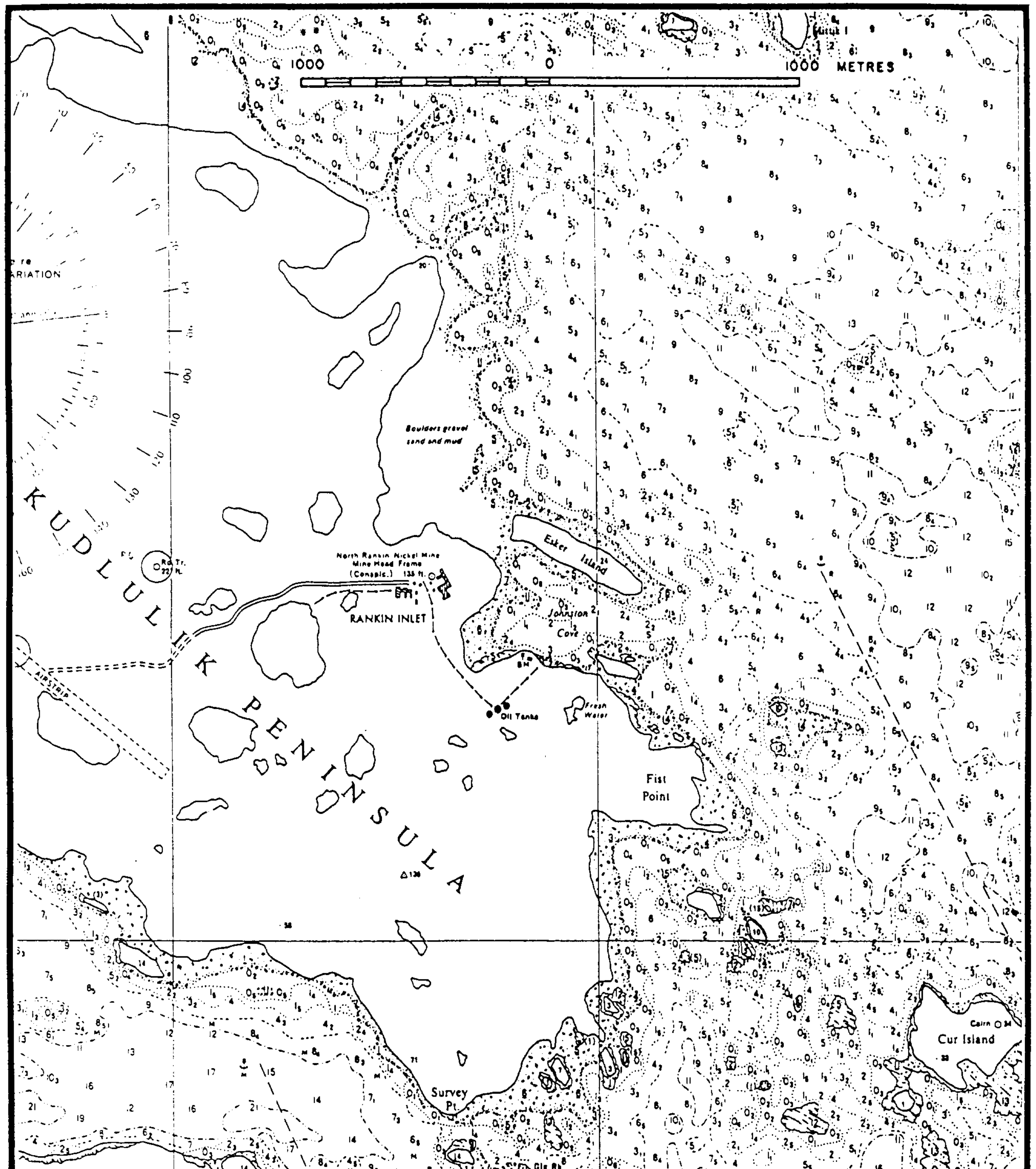


EXHIBIT A-7B: RANKIN INLET HARBOUR

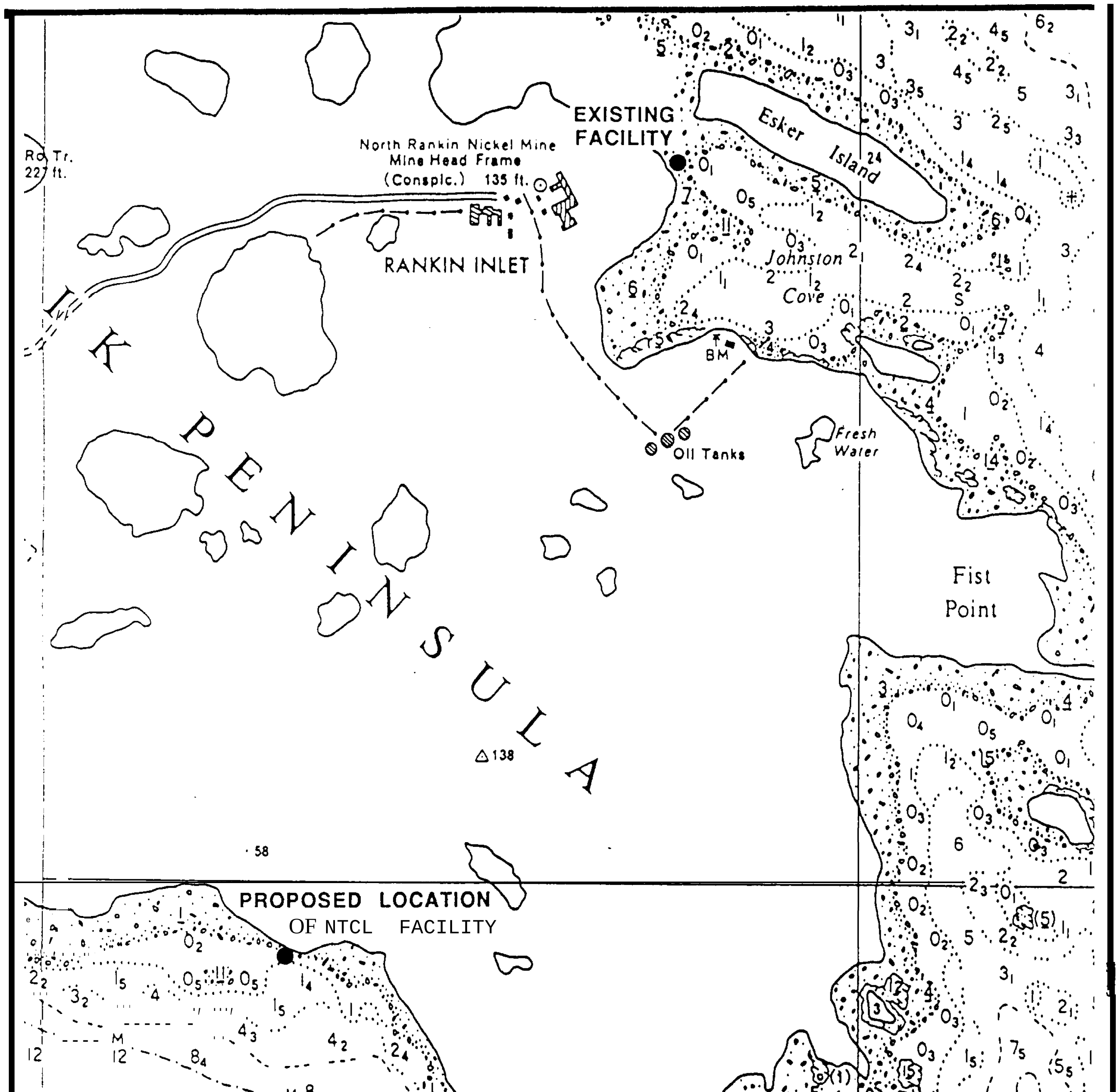
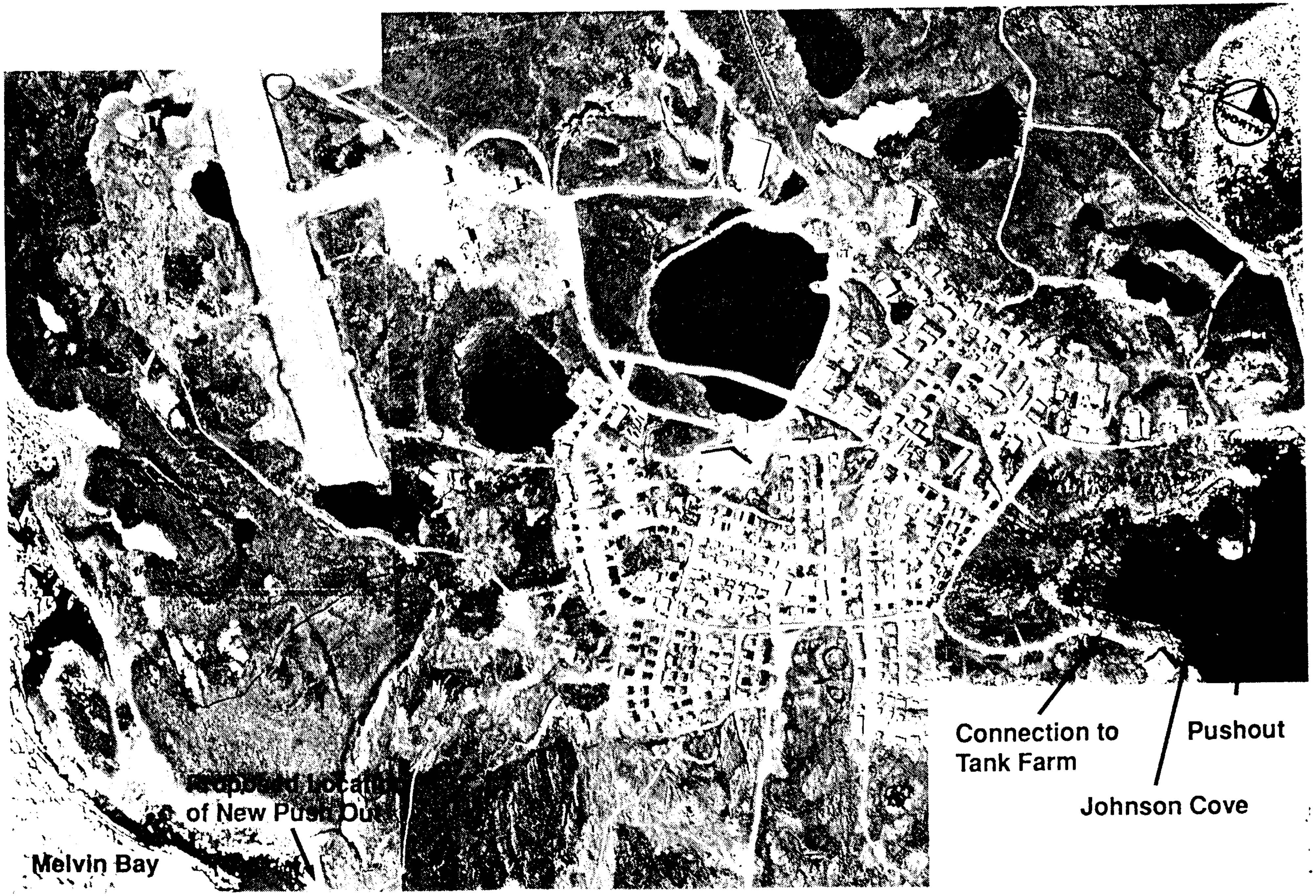


EXHIBIT A-8
RANKIN INLET AERIAL PHOTO-1986



Approaches and Bathymetry

Depths in the inlet and its approaches are very uneven with numerous shoals. A water depth of 12.8 m can be maintained by following the recommended track which runs south of Marble Island to an area between the middle shoals and separation shoals situated approximately 15 km southeast of the hamlet. The track then proceeds into Prairie Bay by changing direction a number of times. The resupply tug and barges follow a narrower, more northern track to avoid shoals that may interfere with the tow lines. The Sailing Directions strongly recommends the use of a pilot possessing local knowledge for any vessel desiring to advance to the head of Rankin Inlet.

The existing harbour area is almost an enclosed cove, known as Johnston Cove, formed by Kudlulik Peninsula to the south and west, Esker Island to the north and an unnamed high tide island or low-tide peninsula to the east. A natural breakwater extension protrudes some 50 m off the eastern end of this unnamed island which results in the partial closure of the harbour entrance. The harbour entrance channel is approximately 30 m wide which produces a well protected harbour area.

Another well-protected water area known as Melvin Bay exists to the south of Kudlulik Peninsula where it is sheltered by Tudlik Peninsula and a number of islands. The approach to Melvin Bay diverges from the "recommended track" to the east of Separation Shoals and winds between a number of islands. Melvin Bay is very shallow in its inner half but has a deep, well sheltered basin in its SE portion.

Anchorage

Good, well protected anchorage is available in Melvin Bay where a mud bottom with 20 to 31 m water depths can be found.

Tide

The tide is semi-diurnal with a mean tidal range of 2.9 m (0.9 m to 3.8 m) and a large tidal range of 4.7 m (0.0 m to 4.7 m). Mean sea level is 2.4m.

Currents

Tidal streams of 2 to 3 knots have been reported in the vicinity of Kresik Island. Strong cross-currents have also been reported to occur at the entrance to Rankin Inlet. These cross-currents usually flow SW at about 1 knot on the flood but sometimes also flow in the opposite direction during ebb tide. Tidal rips are also reported to occur.

Winds

Wind conditions at Rankin Inlet could be expected to approximate those recorded for Chesterfield Inlet where winds from the North to Northwest quadrant predominate during the navigation season (See Exhibit A.12). Only SE winds could be expected to affect vessels approaching Rankin Inlet.

Waves

Both the Johnston Cove and Melvin Bay sites are well protected from any significant wind fetches; consequently wave action at both these sites could be expected to be minimal.

Ice

The shelter provided by surrounding headlands and nearby shoals will limit ice movement to that associated with tidal action. Significant ice rafting is not experienced at either site; in fact, it is reported that Melvin Bay used to be utilized as a winter aircraft landing strip prior to the construction of the present airport.

Bed Material and Littoral Transport

Hydrographic Chart No. 5445 indicates that the area's seabed material consists of boulders, gravel, sand and mud. It is reported that a considerable depth of tailings from the town's former nickel mine cover the bottom of Johnston Cove. The predominance of boulders and gravel coupled with the area's sheltered conditions would indicate that littoral transport is not significant in the deeper water areas.

Fog

Records of Chesterfield Inlet where conditions would be similar to Rankin Inlet indicate that, on average, fog conditions could be experienced five (5) days per month during the navigation season with a slightly higher frequency during the months of July and August.

Aids to Navigation

A radio beacon is located near the settlement to assist navigation.

A.4 CHESTERFIELD INLET

Chesterfield Inlet is located at 63° 20′ N; 90° 42′ W on a small bay about 1.5 km wide and 1.0 km deep, known as Chesterfield Anchorage on the south shore of Chesterfield Inlet (See Exhibits A.9, A.10, & A.11). It is situated approximately 302 nautical miles (562 km) north of Churchill, on a narrow coastal strip composed of sand and gravel and surrounded by low granite outcrops and inland lakes.

EXHIBIT A-9: CHESTERFIELD INLET

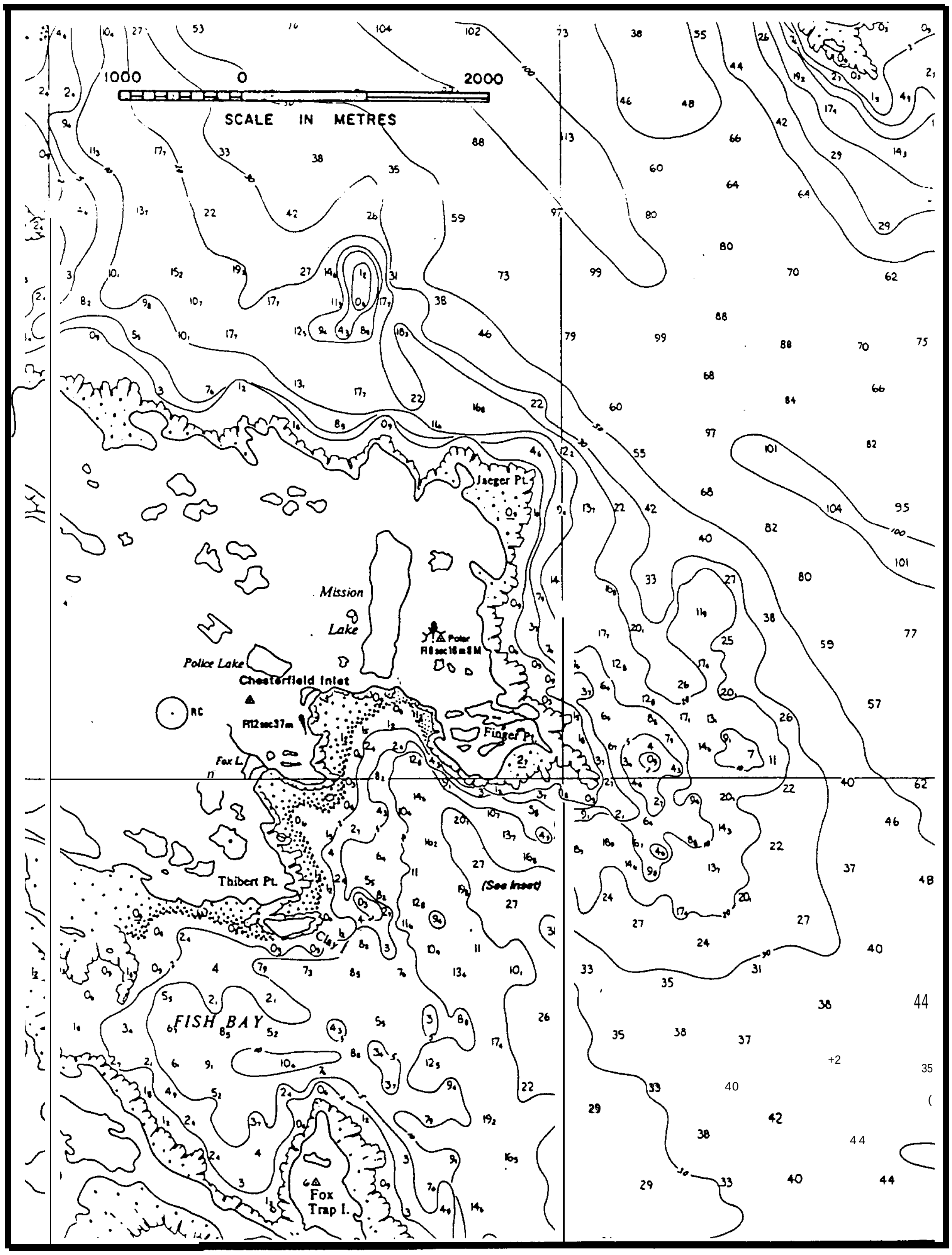


EXHIBIT A-10A: CHESTERFIELD ANCHORAGE

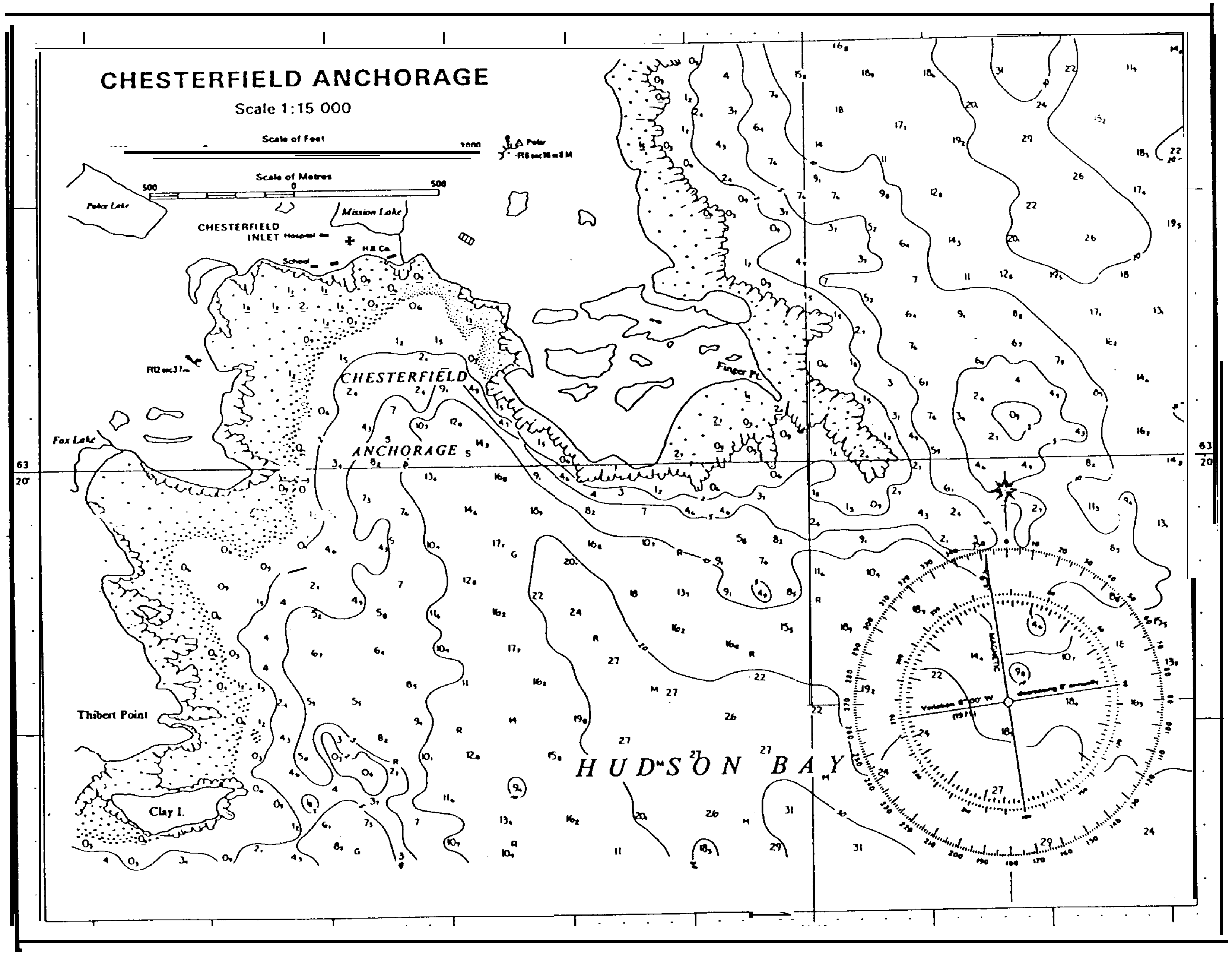
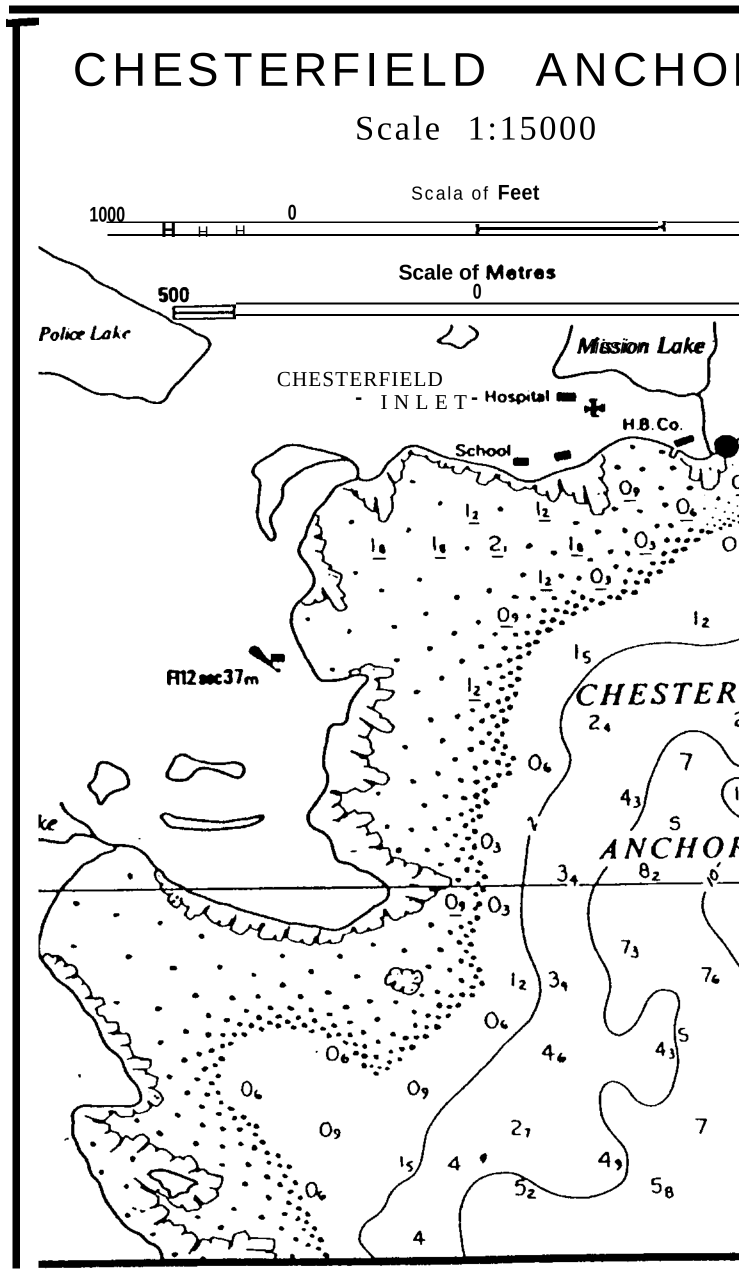


EXHIBIT **A-1OB: CHE**



EXHI
CHESTERFIELD INLE

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Approaches & Bathymetry

Navigation to Chesterfield Anchorage is very open and easy from the east to southeast quadrant. The approach runs south of Promise Island and Finger Point and north of Fairway, Sakpik, Foxtrap and Clay Islands. Within Chesterfield Anchorage water depths decrease rapidly about 400 metres from the shore from about 9 metres to 2 metres within a length of 100 m. After this steep incline the water depths decrease gradually into a gently sloping beach.

Anchorage

Anchorage in 15m of water with fair holding in a sand and gravel bottom can be found about .75 km to the south of the Hudson's Bay Company store. Anchorage can also be found approximately 300 m off the NE shore. Both anchorages are exposed to winds from SE to east making it advisable to leave if strong winds arise from these directions. Good anchorage with protection from all but Northeasterly winds can be obtained on the south side of Chesterfield Inlet in a harbour to the south of Ellis Island.

Tide

The tide is semi-diurnal with a mean tidal range of 3.0 m (0.8 m to 3.8 m) and a large tidal range of 4.2 m (0.2 m to 4.4 m). Mean sea level is 2.4m.

Currents

Although tidal rips are reported to occur off Finger Point during periods of large tides and tidal currents of up to 4 knots occur in the entranceway to Chesterfield Inlet, the sheltered location of Chesterfield Anchorage itself should indicate that only relatively weak current conditions are experienced inside the anchorage.

Winds

Recorded wind conditions for the period. 1955-1980 are presented in Exhibit A.12. Winds from the North to Northwest quadrant predominate during the shipping season. Only winds from the southeast could be expected to affect operations within Chesterfield Anchorage itself.

Waves

Considerable wave action could be expected within Chesterfield Anchorage during times of sustained Southeast winds due to the associated long fetch. The rapid rise in the seabed elevation at the entrance would dissipate much of this wave energy; however, as the beach "area is only some 300 m distant it could be expected to be adversely affected. Local residents state that resupply operations are seldom interrupted by adverse wave conditions.

Ice

The average thickness attained by level shorefast ice at Chesterfield Inlet is 180 cm with a record maximum thickness of 226 cm measured in 1975. The beach area of Chesterfield Anchorage is relatively. sheltered which, coupled with the offshore shallow water conditions that exist, would indicate that very little ice rafting should be experienced.

Bed Material and Littoral Transport

The sea bed of the inlet's northern and western shores consists of sand and gravel strewn with boulders. It becomes bedrock as one progresses along the eastern shoreline. Littoral transport could be expected to be minimal within the established regime; however, any excavation in the sand and gravel sea bed could be expected to be quickly filled in by tidal action.

EXHIBIT A-12
WEATHER TABLE-CHESTERFIELD, N.W.T.

Weather Table — Chesterfield, N, W, T., 63°20' N., 90°43' W. Altitude: 6 m

Month	Mean Sea Level Pressure	Air Temperature					Mean Relative Humidity	Precipitation			Days with						Mean Cloud Amount (Tenths)	Wind Direction									Mean Wind Speed
		Daily Mean	Mean of Daily Max	Mean of Daily Min	Absolute Extremes			Mean Total	Max. Fall in 24 Hours	Mean Snowfall	Rain (0.25 mm or more)	Snow (0.25 cm or more)	Frost	Fog (Visibility less than ½ mile)	Gales (Winds 34 knots or more)	Thunder		Percentage Frequencies									
					Max.	Min.												N/NNE	NE/ENE	E/ESE	SE/SSE	S/SSW	SW/WSW	W/WNW	NW/NNW	CALM	
	kPa	°C	°C	°C	°C	°C	%	mm	mm	cm																	Knots
Jan	101 4	-31. 5	-27.8	-35.2	-0.6	-51.1	71	7.6	10.9	7.9	0	6	31	l	l	o	4	8/3	1 - i	2 - i	5/l	3/	2/	4/10	48/5	4	12.4
Feb	101. $	-11.6	-17.9	-35.1	-0.6	-49.4	71	4.6	15.2	4.5	o	4	18	l	l	o	4	5 - i	l/•	1 - i	1 - i	3/1	l/2	5 i i	46/5	J	13.3
Mar	101.8	-26.5	-22.2	-10. $	-1.1	-46.7	71	8.3	20.3	8.2	0	7	31	1	"	o	4	5/2	2/l	3 - i	5/4	2/l	1/1	J/16	43/5	4	12.5
Apr	101.0	-16. $	-11.7	-21.2	5.6	-31.9	79	12.0	27.9	11.5	•	l	10	3	l	o	5	8 i -	4 i	4/3	6/5	7 i	2 - i	4/10	28 %-	4	11.6
May	101 8	.6.0	-1.4	-9.5	10.6	-27.2	84	15.1	23.6	9,6	l	6	11	4	•	o	7	9/6	7/4	6/4	5/4	5 i -	2 i	4 i i	10/6	3	11.1
June	101.3	2.9	6.1	-0,1	25.6	-15.0	81	2).1	39.1	5.1	5	1	18	5	•	•	1	6/5	7/5	8/1	7/6	7/3	3/3	4 i	17/6	2	10.0
July	100.9	8.9	13.1	4 6	)0.6	-1.1	77	41.2	57.9	0.7	9	•	l	7	•	l	6	6/5	6/4	6/4	8/7	8/2	3/3	6/10	14/6	J	9.1
Aug	101.0	8.4	11.7	5.0	100	-1.7	80	11.7	39.1	0.2	9	"	"	7	•	l	7	7/6	1/4	5/3	7/6	7/5	4/3	5/8	17/7	1	11.0
Sep	101 1	2.5	4.8	0.1	19.4	-12.8	al	406	36.6	7,6	8	)	14	4	l	"	8	10/4	4/3	4 i	6/4	6 i	5/3	7/8	17/11	2	12.6
Oct	101.1	-5.7	-2.8	-1.6	9.4	-30.0	85	33.8	30.5	14.)	4	11	19	4	1	0	8	9 i	5/4	8/4	8/6	5 - i	)/2	6/10	14/8	1	15.1
Nov	101 3	-17.4	-13.6	-21.2	9.4	-38.9	81	19.9	25.9	19.1	"	10	10	)	"	o	6	9/5	4/3	4 - i	4 - i	4 i	2 i	9/15	26/5	3	13.2
Dec	101.5	-26.4	-22.5	-10, s	0.0	-47.8	75	14.0	17.9	13.8	"	9	31	2	"	o	4	6/3	2/2	2/2	5/3	4 - i	1/1	4/10	44/6	)	12.9
Mean	101.4	-11.6	-1.9	-15.2			79										6	7/4	4/3	4/3	6/4	5/2	2/2	5/11	28/6	,	11.0
Extreme or Total					30.6	-51.1		258.9	57.9	111. $	36	66	174	43	6	1											
Period of Record	1911-1980	19$1-1980			19)1-1980		1953-1980	1951-1980	1931-1980	1951-1980			1930-1980	1957-1980	1957-1980	1957-1980	1953-1980	195$-1980									

Note: kPa - KiloPascals = mb + 10
" Average less than 0.5

A: Adjusted normals based on $ to 19 years, inclusive, from 1951-1980 and ● nY other available data from 1931-1950

T - Trace

Fog

Recorded information for the period 1957-1980 indicates that, on average, fog conditions could be expected to occur on 7 days in each of July and August and 4 days during September and October.

Aids to Navigation

A marine/air radiobeacon exists near the settlement of Chesterfield Inlet to assist navigation. Hydrographic Chart No. 5620 indicates that flashing lights exist immediately to the east and west of the townsite.

A.5 BAKER LAKE

Baker Lake is situated at 64° 18′ N; 96″ 03′ W at the northwest end of a 70 km long by 2.9 km wide body of water of the same name located at the head of Chesterfield Inlet, some 200 km from Hudson Bay (See Exhibits A.13 and A.14). The shores of the lake consist mostly of gentle slopes interrupted occasionally by pronounced ridges or rock hills.

Approaches and Bathymetry

The recommended route into Baker Lake from Hudson Bay provides 29 metres of water as far west as Cross Bay and 20 metres from there to Chesterfield Narrows where a rock shelf with only 2.1 metres to 3.0 metres of water depth at low tide obstructs the channel. Navigation over the shelf can be accomplished during high tide conditions by vessels drawing up to 4.6 metres of water. Navigation in Chesterfield Inlet, particular through the Chesterfield Narrows and the north channel around Christopher Island, is considered to be difficult. Water depths in Baker Lake range from 31 to 84 metres decreasing to 9.1 metres near the hamlet. The approach to the townsite's harbour is from the east-southeast and is free of shoals except for the area near the mouth of the

EXHIBIT A-13A: BAKER LAKE

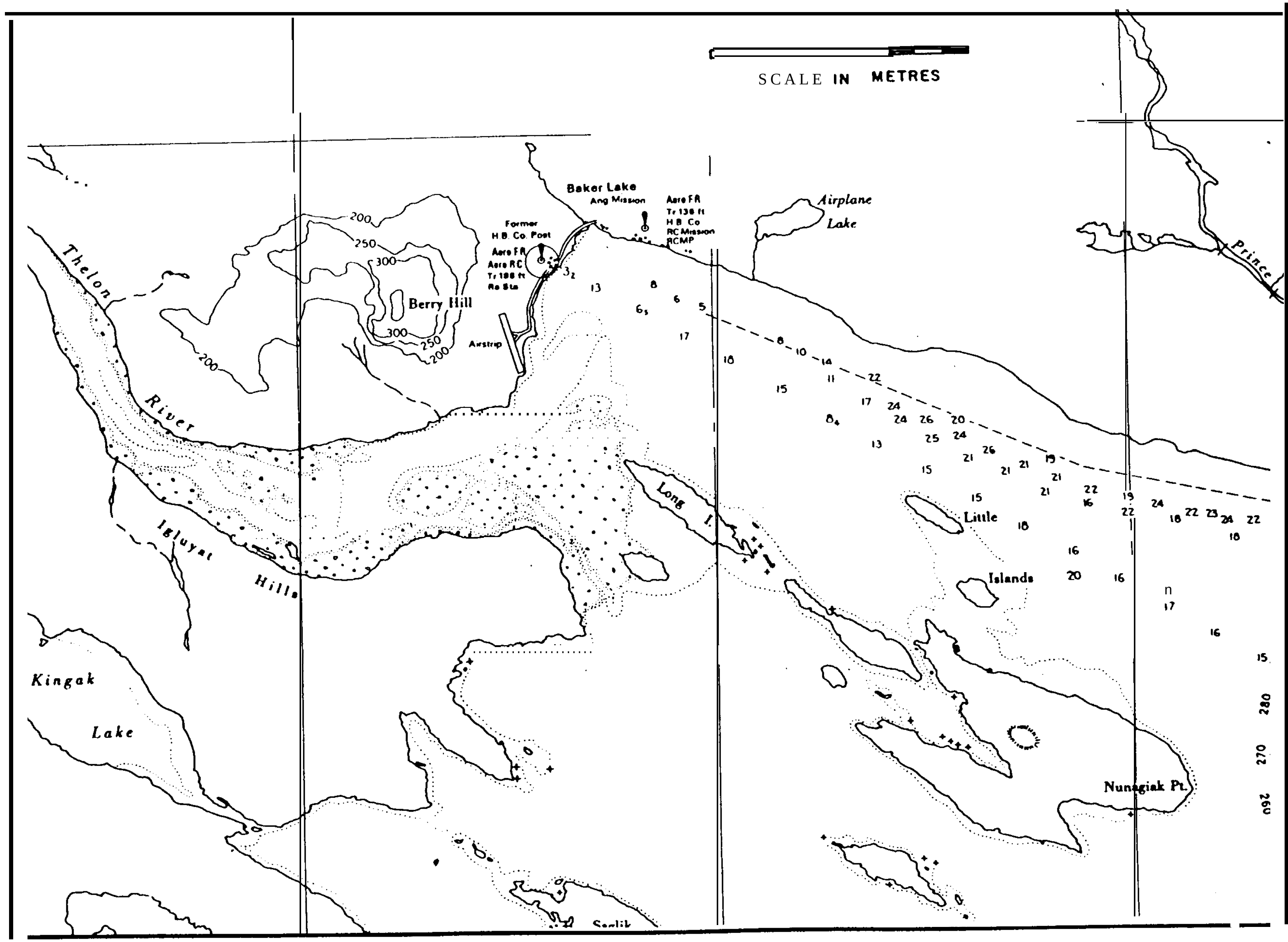

EXHIBIT A-13B: BAKER LAKE

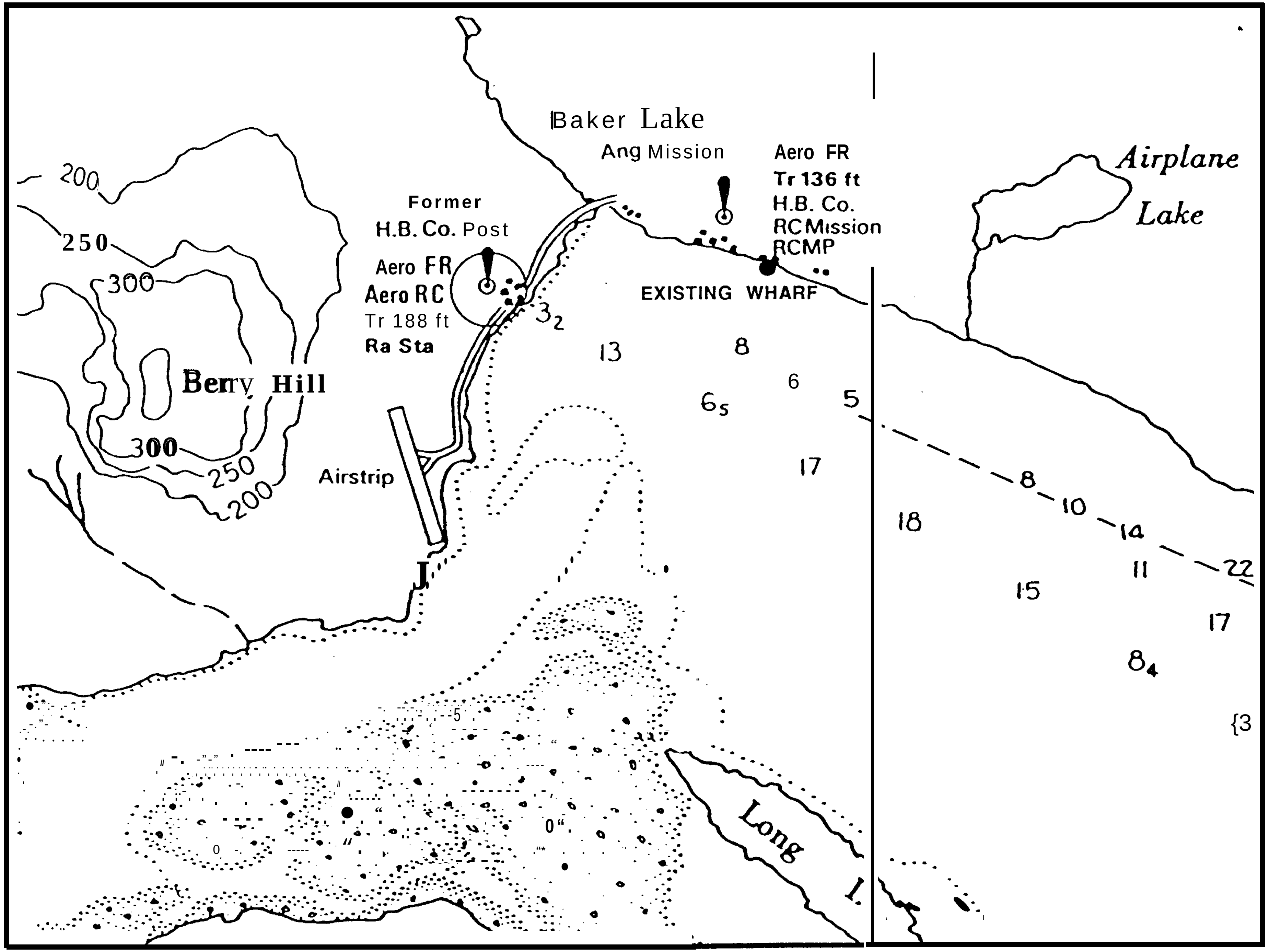

EXHIBIT A-14
BAKER LAKE AERIAL PHOTO-1986

hamlet. The approach to the townsite's harbour is from the east-southeast and is free of shoals except for the area near the mouth of the Thelon River where sand bars extend into the lake. The shores are comprised mostly of sand and gravel and are generally gently sloped.

Anchorage

Vessels usually anchor approximately 700 metres offshore where a soft clay bottom provides good holding.

Tide

Tidal ranges vary from 5.2 metres near Centre Island in Chesterfield Inlet to negligible at the Baker Lake settlement.

Currents

The currents in Chesterfield Inlet can be strong, up to 5 knots; however, near the hamlet they are reported to be strong only at the river entrance but negligible in the vicinity of the harbour area.

Winds

Wind conditions recorded for the period 1963-1980 are presented in Exhibit A.15. These records indicate that during the shipping season, the winds predominately originate from the north to northwest quadrant. The beach area lying in front of the hamlet would be mainly affected by East-Southeast winds which occur reasonably frequent"ly during the months of July and August.

Waves

East-Southeast winds act over a fetch of some 70 km and are reported to occasionally produce waves of up to 1.25 m in height.

EXH

WEATHER TABLE

Weather Table — Baker Lake, N. W. T., 64° 18'N., 96° 00'W.

Month	Mean Sea Level Pressure	Air Temperature: Daily Mean	Air Temperature: Mean of Daily Max.	Air Temperature: Mean of Daily Min.	Absolute Extremes: Max.	Absolute Extremes: Min.	Humidity	Precipitation: Mean Total	Precipitation: Max. in 24 Hours	Precipitation: Mean Snowfall	… or more)	… or more)
	kPa	°C	°C	°C	°C	°C	%	mm	mm	cm		
Jan	101 6	13.0	29.5	-36.4	-8.2	-50.6	66	7.1	9.7	8.0	0	7
Feb	101 8	12 6	29.2	-36.0	-7.8	-50.0	65	4.9	7.4	5.4	0	6
Mar	102.0	17.9	23.7	-)2.0	-1.1	-50.0	66	7,6	7.1	8.3	0	8
Apr	102.0	11. J	12.5	-21.1	5.0	-41.1	14	13.8	17.5	13.6	[illegible]	9
May	101 9	-6.4	-2.6	-10.2	11.7	-27.8	81	12.0	25.2	6.3	1	6
June	101.3	4.1	7.5	0.1	23 J	-13.9	77	20.9	17.5	2.8	6	2
July	101.0	11.0	16.6	6.0	JO.6	-1.7	71	38.1	52.1	0.0	9	0
Aug	101 1	9,7	13.1	5.5	27.8	[illegible]	76	37.)	45.5	0.4	10	*
Sep	101 1	2.3	5	-07	21 1	-14.4	82	37.0	35.3	5.9	8	5
Oct	101.2	.7 7	-4	-11.0	9.4	-J06	83	JO 6	32.0	23.2	3	12
Nov	101 5	10 J	-16	-24 0	2 2	-40.6	75	16 5	30.3	11.4	·	10
Dec	101 7	28 2	-24	-31 6	-1 1	-45 6	69	8.2	7.4	8 7	—	8
Mean	101 5	12 2	-8	-16.0			74					
Extreme or Total		—	—		JO 6	-50.6	—	134.6	52.1	00.0	37	73
Period of Record	1953-1980	1951-1960			1946.1980		1953 196(	1949-1980				

Note kPa . Kilo Pascals . mb - 10

* Average less than 0 5

A: Adjusted normals based on 5 to 19 years, i from 1951-1980 and any other available da

Ice

The average thickness attained by level shorefast ice in Baker Lake is 226 cm with a record maximum thickness of 248 cm measured in 1969. The lack of tidal action produces very little ice movement during the winter months; however, during the spring breakup the current from the Thelon River piles up the flowing ice along the hamlet shoreline.

Bed Material and Littoral Transport

The area's sand and gravel beaches could be expected to extend into the immediate water area. The sandy gravel material is reported to be interspersed with boulders. The lack of any significant current in front of the hamlet would indicate that any littoral transport experienced in the area would be very minimal.

Fog

Recorded information for the period 1957-1980 indicates that, on average, the presence of fog could be expected to occur 2 days in July; 1 day during each of August and September and 3 days during October.

Aids to Navigation

An aeronautical radio beacon is situated near the townsite East-Northeast of Berry Hill to assist navigation. A number of preliminary ranges are also provided along the passage from Hudson Bay.

A.6 CORAL HARBOUR

Coral Harbour is located at 64″ 8′ N; 83° 10′ W on the southern shoreline of Southampton Island (See Exhibits A.16, A.17 and A.18). It

EXHIBIT A-16A: C

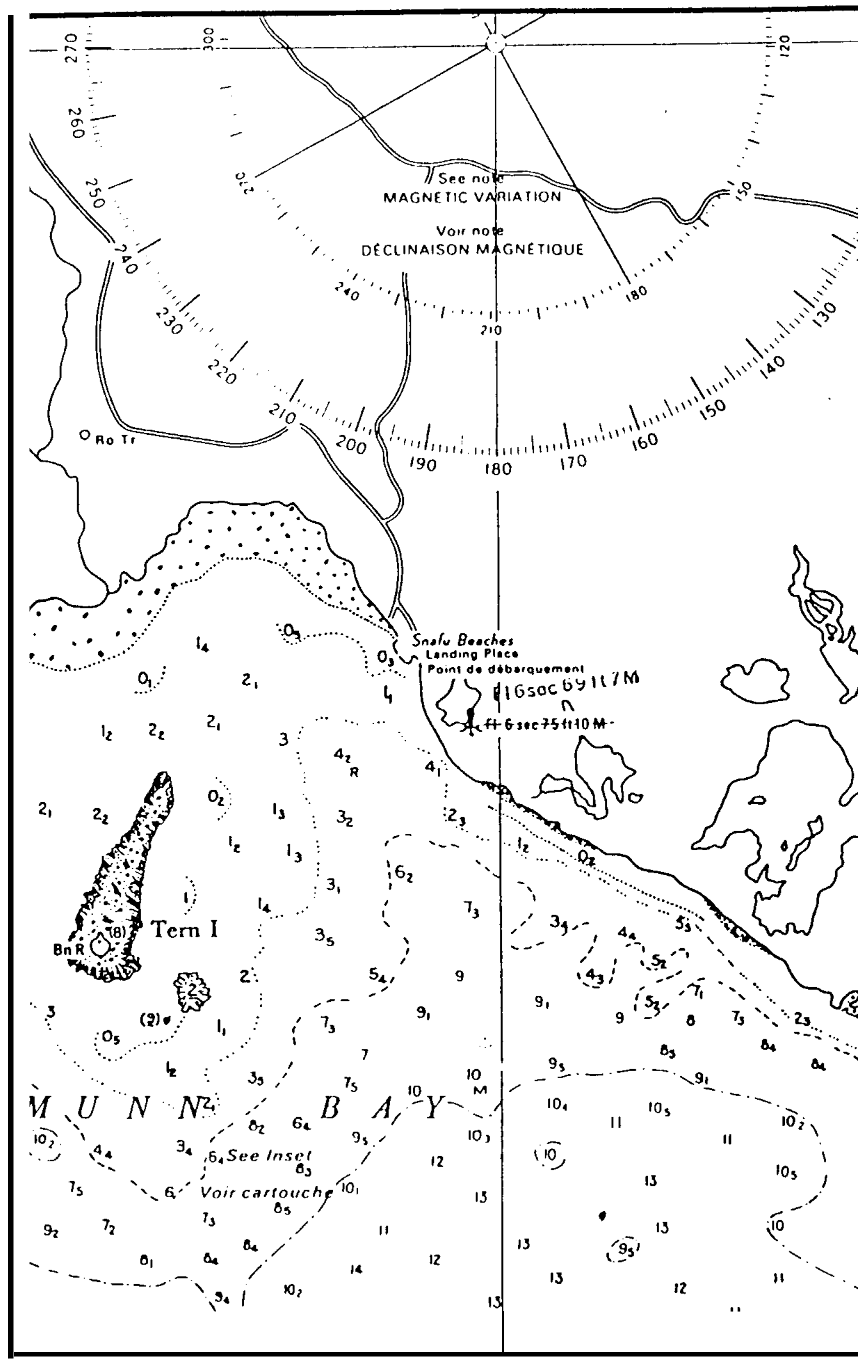

EXHIBIT A-16B: CORAL HARBOUR

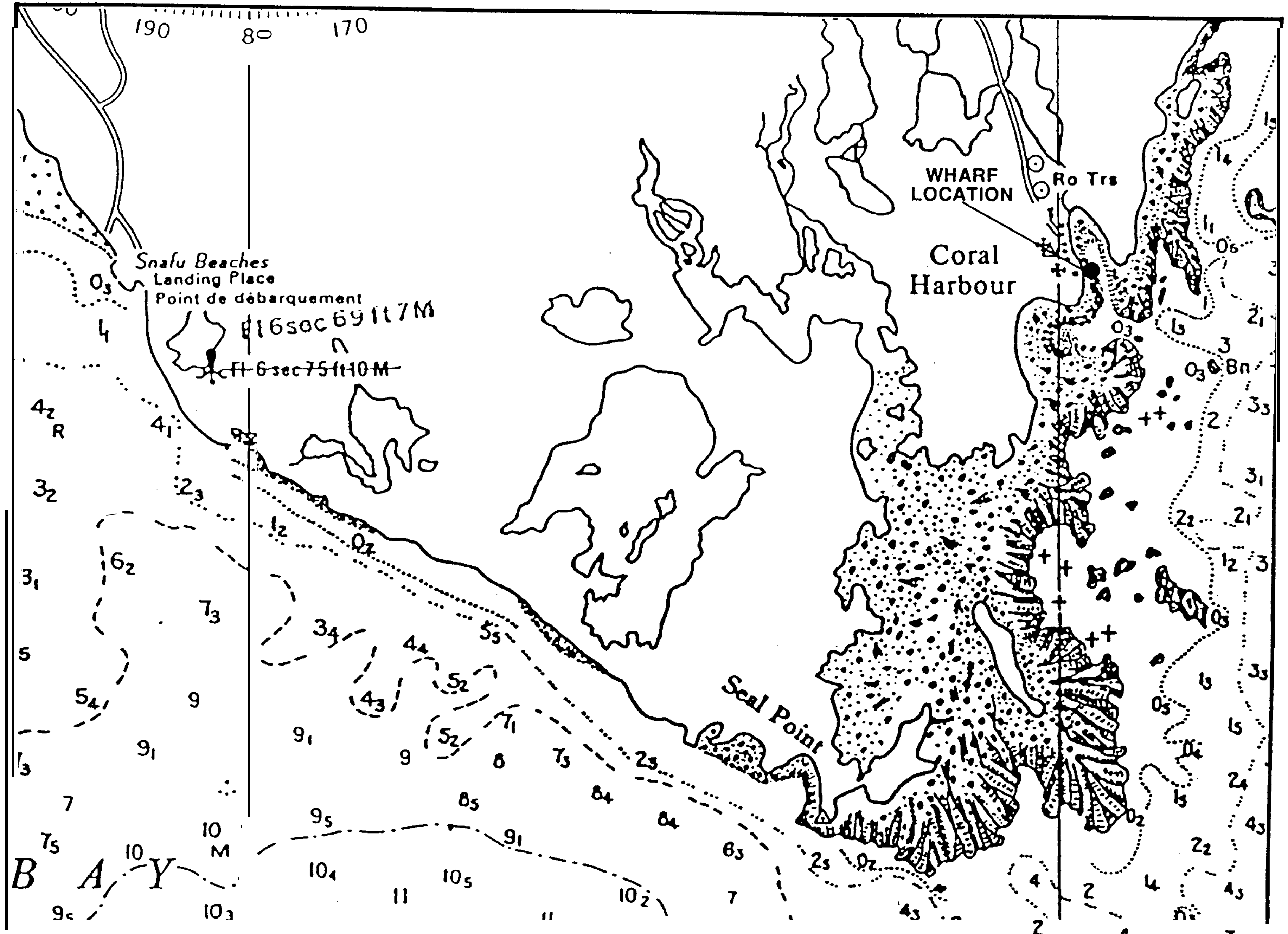

EXHIBIT A-17: CORAL HARBOUR LANDING SITE

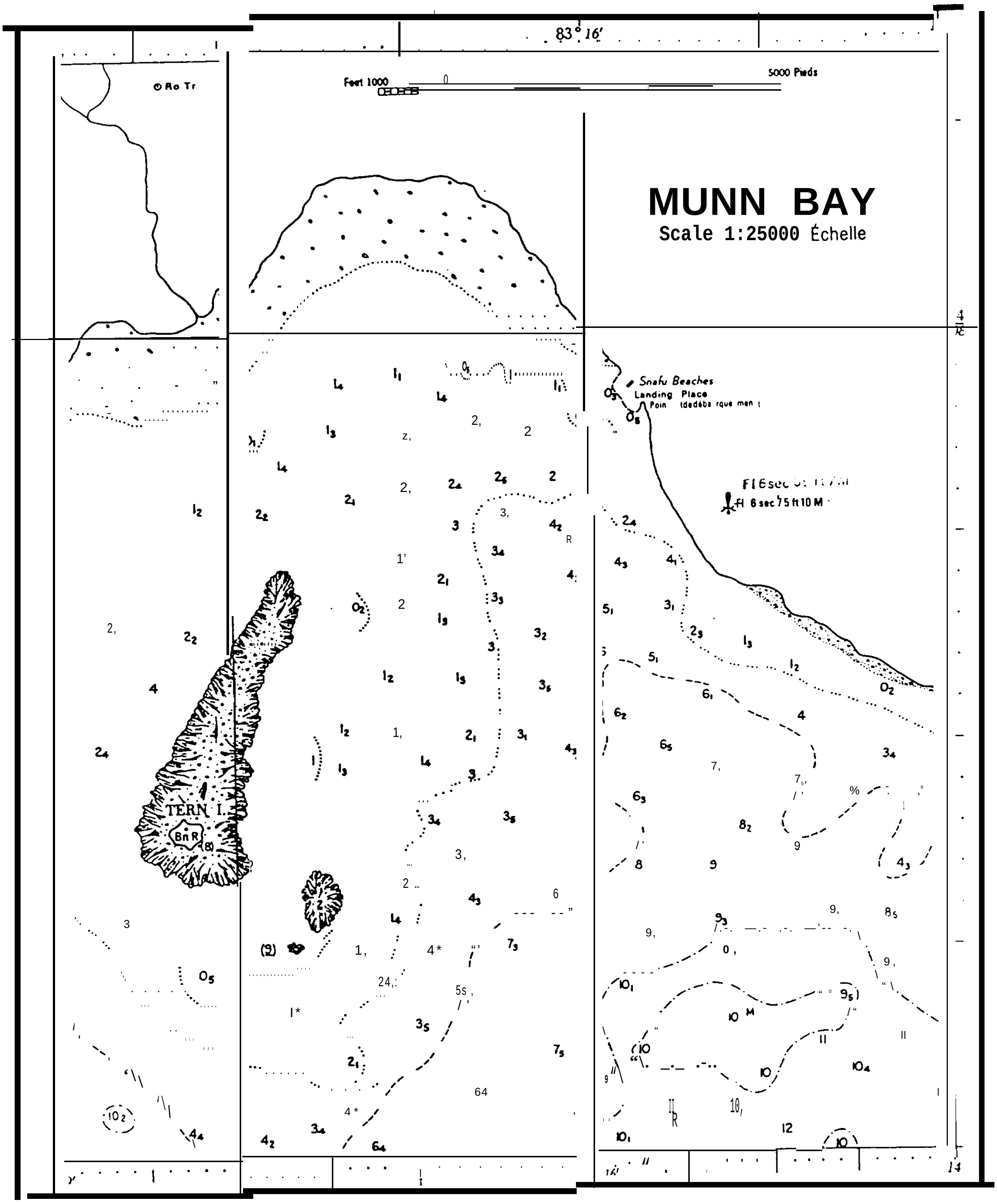

EXHIBIT A-18
CORAL HARBOUR AERIAL PHOTO-1986

is situated at the head of South Bay, on the west side of a cove called Coral Harbour some 848 km north-northwest of Churchill.

Approaches and Bathymetry

Approaches to Munn Bay and the landing site for the resupply vessels are from the southwest, up Fisher Strait north of Coats Island, then north into South Bay, which is located roughly halfway along the southern coast of Southampton Island, and from South Bay directly north into Munn Bay.

Fairly deep water exists close to the bay's northeast shoreline in Munn Bay where the shoreline is comprised of 7 metre high steep rough cliffs. The Snafu Beach landing site is situated where the steep shoreline transforms into a drying flat of bedrock, boulders and mud which forms the bay's northwestern shoreline. In the vicinity of the Coral Harbour settlement deep water is found somewhat further out.

Anchorage

Anchorage is available in 18 metres of water approximately 2 km south of the Munn Bay light where moderate holding can be found over a bottom of sand, rocks and clay. Another anchorage area is available in the inner harbour area approximately 1.5 km off the settlement in 11 m water depths surrounded by lesser depths. Holding at this latter site is reported to be good but it is exposed.

Tide

The tide is semi-diurnal with a mean tidal range of 2.3 metres (0.8 m to 3.1 m) and a large tidal range of 3.6 m (0.3 m to 3.9 m). Mean sea level is 2.0 m.

Current

The maximum tidal stream experienced at the Munn Bay anchorage area is reported to be 2 knots.

Winds

Wind conditions recorded for the period 1955-1980 are presented in Exhibit A.19. These records indicate that the prevailing winds generally originate from the north and northwest but during the shipping season sea breezes from the south become quite pronounced. These southern winds adversely affect the area, especially Snafu Beach.

Waves

Winds from the south travel over an extensive fetch and can be expected to produce considerable wave action. The fact that the deep water extends fairly close to the shore leaving little length to accommodate approaching waves would indicate that the resultant wave action would adversely affect any operations conducted along the area's shoreline.

Ice

The average thickness attained by level shorefast ice at Coral Harbour is 164 cm with a record maximum thickness of 199 cm measured in 1967. Considerable ice rafting could be expected to occur in the Snafu Beach area. The protection available in the immediate vicinity of the hamlet will probably minimize any rafting effects at this latter location.

EXHIBIT A-19

WEATHER TABLE-CORAL HARBOUR, N.W.T.

Weather Table — Coral Harbour, N, W, T., 64° 12" N., 83°22' W. **Altitude: 64 m**

Month	Mean Sea Level Pressure	Air Temperature: Daily Mean	Air Temperature: Mean of Daily Max.	Air Temperature: Mean of Daily Min.	Absolute Extremes: Max.	Absolute Extremes: Min.	Mean Relative Humidity	Precipitation: Mean Total	Precipitation: Max. Fall in 24 Hours	Precipitation: Mean Snowfall	Days with: Rain (0.25 mm or more)	Days with: Snow (0.25 cm or more)	Days with: Frost	Days with: Fog (Visibility less than ½ mile)	Days with: Gales (Winds 34 knots or more)	Days with: Thunder	Mean Cloud Amount (Tenths)
	kPa	°C	°C	°C	°C	°C	%	mm	mm	cm							
Jan	101 1	-29.7	-25.5	-33.8	-06	-52.8	73	8.3	1.6	8.5	"	7	31	2	1	0	4
Feb	101 1	-19,4	-25.0	-33.7	-1.1	-50.6	71	8.8	1).0	9.2	"	7	28	3	2	0	4
Mar	101.8	-25 1	-20.2	-102	00	-49.4	71	10 l	12.4	10.8	"	7	31	2	1	o	4
Apr	101 9	-16 3	-10.8	-21 7	5.0	-39.4	77	13.7	24.6	14.4	*	8	10	2	l	o	5
May	101 7	-61	-2 1	-10 5	9 4	-31 1	83	16.9	12.6	14.6	1	8	31	4	1	o	7
June	101)	2.1	5.5	-1 3	23 3	-15.6	82	26.8	33 1	8.1	5	J	20	5	1	'	7
July	101 0	8.7	13.1	4 2	25.0	-1 1	79	409	41,2	0.5	11	"	1	6	1	"	7
Aug	101 0	1,4	11.4	14	26 1	-3.3	82	44.5	17.6	0.3	10	"	4	5	1	•	7
Sep	101 0	0.9	3.8	-2.0	17,2	-17.2	85	14.0	38.1	9.9	6	5	23	6	1	0	8
Oct	101 1	-7 8	-4.2	-11.4	7.6	-34.4	85	37.1	77.0	26.7	1	12	31	5	1	0	7
Nov	101.2	-17. 5	-13.0	-21.8	1.7	-40,6	79	18.0	13.7	18.1	"	11	10	1	)	0	6
Dec	101.4	-25. 5	-21.5	-29.6	1.1	-48,9	75	10.2	8.6	10.8	"	9	31	1	2	0	5
Mean	101 3	-11.6	-7.4	-15.7			79										b
Extreme Or Total					26.1	-52.8		270.0	77.0	131.9	35	77	291	u	17	"	
Period Or Record	1953-1980	1951-1980			1944-1980		1953-1980	1951-1980	1944-1980	1951-1980			1933-1980	1957-1980	1957-1980	1957-1980	1953-1980

Month	Wind Direction, Percentage Frequencies: N/NNE	NE/ENE	E/ESE	SE/SSE	S/SSW	SW/WSW	W/WNW	NW/NNW	CALM	Mean Wind Speed
										Knots
Jan	17/1	7/7	7/1	1/1	1/1	1/1	3/3	13/23	6	10.9
Feb	18/7	7/7	6/- i	1/1	1/1	1/1	3/3	13/24	6	10.9
Mar	17/6	6/6	7/2	?/-i	1/-i	1/1	1/-i	13/ii	8	9.6
Apr	16/5	6/6	10/3	2/1	1/1	1/-i-	1/- i	12/19	7	10 4
May	14/6	7/5	10/4	4/2	3/2	1/2	5/4	11/15	4	11.1
June	14/6	6/5	7/4	6/4	6/- i	1/- i	5/5	10/i i	4	10.6
July	11/6	6/5	9/5	8/7	10/3	2/i	5/4	6/7	5	9.8
Aug	11/6	7/6	9/5	6/5	7/3	2/J	5/	9/9	,	10.7
Sep	13/5	7/5	7/3	4/3	6/- i -	3/1	6/6	12/11	4	11.4
Oct	14/6	7/6	10/3	4/-i-	4/- i	1/T	4/4	14/16	3	11.9
Nov	18/7	9/6	7/2	1/1	1/1	1/1	3/2	13/21	J	12. !
Dec	la/6	7/6	7/- i	l/- i	r/1	1/1	2/1	13/25	5	11.1
Mean	15/6	7/6	8/-i-	4/- i	4/2	2/2	4/4	12/17	5	10.9
Period Or Record	1955-1980									

Note: kPa = Kilo Pascals = mb ÷ 10
" Average less than 0.5

A: Adjusted normals based on 5 to 19 years, inclusive, from 1951-1980 and any other available data from 1911-19$0

T - Trace

Bed Material and Littoral Transport

The seabed material in the Snafu Beach area consists of sand and gravel strewn with boulders while that fronting the hamlet's shoreline is comprised of bedrock. Littoral transport could be expected to be minimal in the Coral Harbour area; however, any alteration to the existing seabed regime at Snafu Beach could be expected to cause changes in the pattern of such transport.

Fog

Average fog conditions occurring over the period 1957-1980 indicate its occurrences during 6 days for the months of July and September and 5 days for each of August and October.

Aids to Navigation

A marine/air radio beacon situated near the hamlet aids navigation along with flashing lights situated at Munn Cove and on Bear Island close to the entranceway into South Bay.

SOURCES

1. Canadian Hydrographic Service Navigational Charts.

2. Government of NWT Fact Sheets.

3. Canadian Hydrographic Service, Sailing Directions, Labrador and Hudson Bay, Fifth Ed., 1983.

4. Port of Churchill Resupply Operation Study, March 1986, IBI Group.

5. Interviews with various interest groups.

6. Department of Energy, Mines and Resources (EMR) Aerial Photographs.

KEEWATIN PORT FACILITIES STUDY

APPENDIX B

TYPES OF FACILITY CONSTRUCTION

APPENDIX B

TYPES OF FACILITY CONSTRUCTION

There are a number of types of construction commonly used to construct marine facilities. Solid structures can generally be grouped into either open or vertical faced structures while floating structures are also available.

6.1 OPEN STRUCTURES

The open piled supported deck structure is widely used for marine facilities as it offers a great deal of choice with respect to type of materials and is often the most economical when poor soils and/or deep water conditions are encountered. The piles can be fabricated of steel, reinforced or prestressed concrete or timber. The structure's deck will normally be constructed of reinforced concrete, either cast-in-place or partly precast and partly cast-in-place; however, depending on the anticipated loading the deck can also be constructed of timber. Such structures are very vulnerable t oice forces and consequently are considered to be inappropriate for use at the study sites.

B.2 VERTICAL FACE STRUCTURES

Vertical face structures can be classified as being either a " gravity structure or a flexible retaining structure. The basic principle behind gravity structures is for the structure itself to be of sufficient weight in order to offset any lateral forces that may be exerted by the backfill material or in the case of the study ports by lateral ice forces. In flexible retaining structures the vertical face distributes the pressures exerted by the retained fill by bending of the wall, with the loading absorbed by anchored tie rods and by passive earth pressure mobilized in front of the toe of the wall. The wall itself can be constructed of either steel sheet piling or reinforced concrete piling.

B.2.1 Gravity Structures

The vertical face component of such structures can be comprised of mass concrete blocks, reinforced concrete or timber caissons, or cellular bulkheads constructed of flat web steel sheet piling. Also available is a prefabricated metal bin structure often employed in land based retaining wall structures.

Block Wall Structures

Block wall structures consist of a number of concrete blocks placed on top of each other. Although the method of construction is fairly simple the ice conditions coupled with the tidal ranges experienced at the various study sites would dictate the use of fairly large blocks to ensure that the placed blocks are not dislodged. The absence of locally available lifting equipment would indicate that such a type of construction would not be appropriate for the Keewatin Region.

Caissons

Caissons can be constructed of either concrete or timber. Such a structure can be considered to represent an extreme case of a block wall with each cross-section consisting of only one block, not in solid form but rather in the form of a gravel or rock filled concrete or timber box.

Concrete Caissons

Closed bottom concrete caissons are constructed either in a dry dock or on a launch platform, to a height that provides the minimum draft required for flotation. At this stage, the caissons are launched into the water where the remaining wall height is constructed by means of slip-form or jump-form construction while the caissons are moored in deeper water. When the wall height is such that their tops would be above low water when the caisson is submerged the caissons are floated into place and lowered onto a crushed stone mattress. A capping beam, is generally poured after the submerged caissons have been filled sufficiently with rock or sand which permits a proper dock face alignment by correcting any irregularities that may have occurred during the placement procedures. The short spaces between the individually placed caissons are capped with precast slabs to allow the area behind the dock face to be backfilled with rock material. Although this type of construction probably provides the most durable and flexible type of construction for the expected environmental conditions, the complexity of its construction and associated requirement for substantial on-site auxiliary works make their use economical only when substantial dock lengths are to be provided. Therefore, its use is not considered to be appropriate for the various study sites.

Timber Caissons

Timber caissons must also be constructed in a manner similar to the concrete caisson, only with the use of 12" X 12" timbers. When in place the caisson is filled with rocks in order to provide its required weight. The wharfs at the Port of Churchill are made of this type of structure and have been in place since the early 1930's. Openings exist between overlying timbers, consequently the face of the Churchill structures is covered with a wooden sheathing to prevent ice damage to the main structure. The Port of Churchill carries out an annual maintenance program 'to replace any sheathing damaged or dislodged during the previous winter. It can be expected that such a maintenance program would also be required should such structures be utilized at the various study sites. Smaller structures could be constructed by the local workforce under experienced supervision, however, experienced personnel would be required for the launching and positioning operations.

Steel Bin Structure

A number of the existing facilities consist of an old landing craft sunk at the end of a pushout and filled with gravel to form a docking face. This concept is a form of gravity structure which has served well in the past and could be copied for shallow water applications by providing a floating steel bin complete with transverse and possibly longitudinal bulkheads. When in place and filled with gravel such a structure could be expected to serve in " a manner similar to that experienced in the past with the landing craft. To provide a practical solution, the size of the bin would have to be that which could be constructed on skids so that it could be constructed inside during the winter months and transported to the beach area where it would be placed at low tide and floated during high water conditions for transport to its intended location. This launching method is valid only if the bin can be placed far enough out such that sufficient water depth is available to float it. To enable such a method of construction, the structure's height and size would have to be limited. Also experienced supervision of the launching operations would be required to ensure that the structure was sufficiently ballasted so that it did not overturn due to the water's buoyant forces. Although it is unlikely that such a structure would prove to be the most economical, it could be incorporated into a manpower training program and used to teach and upgrade the welding skills of the local work force.

Cellular Bulkheads

Steel sheet pile cells are constructed of flat piles capable of developing tensile stresses without large deformations. The structural strength of such structures is derived from the interaction of the steel and soil within the cell. Generally, this type of structure is used where good fill material is available, and where bottom conditions are firm. Cell diameter is determined by the water depth and the expected loading as the hoop tension developed in the shell can not exceed the allowable capacity of the pile's interlock. During the cell's construction, it is necessary to interlock all the piles prior to commencing driving operations. During construction and until such time as the cell has been partially or completely filled, the structure must be adequately braced against loads exerted by waves, currents and tidal differences. Minimal major construction equipment requirements would be a crane outfitted for pile driving capability and supported by a floating platform unless the crane is capable of working from a land base. Also required would be various floating work craft and earth moving equipment.

Prefabricated Metal Bin - Type Retaining Wall

This type of retaining wall is composed of a series of adjoining closed-face bins, each approximately 3 m long. These bins consist of sturdy, lightweight prefabricated steel members that can be bolted together at the site and backfilled. Although possible to fabricate in place, the water based nature of the proposed installation will dictate that transverse sections be assembled on the ground and hoisted into place by a light crane. This type of structure will be suitable only where limited water depths are encountered. These bins have occasionally been utilized for fresh water applications; however, further study would be required to ascertain how they would withstand the corrosive elements of seawater. Structural components associated with greater depth bins could be used to provide some allowance against this corrosive action of the sea water.

The structure's horizontal undulating features could be expected to result in forces being exerted on the structure during the winter months due to the ice's vertical tidal induced movements. This type of structure was utilized at the new Baker Lake facility which has suffered ice damage. It is not recommended for any of the site in the study area.

B.2.2 Flexible Retaining Structures

Such structures consist of vertical walls constructed of steel sheet piling or reinforced concrete piling which are driven into the seabed a sufficient depth to ensure that the toe of the structure does not "kick out" under load. The severe ice conditions coupled with the tidal range experienced at the various study sites will dictate that these structures be placed deep enough to resist any resultant pull up forces. In order to reduce stress, the top of the wall is generally tied back by steel tie-rods which are anchored by blocks embedded in the fill material a sufficient distance back from the dock face. The structural integrity of such structures depends upon the bending capacity of the steel or concrete sheet piles, the passive soil resistance at the structure's base, and the tensile capacity of the tied-back anchoring system. Although it is possible to utilize reinforced concrete sheet piling, the lack of local concrete batching capability would probably necessitate the piling to be fabricated elsewhere and transported to the work site the same as required for steel sheet piling. Concrete piling is more susceptible to damage during driving operations and as such, should not be considered for use at the various study sites. Minimal main construction equipment requirements would consist of a crane outfitted with pile driving capability along with earth moving equipment. By utilizing a crane of sufficient reach, required earth filling operations could be advanced sufficiently to enable shore based operations for the wall placement. Otherwise the crane will have to be barge mounted.

A variation of the above system is the pile and plank form of construction whereby steel H-piles are driven into the ground and reinforced concrete planks are placed to span between two adjacent H-piles. The H-piles are then tied back to anchor blocks in a manner similar to that outlined above. When hard rock conditions or boulders in the overlying material are encountered, holes can be pre-drilled and the piles concreted in place with tremie concrete. The pre-drilling of such holes underwater would require special barge mounted drilling equipment.

B.3 FLOATING STRUCTURES

A floating pier structure generally consists of a pontoon, an anchoring system and an accessway connecting the pontoon to the shoreline. The pontoon portion is normally box-shaped and if small craft no larger than the study's Peterheads are to be accommodated, can be fabricated using treated timber decking with closed ended hollow steel tubing flotation units as could the required accessway units.

To accommodate the loads associated with the NTCL barge operations, the pontoons and accessway would have to be much more substantial and would consequently be constructed as a ship's hull with longitudinal and transverse bulkheads.

Floating pontoons are usually kept in position by anchor chains or a vertical guide piling. With the anchor chain securing method it will be necessary to place the anchors a reasonable distance from the pontoon so that its associated pull possesses a reasonable horizontal component. This distance would also have to be sufficient to allow for the vertical movement of the structure through the site's tidal range. If the unit is placed close enough to the shore, guide wires connected to shore based anchor blocks could be utilized. It is considered that the vertical piling method of anchoring would not be practical at the various study sites as the piling could be expected to be destroyed each winter by the severe ice and tidal conditions experienced.

These severe ice conditions will also necessitate the removal of any floating structures to the nearby beach area for winter storage. This necessity to remove and replace the structures every year will make the use of the substantial structures required for the NTCL operations impractical. Similarly the use of foam flotation units for the smaller craft facility is not recommended as the flotation units could be expected to be severely damaged during the skidding operations. Foam filled tire structures have been used elsewhere successfully but it is believed that the rough handling that can be expected here would subject them to possible damage.

The lighter structures associated with the Peterhead operations would have to be located within as sheltered a location as possible as they are not capable of withstanding significant wave action.

The most practical method of utilizing these lighter floating structures would probably be in combination with a slope protected pushout which extends into the shallow water area with the floating structures extending the protrusion into the deeper water areas.

The local work force could be used to assemble the various components of the structure during the winter months for early summer placement and in their seasonal removal and placement. These removal and placement operations could be performed by a locally available dozer or loader and the community's available small craft.

KEEWATIN PORT FACILITIES STUDY

APPENDIX C

NTCL ESTIMATES OF POSSIBLE BENEFITS
OF A RANKIN INLET WHARF

MAR 2 2 1989

northern transportation company limited

Suite 1000, First Edmonton Place,
10665 Jasper Avenue, Edmonton, Alberta, Canada T5J 3Z2
Telephone (403) 423-9201 Telex 037-2480

March 17, 1989

IBI Group
5th Floor, 240 Richmond Street West
TORONTO , ONTARIO
M5V 1W1

ATTENTION: L.S. Sims, Director

Dear Sirs:

SUBJECT: Keewatin Port Facility Study

Thank you for your letter of January 13, 1989 together with the two interim reports.

We have now had an opportunity to identify and quantify the benefits and other contingent factors related to the construction of a suitable wharf at Rankin Inlet. We are pleased to submit the following information with estimates based on 1988 cost and revenue levels.

The following benefits have been identified:

1. If a wharf was available at Rankin Inlet capable of accommodating two barges, the saving in tug costs and cargo personnel costs is $87,500 per year. Please note that the estimate provided in our letter of December 23, 1988 is incorrect.

2. The saving in cargo claims is estimated at $3,000 per year.

3. The construction of a wharf would allow the present marine transport system to increase its capacity by at least 4,000 tons with only small additional cost. The resulting increased productivity would produce an economic benefit of $310,000 per year.

4. The presence of a wharf facility would allow barges to be left in Rankin Inlet and create an opportunity for local employment. If there is no wharf and the tug has to remain

with the barges, then it is more economical to use the tug crew for cargo operations.

The following contingent factors should also be taken into consideration:

a) The marine transportation system for the six Keewatin communities consists of one tug and four barges operating in a vast area with no other significant vessels in the area capable of rendering assistance in case of accident. Coast Guard vessels do not come to this region and do not operate in the area except for an occasional voyage. The N.T.C.L. marine transportation system must be able to provide its own primary salvage capability.

   If there is any disablement of either the tug or a barge, there are no replacement vessels in the north and replacements would have to be secured from Atlantic Canada, the St. Lawrence, or the Great Lakes which would entail considerable lead time. Tugs with a combination of suitable shallow draft, horsepower level, and voyage class are practically non existent in southern Canada.

   There is no safety net for this marine transportation system and the proposed wharf would provide a basic salvage, repair, and cargo protection facility.

   If a tug or barge were disabled in early September, there would be insufficient time to obtain a replacement vessel or organize an alternative marine delivery system before the end of the open water season. If a barge was rendered unable to perform in early September, there would be a need to deliver by air up to 3,000 tons of cargo at a cost of approximately $4,000,000.

   If the tug was incapacitated in early September, there could be the expectation of flying up to 12,000 tons of materials consisting of dry cargo and fuels at a cost of up to $11,666,000.

b) If a barge was lost, the insurance premium would increase by $249,000 per year. If the tug was lost, the insurance premium would increase $350,000 per year.

c) If there was an oil spill in the Keewatin region as happened off Vancouver Island in January 1989, how efficiently could Coast Guard carry out the clean up without an accessible shore base to handle materials and equipment?

d) A wharf at Rankin Inlet would greatly increase the safety of the discharge operation for dry cargo. The operation of heavy equipment on steep ramps leaves much to be desired. With the high tonnage now transported to Rankin Inlet, the operating hours using primitive facilities greatly increases the risk.

e) The possibility of serious accident exists and the effects of an accident would be compounded by the lack of equipment and facilities in the Keewatin region to render assistance. It is noted that official investigations, judicial enquiries and inquests into marine and air disasters often attach responsibility to the Government for not having provided adequate facilities, systems, and standards. The construction of suitable wharf facilities at Rankin Inlet could only be interpreted as a positive move.

Please advise if further information is required with respect to the foregoing. We have some comments with respect to the interim reports and propose to discuss these with you by telephone.

Yours truly

Paul A. Preville

Paul A. Preville
Vice President Operations

PAP:dbf
1L0316P
cc H.G. Amos
J.G. Anderson
D.J. Burnett
R. Gelinas
G.W. Hill
A.I. Woldmo