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VEY OF CURRENT FACTORS INFLUENCING

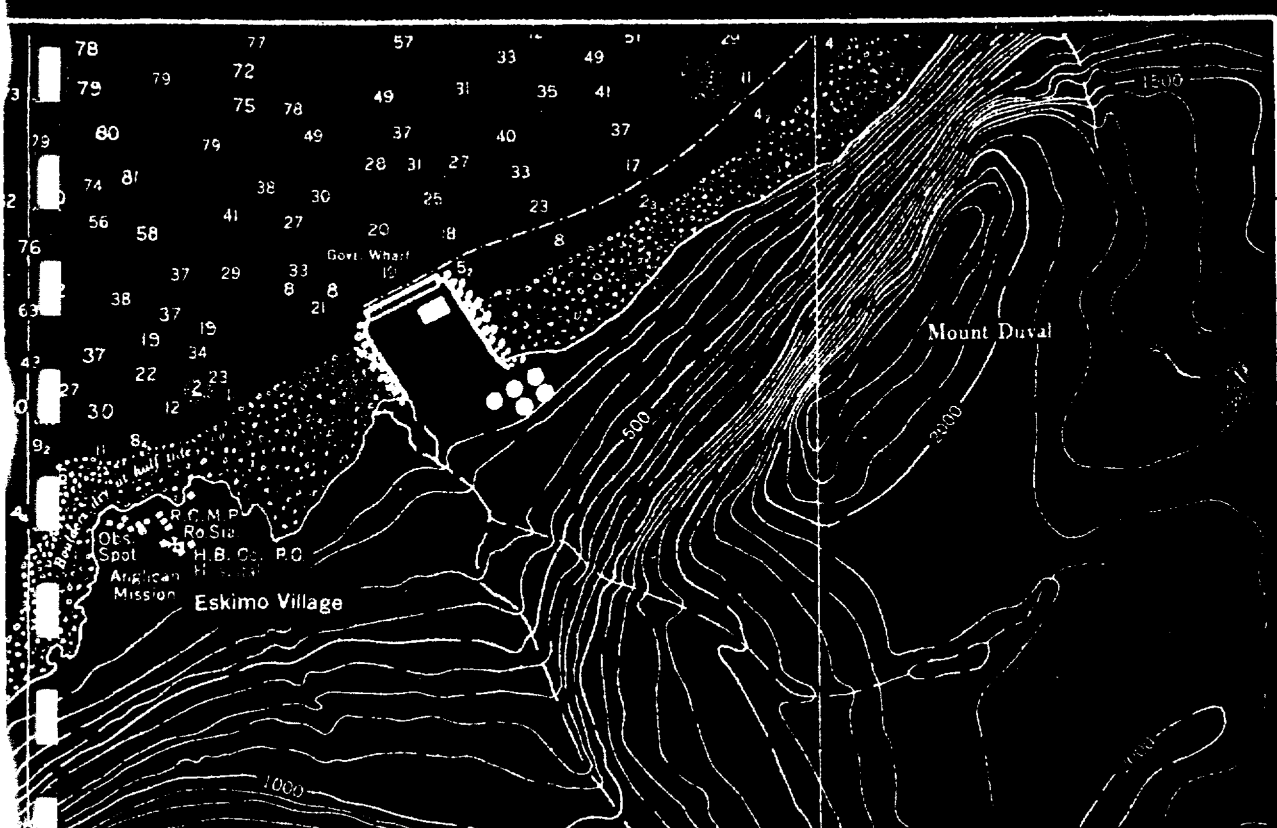
ARBOUR AND PORT DEVELOPMENT

IN THE

ANADIAN NORTH

by

D.E. McLAREN



HARBOURS AND PORTS

DIAN MARINE TRANSPORTATION ADMINISTRATION

Transport Canada   Transports Canada

Your file   Votre référence

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January 24, 1975

F.J. Joyce,
Director of Northern Natural
  Resources and Environment Branch,
Department of Indian and
  Northern Affairs.

Dear Mr. Joyce:

Attached is one copy of a report entitled a Survey of Current Factors influencing Harbour and Port Development in the Canadian North. This report was prepared for us by D.E. Mc Laren and was completed in late 1974.

This report was intended primarily to give us an appreciation for what is happening in the Canadian North and how this might relate to potential harbour development, and to provide a compendium of basic data which would unable us to give a quick initial overview on any proposed new port development in the Arctic. The report also makes some suggestions on possible policies which we should consider in evaluating Arctic Port Development Proposals.

Although you are of course very much in the know on current Arctic developments, you might nevertheless find this report of some interest. Should you have any comments at any time on its contents, I would be pleased to hear from you.

J.H.W. Cavey,
Chief,
Harbours and Ports.

Enclosure

Inglis

A SURVEY OF CURRENT FACTORS INFLUENCING HARBOUR AND PORT DEVELOPMENT IN THE CANADIAN NORTH

Prepared for Harbours and Ports,

Canadian Marine Transportation Administration

Ministry of Transport

Ottawa

by

D.E. McLaren

1974

I would like to acknowledge the aid of the following persons whose contribution of knowledge and experience during the research for this report was valuable and appreciated: Capt. J.E.R. Seck, MOT, Harbours and Ports; D. von Richthofen, MOT, Harbours and Ports; Mr. D.E. Evans, MOT, Arctic Transportation Agency; Ms. C. Stephenson, MOT, Marine Finance; Mr. E.L. Kelly, Capt. H.R. Oldford, Capt. J.C. Smith, and K. Hamilton, Canadian Coast Guard; and Mr. H. Mokhtar, DINA, Northern Policy and Program Planning Branch.

DE McLaren

D.E. McLaren.

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SECTION I INTRODUCTION

The purpose of this report is to bring together diverse information on current factors influencing harbour and port development in the Canadian North. The terms "North" and "Arctic" will be used interchangeably and will refer to Canadian lands north of 60° latitude, with the specified addition of southern Hudson Bay and James Bay.

Until the late 1960's, activity along the Northwest Territories mainland coast and Arctic Islands related to settlements of indigenous population, government administration and military installations for the purpose of air defence. Most mineral exploration and production took place on the interior mainland of the Northwest Territories, around Great Slave and Great Bear Lakes and in the Yukon. Demand for cargoes carried by sea into the eastern Arctic and by the Mackenzie River into the western Arctic was, therefore, fairly stable and predictable.

Since the late 1960's, five major developments have evolved or are evolving which have strong implications for harbour and port developments in both the eastern and western Arctic.

Firstly, oil was discovered at Prudhoe Bay on the north coast of Alaska, a short distance from the Alaska - Yukon border in mid-1968. The geology of the area encouraged exploration on the Canadian side of the western mainland coast, principally in the Mackenzie Delta area. Later, exploration in the Arctic Islands resulted in several successful gas wells and some oil discoveries. These discoveries have resulted in a demand for marine terminal facilities for inward supply cargo during the exploration period, as evidenced by the pattern of resupply of exploration in the Mackenzie Delta. A large proportion of exploration supplies are carried down the Mackenzie River from Hay River to Tuktoyaktuk, on the Delta, and this cargo movement is reflected in the growth of facilities at these two ports. Demand for marine terminal facilities, once the production stage is reached, will be determined by the mode of shipment of the oil and gas to southern markets.

Secondly, it appears likely that several large, high-grade mineral deposits in the eastern Arctic may reach the production stage in the near future, due to price and availability factors on the world's mineral markets. These developments have even more definite marine terminal development implications than oil and gas activities, since the mode of transportation of Arctic minerals to market appears to be marine. This is due first of all to the characteristics of the resources, and secondly, to the less severe ice conditions in the eastern Arctic where most of the major known mineral discoveries are located.

Thirdly, the Arctic Waters Pollution Prevention Act (AWPPA) has an overall impact on navigation patterns and types of vessels used to carry cargo in the North, and thus on the development of Arctic marine terminal facilities.

Fourthly, the James Bay dam project on the eastern shores of James Bay, (although fraught with many legal and labour difficulties), if carried to completion, could generate new shipping patterns from Eastern Canada into James Bay and movements within James Bay, (such as from Moosonee).

Lastly, on a smaller scale, but nevertheless important in terms of future patterns of cargo movement, are the locations of the Government of the Northwest Territories regional administrative centers. The four centers are located at Frobisher Bay, Churchill, Fort Smith and Inuvik. From a marine cargo resupply standpoint, Frobisher Bay and Churchill are important to the eastern Arctic resupply pattern and Inuvik to the western Arctic (Mackenzie Basin) resupply patterns.

Since January 1, 1973, cargo movements north of 60° in eastern Canada and north of the Arctic Circle in western Canada, have been determined by navigation seasons specified in the AWPPA. By this Act, the Arctic area was subdivided into sixteen zones, as determined by ice conditions in Arctic waters. These are called "Shipping Safety Control Zones", and generally speaking, the higher the zone number, the longer the allowable shipping season, from Zone 16 in the east to Zone 1 in the Queen Elizabeth Islands in the western Arctic. The length of the shipping season in each zone for various degrees of vessel ice-strengthening is detailed by the Regulations pursuant to the Act.

The impetus for the Arctic Waters Pollution Prevention Act was, as the name implies, a result of concern over pollution in Arctic waters and is designed to ensure that large cargo carrying vessels, such as oil tankers, have a sufficient degree of ice-strengthening for the route they will travel. Although the Act and Regulations were primarily concerned with preventing pollution of Arctic waters, they have affected the Arctic resupply by defining the standard of resupply vessel and the seasonal limits on cargo shipments to different zones in the North. As well, the Act and Regulations have vitally affected the development of large Arctic mineral deposits. The location of a given deposit with respect to the Shipping Safety Control Zones determines the allowable navigation season in which production can be transported out of the North to market, a factor crucial to the economics of production.

Implications of the five factors discussed briefly on the preceding pages are made more complex due to the overlapping jurisdiction of the various government departments concerned. There are currently over thirty government departments and agencies with activities in Canada's Arctic. In addition, there are the exploration activities of private companies. The difficulties with evolving any policy on northern harbour and port development stem in large part from a lack of co-ordination of interdepartmental objectives in the North. Since transport is an intermediate good and as such reflects objectives, it is particularly important that provision of marine infrastructure be provided on a co-ordinated basis with objectives in mind, due to the high costs associated with Arctic construction and the great distances involved.

SECTION II SUMMARY AND CONCLUSIONS

SECTION II SUMMARY AND CONCLUSIONS

A. SUMMARY

Until the late 1960's, marine cargo shipments to destinations north of 60° were fairly stable and predictable. Activity related to settlements of indigenous population, government administration and military installation. Most mineral exploration and production took place on the interior mainland of the Northwest Territories.

Since the late 1960's, oil and gas exploration, imminent mineral exploitation, construction of the James Bay Hydro Project, and development of population centers in the Northwest Territories have combined to create a necessity for Federal Government policy development on the provision of marine terminal infrastructure north of 60°.

Marine transport into the North has evolved differently in the eastern and western Arctic. Since 1958, the (then) Department of Transport has been responsible for the assembly, transportation and delivery of supplies for all government departments in the eastern and western Arctic. In the eastern Arctic, where no marine terminals existed, DOT provided the equipment, maintenance facilities and services by which cargo delivery was carried out from commercial supply vessels under charter to the Department.

In the Mackenzie River Basin of the western Arctic, marine cargo shipment began as a private venture, which later became a Crown Corporation responsible to the Department of Transport. The Northern Transportation Company Limited as well as some smaller carriers supply settlements, oil and exploration and mineral activities in the Mackenzie Basin, utilizing a barge/tug system.

Marine terminal facilities have not developed to any extent for resupply purposes in the eastern Arctic. The only large, permanent facility in the eastern Arctic is located at Churchill on the Hudson Bay. The wharf is administered by the National Harbours Board and has been used until the present primarily for outward grain shipments. Elsewhere in the eastern Arctic, there is a private gravel jetty at Resolute Bay, Cornwallis Island, a gravel and corrugated iron facility at Hall Beach, Melville Peninsula, used by the Canadian Coast Guard, floating wharves at Moosonee and Fort George on the James Bay, administered by MOT and James Bay Hydro Development respectively, and a permanent wharf of the steel pile cell type at Deception Bay in northern Quebec, owned by the Asbestos Corporation Limited. There is a facility at Frobisher Bay in a state of disrepair due to ice action.

In the western Arctic, MOT administers eighteen public wharves in the Mackenzie Basin area. The eighteen wharves are facilities of two construction types: permanent structures including timber crib, timber pile and steel sheet pile structures; and floating wharves. In addition, several non-MOT administered facilities exist along the Mackenzie, generally NTCL owned structures, concentrated at Hay River, Inuvik and Tuktoyaktuk. These latter facilities are generally of a more permanent nature and contain modern cargo handling equipment. Facilities for handling containers (8' x 8' cross section, 20' and 40' lengths) exist at Hay River and Inuvik.

The annual eastern Arctic resupply is characterized by the carriage of relatively small cargo lot sizes, delivered to a large number of destinations by shallow draft vessels. The draft of the nineteen vessels used in the 1973 MOT resupply ranged from 14 feet to a maximum of 24 feet. Shallow draft barges of maximum five feet draft are utilized on the Mackenzie River in the western Arctic.

Cargo quantities shipped in the western Arctic are approximately twice that of cargo shipped in the eastern Arctic. NTCL tonnage for 1972 was approximately 400,000 tons. NTCL carries about 80% of the total traffic on the River, so total Mackenzie Basin traffic in 1972 was about 500,000 tons.

In the eastern Arctic, MOT resupply tonnage has been decreasing from 122,235 tons in 1970 to 96,713 tons in 1972, whereas private resupply in the Eastern Arctic is estimated at 175,000, totalling 275,000 tons. Tonnage carried on the Mackenzie River to supply the western Arctic has been increasing steadily.

Marine cargo transport in both the eastern and western Arctic is of a predominantly one-way nature. Cargo is composed of general (dry) cargo and bulk petroleum products (POL). In both the eastern and western Arctic, POL accounts for approximately 60% to 70% of the total cargo tonnage carried. POL in both areas is projected to increase its share of total marine cargo carried in the future.

Demand for marine cargo arises from settlements, non-renewable resource exploration and military sources. In both the eastern and western Arctic, cargo carried for resource exploration is increasing relatively rapidly, settlement cargo is increasing but less rapidly, and military cargo remains relatively constant.

Price/ton of cargo delivered in the eastern Arctic resupply has been rising rapidly. A prominent example is the average 40% rise in freight rates between 1972 and 1973 of cargo destined for Frobisher Bay. General cargo is now delivered on a rate/ton basis to the high water mark, rather than by chartered vessels as was done formerly when MOT arranged stevedoring and marine insurance. Under the rate/ton system, direct costs to MOT have decreased, but delivered cost to consignee have continued to rise, and are reflected in the rate/ton charged.

Northern transport is characterized by a high degree of intermodal dependency, especially in the case of air/marine transport. Cargo brought in by vessel during the summer navigation season is transported by air to further destinations during the winter. A prominent example is cargo destined for oil and gas exploration purposes in the western Arctic Islands, which is shipped by sea to Resolute Bay and then flown on to the exploration site.

A joint announcement was made by the Ministers of Transport and Indian and Northern Affairs in March 1974, with respect to a new policy for provision of improved airport facilities in Arctic Canada. MOT will continue to operate and maintain the eleven major Arctic airports and under the new policy, the Ministry will have responsibility for the maintenance and construction of new or improved facilities at 50 other communities. Due to the air/marine relationship existing in the Arctic, policies for provision of air and marine terminal facilities are closely related.

Controls on construction of marine terminal facilities in the Arctic are shared between MOT and DINA. MOT administers the Navigable Waters Protection Act, under which approval must be granted on the basis of whether a structure would interfere substantially with navigation. DINA administers the leasing of site and waterlot required for the construction of marine terminal facilities.

Current development proposals for provision of marine terminal facilities exist for Frobisher Bay, Resolute Bay and two locations on James Bay.

Frobisher Bay is the administrative, medical and educational center of the eastern Arctic. Marine cargo tonnages to Frobisher have been rising steadily since the mid-1960's. Cargo has been brought in increasingly large cargo lots in a decreasing number of vessels. The proportion of POL carried in comparison to total cargo is increasing. The population of Frobisher Bay is steadily increasing, and will continue to do so due to the functions performed by the settlement.

Use of Frobisher Bay as a transshipment center has been suggested as a justification for Federal Government provision of new wharf facilities. A regular vessel service could be established between eastern Canada and Frobisher Bay to bring in cargoes, which would then be transported by smaller vessel, or barge, or aircraft during the ice season, to destinations nearby to Frobisher. Resupply tonnages to five nearby settlements in the Cumberland Sound, Hudson Strait and Foxe Basin may be used as an example of potential cargo magnitude. Waterborne tonnages amounted to about 8,000 tons in 1973, of which approximately 50% consisted of POL. There is very little mineral exploration activity being carried out nearby to Frobisher. With reference to the length of the navigation season, Frobisher is located in a Shipping Safety Control Zone (of the Arctic Waters Pollution Prevention Act) with a longer allowable navigation season than other nearby settlements.

Resolute Bay is the site of the only year-round airport in the high Arctic and serves as the major marine/air transshipment center for cargoes from eastern Canada destined for oil and gas exploration sites.

A proposal for the construction of a new marine terminal facility at Resolute is currently under consideration at DINA. Resolute Shipping Limited has requested permission to lease waterlot and land area in the northeast corner of Resolute Bay. There presently exists a gravel jetty built by Cardwell Supply Limited in the same corner of the Bay, constructed in 1972. The proposed Resolute Shipping jetty has been cleared under the Navigable Waters Protection Act by MOT as presenting no obstacle to navigation in the Bay, and the question of leasing is now being considered by DINA. The question of the construction of private terminal facilities in Resolute Bay is a complex one, due to the presently vital role which Resolute plays in resupply of the high Arctic, and the possible benefits which may be derived from a permanent public marine terminal facility. The recent decision of DINA and GNWT to establish a new town at the head of the Bay puts a stamp of permanence on Resolute Bay irrespective of its role as a transfer point for the oil and gas industry. This may strengthen the case for public versus private facilities.

For the past fifteen years, a debate has been ongoing over the relative merits of Resolute versus Radstock Bay as a principal Arctic transshipment center. It appears that although Resolute has certain disadvantages, notably a maximum draft of 35 feet due to bars at the entrance of the Bay, a restricted manoeuvring area for larger vessels and problems of pack ice drifting in under the influence of tidal currents and prevailing winds, it is performing its function as a transshipment center satisfactorily at present. If and when the exploitation stage of oil and gas resources is reached in the Arctic Islands, larger vessels will be used to transport bulk fuel and construction materials, for which Resolute may not be adequate as a transshipment center. However, for conventional general cargo supply and transshipment, the port is likely to be sufficiently suited for use for the foreseeable future.

Radstock Bay to the east is a very deep harbour and is generally mentioned as an alternate to Resolute. However, there are topographical problems at Radstock with respect to airport construction and air navigation which may make it unsuitable. In addition, the Bay is so deep that the smaller resupply vessels would be unable to anchor. Adjoining Erebus Bay could be used as a small vessel anchorage.

The problem of constructing marine facilities at a location in the high Arctic other than Resolute rests in the future at such time as resource exploitation in the Arctic Islands commences, possibly in a ten-year time frame. The immediate problem is to maintain a close degree of co-operation between DINA, MOT and GNWT to ensure that the best wharf sites are not taken up by private industry, inhibiting public cargo transport which will arise as a result of the new townsite construction and subsequent resupply at Resolute Bay.

Proposals for new permanent wharf structures at Fort George and Moosonee have been received by MOT. The structures would support cargo shipments to the James Bay Hydro project. Estimated tonnages are for some 1,500,000 tons between 1975 and 1984. The James Bay Development Corporation has requested the Ministry of Transport to provide a 650' wharf with 30' of water alongside to handle 30,000 ton tankers and other vessels at a cost of about $7 million. The proposal as presented to date has not been deemed acceptable from a safety of navigation point of view.

A study was done in 1960 by DPW to identify a suitable location for a permanent wharf structure at Ships Sand Island near Moosonee, where 15' of water exists close to shore. Cargo transport from Moosonee to Fort George in support of the Hydro project in 1973 was about 10,000 tons, and was shipped over a floating wharf in Moosonee and received over another, very small floating wharf at Fort George.

Marine resupply of Arctic Island and coastal locations has been carried out by MOT since the 1950's. The situation for outward movements of cargo from the Arctic is entirely different. Commercial resource exploitation along the Arctic coast above the Arctic Circle or in the Arctic Islands has not yet occurred.

The cost of transporting resources out of the Arctic is a main factor determining the rate and nature of future resource exploitation. The influence of transport cost on resource exploitation is due in part to the nature of the resource (transport cost is relatively large in relation to commodity value), and to Arctic climatic factors which cause construction, operation and maintenance problems resulting in large capital and operating costs for vessels, transport way and terminal facilities. Large capital costs are exemplified by the need for special Arctic pipeline technology, ice-strengthened and ice-breaking vessels and wharf structures capable of resisting ice forces.

Arctic resource exploitation creates a need for both facilities for outward commodity transport and increased inward transport of construction, operation and maintenance supply and resupply. Generally speaking, major oil and gas discoveries have been in the western Arctic, and metallic mineral discoveries in the eastern Arctic. Hydrocarbon discoveries in the western Arctic

Islands are located in ice conditions of extreme severity. Metallic mineral discoveries in the eastern Arctic are located in areas of relatively less severe ice conditions.

The Arctic Waters Pollution Prevention Act (AWPPA) and pursuant Regulations define allowable navigation seasons for varying standards of vessel construction, depending on ice conditions. Areas north of 60° have been divided into Shipping Safety Control Zones on the basis of ice conditions, and generally as the zonal number decreases from east to west, ice severity increases. The AWPPA has had a major influence on standards of vessel construction and patterns of cargo transport of resupply movements to locations north of 60°. This influence is even more marked with respect to determining the economic feasibility of bulk resource transport out of the Arctic.

Estimates of Arctic oil and gas potential have been differing and controversial. Approximately one-third of the oil and gas potential for all Canada is estimated to be found north of 60°, whereas the proportion of proven oil and gas reserves north of 60° is less than three percent.

Exploration drilling has been carried on with increasing intensity in the Arctic since 1960, when the Federal Government first allowed commercial resource exploration to take place. Gas has been found in commercial quantities on the Mackenzie Delta. It is estimated about one-third of the required threshold volume of gas has been formed in the Arctic Islands. Potential pipeline construction from wells in the Islands is at least ten years in the future, depending on discovery rates and advances in pipeline technology.

Oil has not yet been found in commercial quantities on the Delta or in the Arctic Islands. Current industry thinking is that oil may have accumulated in the shallow waters of the Beaufort Sea, offshore from the Mackenzie Delta. Imperial Oil and others constructed artificial islands up to 12 miles offshore, consisting of bottom sediments dredged from the Beaufort Sea. Further artificial islands are planned and accelerated drilling programs are planned; however, in March 1974, the Minister of Indian and Northern Affairs announced there would be no more offshore drilling allowed in the Beaufort Sea until 1976. This period of time allows for a two-year, $5.5 million joint DINA/Arctic Petroleum Operators Association environmental study.

Areas of potential future oil and gas discoveries are in sedimentary basins of the western Arctic mainland, the western and central Arctic Islands, and in areas offshore of Baffin Island and Hudson Bay.

Areas of mineral exploration north of 60° are centered around Great Slave and Great Bear Lakes, the central Yukon, western Hudson Bay, northern Baffin Island, Cornwallis and Little Cornwallis Islands. Major known Arctic mineral ore deposits are located on Melville Peninsula, northern Baffin Island and Little Cornwallis Island. Several areas of potential future mineral deposits (based on current mineral showings and geological structure) occur in areas of the eastern Arctic where surface vessel transport of bulk resources to market may be technically and economically feasible.

In late 1973 and early 1974, the Federal Government received the first formal proposals for resource production and transport to market for locations north of the Arctic Circle. Decisions on Government financial participation in these projects will imply policy decisions as to the manner in which non-renewable resources in the Arctic Islands are to be exploited.

Mineral Resources International (MRI) has applied for financial aid to exploit a lead-zinc deposit at Strathcona Sound on north-western Baffin Island, and Canadian Arctic Gas Pipeline Limited have submitted an application to build the Mackenzie Valley gas pipeline from the Mackenzie Delta area to the Canada/US border. The MRI request for financial aid involves provision of a cell type marine terminal facility at a cost of $3.8 million for outward shipment of ore concentrates, as well as provision of other infrastructure such as schools and roads.

Construction of a gas pipeline along the Mackenzie Valley, with potential cargo tonnages of 2 million tons of pipe and 400,000 of bulk oil, will create a strong pressure on marine terminal facilities on the Mackenzie River.

Several research projects and programs affect the rate and pattern of resource exploration and exploitation north of 60° such as industry research activities by the Arctic Petroleum Operators Association and Federal Government programs. DINA administer several programs designed to stimulate the exploration for non-renewable resources in the Canadian Arctic, such as the Northern Roads Program, the Northern Resource Airports Program and the Remote Airports Program.

Research on Arctic tanker transport and associated marine terminals was initiated in 1969 and 1970 by the voyages of the S.S. Manhattan. A study on the feasibility of a marine tanker terminal in the Prudhoe Bay area was completed by the Department of Public Works in 1971. A marine terminal structure consisting of two breasting dolphins was proposed, at a cost of $80 million. However, subsequent decisions to move the Prudhoe Bay oil by a trans-Alaska pipeline and low oil discovery rates in the Arctic Islands have halted further specific studies on Arctic oil tankers and oil tanker terminals. Some intergovernmental research is being undertaken on possible

Arctic harbour sites for tanker terminals located at termination points of an inter-island pipeline system in the eastern Arctic.

Feasibility studies have been or are being conducted on development of three large mineral deposits north of the Arctic Circle. These are: a lead-zinc deposit at Strathcona Sound, a lead-zinc deposit on Little Cornwallis Island and an iron deposit at Mary River near Milne Inlet on northern Baffin Island. The Strathcona Sound deposit is the nearest to the production stage. The Little Cornwallis deposit, although larger than the deposit at Strathcona Sound, is located in a more severe ice zone. The Mary River iron deposit is the least likely to be developed in the near future, due to world market conditions and the large size, low value characteristics of the deposit, probably necessitating year-round icebreaking surface vessel shipments. Designs for a commercial icebreaking vessel capable of year-round movement in the Arctic have yet to be fully developed. Conditions would require a vessel of a higher ice rating than any existing Canadian icebreaker.

Two major studies have been done during the past three years on feasibility and modes of transporting resources from the Arctic to market. The first of the two was done in 1969 by Warnock Hersey International Limited for DINA. The voyages of the Manhattan and the passage of the Arctic Waters Pollution Prevention Act have dated much of the information in the report. Very rough estimates were given on construction costs of marine terminals although no specific sites were considered. Proposed marine terminal facilities consisted of single and multiple buoy systems at a cost of $2 million to $16 million.

Northern Associates (Holdings) Limited completed a study for the Ministry of Transport in 1973 entitled "Arctic Resources by Sea". The study deals with the comparative feasibility and economics of transport by surface, sub-surface and submarine vessels of export cargoes of bulk oil, gas and minerals from the Arctic to market.

The study indicates three operating zones in Arctic waters where surface, semi-surface and submarine vessels have a relative advantage as determined by ice conditions. Transport costs per ton are compared by vessel type for the three vessel types for carriage of oil, liquid natural gas and metallic minerals. The study concludes that year-round Arctic shipping routes for surface vessels may not extend much beyond the range of present summer season activities, and that the main Arctic sea traffic lanes in the near future will be eastbound for both surface and submarine vessels. Questions of variation in marine transport costs with length of season and transshipment of Arctic bulk cargoes are discussed.

Thirty-six potential Arctic harbour locations are indicated in the report, on the basis of water depth only. Sites were derived from current Arctic charts, and detailed site criteria such as accessibility, exposure, ice conditions and topography were not used.

The use of 250,000 dwt surface vessels, semi-submersibles and submarines was assumed, with assigned drafts of 90, 90 and 145 feet respectively. Two categories of harbours were chosen, those with a minimum depth of 240 feet of water, and those with a minimum of 120 feet of water. Twenty-six sites were chosen in the first category and ten in the second. It was estimated that about six years would be required for the construction of an Arctic terminal; one to two years for exploration, collection of data and site selection, and three to four years for design and construction.

With respect to type of terminal facility suitable for Arctic conditions, it was emphasized that single-point moorings are vulnerable to severe wind and ice conditions, and if more than occasional traffic is envisaged, a conventional wharf would be required.

A great deal of public attention has been concentrated on the influence of the availability of icebreaker services on resource exploration and transport of bulk cargoes out of the Arctic. At present there is no policy which effectively controls the rate of development of Arctic resources consistent with the present or future capacity of Canadian icebreakers to escort shipping or provide an emergency service. Only seven of Canada's twenty-four icebreakers are capable of summer operations in the Arctic.

Arctic marine traffic to the present time has consisted of icebreaking and ice-strengthened vessels. Designs of icebreaking bulk cargo vessels, capable of operating without icebreaker support, are being developed. On an international basis, designs may be developed by the West German Government through a Canada-Germany Technological Exchange Agreement. Discussions between the two governments are ongoing.

The principal deterrant to Arctic resource exploitation and transport to market is lack of knowledge of climatic factors. In the early 1970's, the Federal Government initiated a program of accelerated basic data collection on bathymetry, ice conditions and climate.

Tidal data is available for a relatively limited number of harbour areas. Standard bathymetric surveys are concentrated in the Lancaster Sound, Barrow Sound and Mackenzie Bay areas, and at currently used harbour sites. Information on ice conditions has been collected for about 10 to 15 years in most Arctic areas; however, data is generally available only for the summer months due to low winter light levels. Beginning in 1974, information will become available from a meteorological satellite equipped with infra-red instruments. Research on ice pressure ridging, possibly the most important ice influence on marine navigation, is still in its infancy. Present programs, while still relatively small in scope, can be expected to be broadened in scope and further accelerated through a new program begun in 1974 under the Ministry of State for Science and Technology which is designed to place Canada in a position of scientific, technical and practical excellence in ice-covered waters by the 1980's.

The cost of marine insurance for vessel and cargo movements in Arctic waters reflects the severe Arctic climate, lack of climatic data and general absence of marine terminal facilities. Current insurance rates for resupply vessel movement are based on an advisory scale of additional premiums which in turn is based on the time a vessel spends in different areas of ice severity as outlined in the Arctic Waters Pollution Prevention Act. The exact rate is based on individual underwriter past damage statistics, and some mechanism for pooling these risk statistics among underwriters is needed.

Provision of permanent wharf facilities in the Arctic would probably have a greater impact on reduction of cargo insurance than on vessel insurance. The wharf facility would reduce cargo handling and the time cargo sits on a beach, whereas damages to ships from ice are encountered en route as well as at the destination.

Cost of marine insurance for bulk vessel movements in Arctic waters will be a principal factor on which the economic feasibility of year-round vessel transport of bulk resources out of the Arctic will depend.

Before World War II, resource exploitation and transport facility investment was left largely to private enterprise. Since then, Government expenditures in the North have been increasing. By the 1960's, the objective of northern economic growth was given highest priority, and subsidizing resource exploitation was seen as the chief means to accomplish this goal. However, fragmentation of decision-making within Federal agencies in the Arctic, who were basing their operations on different investment criteria and administrative regions, plus the encouragement of government subsidize industry participation has led to the rise of a strong role for the private developer. This has ultimately led to government decisions with respect to resource development in the north being made on an ad hoc basis in response to industry initiative and in some cases, pressure.

Interdepartmental government planning on northern development is primarily effected through the Advisory Committee on Northern Development (ACND), chaired by DINA, and the Task Force on Northern Development (TFNOD), chaired by DEMR. The ACND was established after World War II to co-ordinate matters relating to northern development at the Deputy Minister level, for advice to Cabinet. The TFNOD was established during the 1960's to co-ordinate northern hydrocarbon development in the Ministry of Transport.

The Arctic Transportation Agency was established in 1971, and was formed to co-ordinate northern transportation development. The Canadian Ports and Harbours Planning Committee (CPHPC) is an interdepartmental committee established by Cabinet in 1971 to advise the Minister of Transport with respect to port and harbour developments. Proposals for government financial participation in provision of marine transport facilities are brought before this Committee for all of Canada including locations north of 60°.

The core issue about which the various Federal Government transport roles of operation, regulation and development cluster in the North is the relationship between activities of the private (profit-oriented) transport and resource enterprise and Federal Government objectives. Since transport is an intermediate good, the provision of transport infrastructure reflects the priorities and objectives of Government planners.

Current DINA policies for the North give priority to social improvement of native peoples, followed by enhancement of the natural environment, stimulation of the development of renewable resources and stimulation of non-renewable resource development. Provision of marine terminal facilities is based on the extent of Government responsibility and the range of public interest -- single or multi-users and shippers.

Legislation pertinent to marine terminal structures, vessel movements and land management is administered primarily by MOT and DINA. The main bodies of legislation are the Navigable Waters Protection Act, the Canada Shipping Act and the Arctic Waters Pollution Prevention Act, all administered by MOT, and the Territorial Lands Act and the Northern Inland Waters Act administered by DINA.

Future policy problems on northern economic development and provision of transport infrastructure will be considered by a large number of decision-makers, within government departments and interdepartmentally, making communication and co-operation vital to development of northern policy.

B. CONCLUSIONS & RECOMMENDATIONS

Two major studies have been done on the technical and economic feasibility of marine bulk cargo transport of non-renewable resources out of the Arctic. Individual consultants reports have been done on the feasibility of developing specific oil and gas and mineral deposits in the western and eastern Arctic. Individual government studies and reports have been prepared on provision of marine terminal facilities for supply purposes at Frobisher Bay, Resolute Bay and locations in the Hudson Bay and Mackenzie Basin.

This report is a compendium of information gathered from past studies, presented with background information gathered from diverse sources. In presenting an overview of factors influencing harbour and port developments in the North, this study suggests certain essential factors that should be considered systematically when specific proposals for marine terminal facilities for supply of bulk commodity shipment are advanced.

Factors influencing provision of marine transport infrastructure vary between the western and eastern Arctic due to differing population concentration and non-renewable resource type. More than 50% of the population of the Canadian North is concentrated in the Mackenzie Basin area. It appears that the oil and gas resources in the Mackenzie Delta area will be transported to market via pipeline, rather than by marine transport. Marine way and terminal facilities required for construction and maintenance of a pipeline system will also be used for settlement resupply purposes, since resource developments and population concentration occur in the same geographic area. Thus there is a multi-user nature to the provision and use of marine terminal structures in the Mackenzie Basin area.

In the eastern Arctic, population centers are not concentrated, with the exception of Government of the Northwest Territories Administration Centers. The non-renewable resources found in the eastern Arctic are large metallic mineral deposits whose mode of transport out of the Arctic will be marine, and which generally are not located near centers of population. The delimitation between marine terminal facilities used for settlement resupply purposes and private industry purposes is therefore clearer.

Currently, public marine terminal facilities in the North are provided on a user pay-back basis as they are for facilities south of 60°. Under this criterion the provision of facilities in the western Arctic can more easily be justified due to the greater degree of population concentration. However, for the eastern Arctic, with a population pattern of isolated clusters, this policy, combined with the MOT annual eastern Arctic resupply policy of arranging cargo delivery on a rate/ton basis, results in decreased costs to MOT and a rising price of delivered cargo to the consignee. It may be therefore that this policy should be reviewed to ensure that it is not working to the disadvantage of the area and as a deterrent to its growth.

If a proposal for an Arctic marine terminal facility for supply purposes is being considered in the eastern Arctic, given a population concentration of sufficient size and income to constitute effective demand for cargo, several factors suggested by information in this study should be considered, such as:

> Origin (government or private) and magnitude of cargo demand. Whether the cargo demand originates from private or public sources may determine the predictability of cargo tonnages, as for example, the demand posed by a government administrative center versus a natural resource exploration demand.
>
> The probable cargo composition. Is it cargo that could be shipped more cheaply by air.
>
> Suitability of the proposed site as a transshipment point, either marine/air or from large vessel to smaller "feeder" vessels. Location of a proposed marine terminal site in an ice zone which is markedly less severe to the one adjacent to it may tend to lead to a marine/air transshipment situation, as in Resolute Bay.

Federal Government financial participation in part or all of the costs of providing a marine terminal facility to facilitate export movement of Arctic bulk cargoes implies some policy decision on the rate of northern resource development. Since marine facilities built for the shipment of bulk commodities from the resource extraction site to market are generally single user facilities, there would not appear to be justification for Ministry of Transport involvement in such projects. Such a facility would not be a multi-user facility and thus not normally eligible for public wharf status. It is at this point that the factor of using transport facilities to advance the objectives of other Federal Government departments enters, in this case those of DINA.

The proposed development at Strathcona Sound can be used as an example, since it is the first formal proposal the Federal Government has received from industry for the development of a major mineral resource in the Arctic. The problems presented by this project will occur each time a new development proposal is put forth by industry, due to the huge area of the North and the scattered population pattern.

The stated objectives of DINA in the North place developing the quality of life for northern peoples in a first priority position and development of the resources of the North in a secondary position. This is exemplified by the insistence of DINA that any resource deposit put into production have an operating life of at least fifteen years.

The optimum extraction rate, as determined by the company developing the project is in the neighbourhood of eight years. The marine facility advised by the consultants is a steel sheet pile cell wharf, the design of which is not particularly suitable forlarge quantity of shipment of inbound supply cargoes but should be adequate to meet the demands of the mine and the new community itself. The consultants retained by the company to study feasibility of project development suggest as a justification of MOT funding of the wharf, that it could be used as a distribution point for cargoes destined for points in the general area. However, population centers in the eastern Arctic are located in points further south than northern Baffin Island and there is probably no advantage to be gained by shipping supply cargoes north to Strathcona Sound from ports in the southeast area of Canada, and then transshipping them in a southerly direction again. This also illustrates the problem that the major known mineral deposits in the eastern Arctic north of the Arctic Circle are located remote from existing centers of population and that marine facilities provided in conjunction with these mineral developments are therefore not likely to be of value as transshipment terminals.

This is a case where, if MOT funded a concentrate loading wharf under a user pay-back scheme, technically MOT would still own the wharf. When the mineral resource is exhausted and the company leaves, MOT will own a public wharf at a location which may not provide a significant means of reducing the costs of supply cargo shipped to northern Canada and yet cost substantial amounts to maintain.

There is the point of view that the new town planned to be part of the Strathcona Sound project plus the nearby community of Arctic Bay will have gained enough "momentum" to exist on their own after fifteen years of mine production, and thus serve as a nucleus for a permanent population center and a permanent wharf would then be justified. However, the construction of a new town versus bringing in commuters to work in the mine from other nearby communities has been a point of contention from the start.

Obviously, the total capital cost of the project would go down considerably if there were no requirement for the construction of a "new town". There does not appear to be a DINA policy of encouraging the concentration of indigenous populations in the North and as such a "growth pole" concept of development at one site creating a center of growth for that area is not applicable.

The criteria for determining whether or not a mineral or petroleum deposit in the north should be developed and the time frame for such development rests completely with DINA who control all resource development north of 60°. The Department of Energy, Mines and Resources act in an advisory capacity only.

There are nevertheless problems in formulation of policies of resource extraction, and these are most acute for metallic minerals as opposed to oil and gas. Both the Federal and Provincial Governments have conservation agencies which regulate the development of oil and gas fields, and north of 60°, the agency with prime responsibility is DINA. Oil and gas companies disclose fully to DINA the magnitude of discoveries, since DINA has the responsibility for deciding matters such as spacing of wells and allowable production rates.

On the other hand, there is no conservation agency for mineral resources north of 60°, nor is there any legislation requiring mineral firms to publish or make available to Government definite figures on their discoveries. This makes policy decisions difficult from a view point of determining Canada's total known deposits of a particular mineral resource, of future extraction requirements, or whether it may be in the country's interest to put a deposit into production and when.

While there are probably more controls on resource activities north of 60° than in any other area in Canada, despite certain shortcomings, more effective application of these controls appears to be hampered because the implications of resource development are so complex and affect so many government departments that most effort is expended in co-ordination of what is going on, leaving little time for co-ordinated formulation of actual policy.

North of 60°, policy formulation clearly rests primarily with DINA. However, participation by other government departments in northern development, including provision of marine terminal facilities by MOT, could be effected in such a way as to reflect that department's policy goals, as well as those of related departments. For example, a marine terminal facility in the North could be provided on the condition that only Canadian vessels could be used to transport resource production, or that the ore would have to be refined in Canada.

Several specific recommendations could be made with reference to provision of Arctic marine transport infrastructure, based on information contained in this report.

Northern harbour and port development is and will be in the future an integral part of harbour and port development in the south of Canada. It is proposed that Harbours and Ports, MOT take the initiative to define and clarify this interrelationship with respect to other agencies involved in the northern development.

Formal acknowledgement of this principle could be effectively accomplished by transferring from DINA to MOT, Harbours and Ports, the administrative responsibility for property management of harbour areas where notable commercial activity or settlement population cargo requirements are present or are likely to occur. Such a transfer was proposed in 1972 to the Advisory Committee on Northern Development. Although there was no outright opposition to the concept, the proposal did not result in the transfer of leasing powers. It is suggested that this transfer be proposed again.

In addition, certain harbours should be proclaimed as Public Harbours, under the Canada Shipping Act, in order to define their limits for development and control purposes while also providing a uniform set of operating regulations. Suggested here are Resolute Bay and Hay River; Resolute Bay because of its function as a sea/air transshipment center, two commercial applications to lease waterfront land and waterlots and the proposed construction of a new town of Resolute; and Hay River because of a combined function of staging point for resource exploitation supplies and settlement resupply. Currently, Frobisher Bay is the only Public Harbour north of 60°.

It is proposed that a formal liaison be established between Harbours and Ports, MOT, and DINA and DEMR through the Canadian Ports and Harbours Planning Committee (CPHPC). A representative from each of DINA and DEMR could be nominated who would, as a matter of course, sit in on any meetings concerned with provision of northern marine terminal facilities. This would be in recognition of the fact that although terminal facilities are generally provided on a user cost recovery principle, their provision indicates an implicit policy reflecting in some cases other Department's objectives. Provision of transport facilities make possible the facilitation of other department's policies in Northern Canada, most notably DINA's. DINA have the responsibility for an often contradictory set of objectives including betterment of the native peoples, protection of the environment, and resource development. Formal liaison between the CPHPC and regular members from DINA and DEMR would permit sufficient time for preparation of input into the CPHPC by these members on questions of northern marine facilities. Although DEMR act only in an advisory capacity for developments north of 60°, the Department is concerned with policy on overall Canadian resource development and as such can give an overview to implications of individual projects. Due to the intermodal nature of northern transportation, most notably the close relationship between marine and air transport, an established member of the MOT Arctic Transportation Agency, should also attend CPHPC meetings on projects involving northern marine terminal facilities.

It is proposed that a marine terminal facility be constructed at Frobisher Bay, in recognition of its role as administrative, educational and medical center of the eastern Arctic. Specific attention should be paid to the marine/air relationship at Frobisher in order to determine required capacity of a new terminal and storage facility.

It is suggested that a request may be expected for a wharf facility at Resolute in support of the construction and continuing resupply of the planned new townsite to be built at the head of the Bay. Existing gravel jetties may not be adequate for this purpose.

A situation often arises in the North in which a marine terminal facility is required for a short term, either to support a construction project or non-renewable resource exploration. Either cargo flows will end at the end of a finite time span or will be significantly lower than at a short peak period. In such cases (which are in a majority at present due to population distribution in many areas of the Arctic), a temporary floating facility could be considered. Use of a floating wharf in such a case would be practical in areas of low tides, possibly up to about a 10 foot range. Industry use of such facilities is fairly common, such as the example at Rae Point on Melville Island.

SUMMARY OF RECOMMENDATIONS

1. That the administrative responsibility for property management of harbour areas where notable commercial activity or settlement population cargo requirements are present or are likely to occur be transferred from the Department of Indian and Northern Affairs to the Ministry of Transport.

2. That Resolute Bay and Hay River be declared Public Harbours under the Canada Shipping Act, in addition to Frobisher Bay which is presently the only Public Harbour north of 60°.

3. That a representative from each of the Department of Indian and Northern Affairs, the Department of Energy, Mines and Resources, and from the Arctic Transportation Agency in the Ministry of Transport, be nominated to attend meetings of the Canadian Ports and Harbours Planning Committee dealing with projects involving northern marine terminal facilities.

4. That a marine terminal facility be constructed at Frobisher Bay, in recognition of its role as the administrative, educational and medical centre of the eastern Arctic.

SECTION III CARGO TRANSPORT INTO THE NORTH

SECTION III CARGO TRANSPORT INTO THE NORTH

A. EVOLUTION OF MARINE ACTIVITY

Prior to World War II, Federal Government activity north of 60° consisted principally of administration, policing and some survey work, for which very small quantities of resupply cargo were needed. The only port activity began when the railway reached Churchill in 1929 and the Port of Churchill opened in 1931 to be used as an export port for western grain shipments.

Significant marine cargo movements into the Arctic were initiated after World War II, when Canada and the United States signed the Joint Arctic Weather Station Agreement by which five weather stations were established in the high Arctic.* The stations were jointly operated and manned by Canada and the U.S., but were supplied by the U.S. In 1953 Canada assumed responsibility for the resupply of the stations under an agreement with the United States Air Force.

The next significant development occurred in 1955 when the Distant Early Warning Line Agreement was signed between Canada and the United States, establishing a line of aircraft detection stations across northern Canada. In 1958 Canada assumed responsibility for the resupply operation. At the same time, under an Order-in-Council, the (then) Department of Transport was assigned the task of co-ordinating "the assembly, transportation and delivery of supplies for all government departments in the eastern and western Arctic".

The Ministry of Transport became involved not only in the co-ordination of the resupply, but in the operation as well. No port facilities existed in the Arctic, and so no facilities existed for the reception and handling of cargo which had to be landed on the beaches utilizing military equipment and techniques. No existing Canadian stevedoring companies were equipped for such operations, nor could they justify large capital investment for such a specialized operation for such a short season. The Ministry had to provide most of the equipment and services required, such as landing craft, barges, maintenance facilities, operating crews and administrative services. Commercial vessels were available for most of the required cargo shipments and government ships were used only for work that commercial vessels were unable to do, or when relatively small cargo parcels could

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* The weather stations were located at Alert, Eureka, Isachsen, Mould Bay and Resolute Bay.

be carried incidental to an icebreaker's operations.*

In the western Arctic a different system evolved, resulting in the bulk of the resupply in the western Arctic being carried by a Crown Corporation, the Northern Transportation Company Limited (NTCL), responsible to the Minister of Transport. The NTCL began in 1931 operated by a predecessor, Northern Waterways Limited, serving as a common carrier between Waterways, Alberta and Aklavik, Northwest Territories. The service was extended in 1933 into Great Bear Lake to serve the developing Eldorado Mine at Port Radium. The company changed hands in 1934 acquiring the name of the NTCL and in 1936 the NTCL was bought by Eldorado Gold Mines Limited, primarily to assure service to its mine. However, the fleet was maintained as a common carrier and was enlarged and modernized. NTCL became a Crown Corporation in 1944 when its parent company, Eldorado Mining and Refining Limited (now Eldorado Nuclear Limited), was expropriated by the Government. In 1946 all transportation on the Mackenzie system was brought under the regulation of the Board of Transport Commissioners.

In 1949, the RCAF requested the NTCL to operate a supply ship between Tuktoyaktuk and Cambridge Bay, extending company services onto the Arctic coast for the first time. Beginning in 1955, a tug and three barges were designed and built to deliver construction materials to six DEW Line installations on the Mackenzie Delta. In 1958, the NTCL began the resupply of twenty-five DEW Line sites along the Arctic coast, operating LST's and tankers supplied under a loan agreement between the U.S. and Canadian governments. A floating drydock was put in at Tuktoyaktuk, acting as a repair and maintenance facility.**

B. EXISTING MARINE TERMINAL FACILITIES IN THE NORTH

1. Ministry of Transport Public Wharves

Ministry of Transport public wharves north of 60° latitude consist of eighteen wharves in the Mackenzie River Basin area ***, a wharf at Cambridge Bay and a wharf (in a state of disrepair) at Frobisher Bay. These wharves were built by DPW, who have transferred administration of the wharves to the Ministry of Transport.

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* A.H.G. Storrs, "East Arctic Marine Resupply", Proceedings of the Arctic Transportation Conference, 1970 (Ottawa: Information Canada, 1971) p. 87 to 90.

** The Northern Transportation Company Limited, Annual Report, (1971).

*** See Appendix , "Ministry of Transport Public Wharves in the Mackenzie River Basin" for a detailed description of these wharf facilities.

The eighteen wharves in the Mackenzie are facilities of two construction types: permanent structures including timber crib & timber pile structures and floating wharves* with less than ten feet of water alongside. The facility at Cambridge Bay is a T-shaped pier** with a minimum depth alongside of about eight feet. The facility in disrepair at Frobisher Bay consists of a gravel berm with minimum ten feet alongside, constructed by the Department of Public Works in 1955. Rafting of ice has eroded the top of the gravel approach beyond repair.

2. Other Marine Terminal Facilities

Appendix I contains a description of terminal facilities on the Mackenzie in addition to MOT administered wharves. These non-MOT administered facilities are concentrated at Hay River, Inuvik and Tuktoyaktuk and are for the most part NTCL facilities.

In the central and eastern Arctic an assortment of terminal facilities are located at Churchill, Resolute Bay, Hall Beach, Moosonee and Fort George in Hudson Bay, and Deception Bay in northern Quebec.

a. The National Harbours Board wharf at Churchill is the only large terminal in the eastern Arctic. Facilities consist of a marginal structure with a total berthing length of 3,073 feet, with minimum depths alongside as follows:

- three berths with 31 feet
- one berth with 32 feet
- one berth with 24 feet
- one berth with 20 feet

(Three grain loading berths, two general cargo berths and one coastal berth).

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* Construction Types: Permanent Wharves - generally of bulkhead type construction, consisting of a vertical wall retaining a fill of sand or gravel. Timber piles driven side by side have been used for many wharf bulkheads. Some of the newer facilities have been constructed using interlocking steel sheet piles.
Timber Cribs - consist of boxes formed by horizontally laid timbers or logs and filled with rock or gravel.
Floating Wharves - consist of modular steel pontoons about 17' long by 8' wide each with a timber decking and a rated load carrying capacity of ten tons. Several units are connected to form a wharf head and additional units are connected to form an access float to shore. The wharf is anchored in position and is moved to maintain water depth as river levels change during the season. The wharves are removed from the river at the end of the season and replaced after Spring breakup.

** Structure consists of a steel sheet pile pierhead, 84' long by 29' wide, a wooden pile bent 21' x 24', and a rock-filled, gravel surfaced approach 184' x 24'. (Source: DPW Transfer Plan, 1962).

b. A private facility, consisting of a gravel and rock filled causeway, was constructed in the northeast corner of Resolute Bay by Cardwell Supply Company Limited in 1972.

c. A permanent structure consisting of corrugated culvert pipe filled with gravel, measuring 350 feet by 60 feet with about 3 feet of water alongside, was constructed in the early 1950's at Hall Beach by the C.C.G.S. and is used for Arctic resupply.

d. A floating wharf 114 feet long by 16 feet wide with 8 feet alongside,constructed in 1968,is located at Moosonee, Ontario.

e. A small wharf is located at Fort George Quebec, about six miles up from the mouth of the Fort George River on the Hudson Bay. The wharf has about 7 feet of water alongside.

f. A permanent structure was built in 1972 by the Asbestos Corporation Limited on the southwest shore of Deception Bay. (Lat. 62°08'46"N., Long. 74°41'34"W.). The structure is "Y"-shaped and composed of three steel pile cells connected to shore by a causeway. Dredged depth alongside the main wharf face is 43 feet. The wharf faces in an easterly direction. There are two cells on the north arm of the "Y", one of which is used for small coastal vessels and the depth alongside is 25 feet.

C. THE DEMAND FOR SUPPLY CARGO

Demand for supply commodities north of 60° results from three principal sources: settlements, resource exploration and development, and military sites.

1. Settlement Population

There are four ways in which the relationship of population to cargo demand may be considered: population concentration, ie. the relationship of population to the land area; ethnic components of total population; relative size of population clusters; and regional distribution of population.

Total population estimates for the Northwest Territories is presently about 53,200 persons.* The total population is spread over about 98 clusters of which only eight have more than 1,000 people. If the population figure of 55,000 persons is used, then 55,000 persons living in an area of just over 1.5 million square miles gives a population density of 3.7 persons per 100 square miles. The effect of this relationship of population to land has been summarized as follows:

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* From a talk given by A. Digby Hunt, ADM, Northern Affairs, Department of Indian and Northern Affairs, at a Canadian National Energy Forum, Winnipeg, in Oilweek, February 25, 1974, p. 12.

"These vastly separated and relatively small clusters have a very low inter-linkage base, there is little scope between them for complementarity in economic production and they are severally and jointly isolated from the rest of Canada, where the population density is 924 persons per 100 square miles and where the major markets in the country are located."*

Total NWT population was equal to about 0.15% of Canada's total population in 1971 and the former has been growing at a rate consistently higher than for Canada as a whole (see Table III-1). Of this total population, the ethnic composition in 1971 was approximately 20% Indian, 30% Eskimo and 50% Other. (See Table III-2.) The relative share of the Indian and Eskimo population to "Other" has been steadily decreasing.

Relative size of population clusters in the NWT is summarized in Table III-3. There are eight centers of more than 1,000 persons of which only one center, Yellowknife, has more than 4,000 population. These eight centers comprise about 55% of the total population. If centers in the 500 to 1,000 population range are included, the percent of total population rises to nearly 80%. Individual population centers in the NWT have experienced differential rates of change in the period from 1961 to 1971 (see Table III-4), due principally to influences of resource development and establishment of administrative centers.

Map III-1 illustrates the Administrative Regions of the Government of the NWT and details location of Headquarters, Regional Administrative Centers and Incorporated Municipalities. Table III-5 lists the settlements in each Administrative Region.

Marine resupply of settlement in the western Regions is carried out by barges travelling northward along the Mackenzie River to the Delta and then eastward along the Arctic mainland coast as far as Spence Bay on the Boothia Peninsula and including some sites on the southern portions of Banks and Victoria Islands. Settlements in the eastern two Regions are supplied by water by the annual eastern Arctic resupply co-ordinated by MOT, leaving from eastern Canada and extending as far west as Resolute Bay on Cornwallis Island. (See Map III-2.)

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* M. Ifill, Regional Planning in Northern Canada, (Department of Indian and Northern Affairs, 1972), p. 60-61.

TABLE III-1

TOTAL POPULATION AND AVERAGE ANNUAL PERCENTAGE CHANGE IN POPULATION, NORTHWEST TERRITORIES AND CANADA, 1911-1971

	Northwest Territories		Canada	
Year	Population (No.)	Av. Annual Percentage Change	Population (No.)	Av. Annual Percentage Change
1911	6,507		7,206,643	
1921	8,143	2.51	8,787,949	2.19
1931	9,316	1.44	10,376,786	1.81
1941	12,028	2.91	11,506,655	1.09
1951	16,004	3.31	14,009,429	2.18
1956	19,313	4.14	16,080,791	2.96
1961	22,998	3.82	18,238,247	2.68
1966	28,738	4.99	20,014,880	1.94
1971	34,805	4.22	21,568,310	1.70

Source of Data:

1. Dominion Bureau of Statistics, Census of Canada, 1961 and 1966.

2. Statistics Canada, 1971 Census of Canada, Population by Age Group, Cat. No. 92-715, Vol. 1, Part 2, April 1973.

Source: Lu, C. and Mathurin, D., Population Projections of the Northwest Territories to 1981 (Department of Indian and Northern Affairs, November 1973) p. 6.

TABLE III-2

POPULATION DISTRIBUTION BY ETHNIC GROUP, NORTHWEST TERRITORIES, 1961-1969 INCLUSIVE AND 1971

Year	Distribution of Population (%)		
	Indian	Eskimo	Others
1961 (Census)	22.8	34.7	42.5
1962	21.7	34.9	43.4
1963	21.6	34.1	44.3
1964	21.7	36.0	42.3
1965	21.6	34.2	44.2
1966	21.7	36.5	41.8
1967	21.8	36.7	41.5
1968	21.5	38.2	40.3
1969	21.0	36.1	42.9
1971 (Census)	20.6	32.8	46.6

Source of Data:

1. The 1961 and 1971 population data by ethnic group were obtained from Census Division, Statistics Canada.

2. Total Indian population data for 1962-69 inclusive were obtained from Appendix 2: corresponding data for Eskimos were obtained from the Eskimo Disc List of the R.C.M.P. as of December 31 of each year.

3. Total population data at the end of each year represent the average mid-year population of that same year and the following year, obtainable from the Population Estimates and Projections Section, Statistics Canada.

Source: Lu, C. and Mathurin, D., Population Projections of the Northwest Territories to 1981 (DINA, Nov/73) p.14

TABLE III-3

COMMUNITIES IN THE NORTHWEST TERRITORIES
AS ON JUNE 1, 1971

	Community	Population	Total	% of Whole
(a)	Yellowknife	7,100		
	Inuvik	3,300		
	Hay River	3,000		
	Fort Smith	2,500		
	Frobisher Bay	2,100		
	Pine Point	1,200		
	Fort Rae	1,170		
	Fort Simpson	1,000	21,370	55
(b)	Fort MacPherson	800		
	Baker Lake	765		
	Coppermine	732		
	Eskimo Point	700		
	Fort Resolution	680		
	Aklavik	680		
	Cambridge Bay	670		
	Pangnirtung	667		
	Tuktoyaktuk	667		
	Fort Providence	648		
	Cape Dorset	635		
	Igloolik	602		
	Rankin Inlet	537	8,783	23
(c)	Pond Inlet	450		
	Fort Franklin	450		
	Fort Good Hope	380		
	Norman Wells	363		
	Coral Harbour	360		
	Spence Bay	350		
	Broughton Island	327		
	Gjoa Haven	284		
	Clyde River	281		
	Chesterfield Inlet	276		
	Fort Norman	268		
	Fort Liard	260		
	Hall Beach	260		
	Arctic Bay	257		
	Snowdrift	256		
	Tungsten	250	5,072	13
(d)	Holman	243		
	Belcher Islands	238		
	Whale Cove	238		
	Repulse Bay	220		
	Resolute Bay	210		
	Wrigley	185		
	Port Burwell	181		
	Lake Harbour	180		
	Lac la Martre	170		
	Pelly Bay	157		
	Sachs Harbour	137		

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2.

Community	Population	Total	% of Whole
Yellowknife Village	134		
Grise Fiord	103		
Echo Bay	100		
Arctic Red River	96		
Paulatuk	90		
Reindeer Station	79		
Rae Lakes	70		
Nahanni Butte	65		
Thom Bay	60		
Bathurst Inlet	50		
Colville Lake	50		
Enterprise	50		
Hislop Lake	50		
Jean Marie River	50		
Trout Lake	45		
Trout Rock	30		
Rsolution Island	32		
Contwoyto Lake	25		
Alexandra Fiord	18		
Mould Bay	13		
Snare Lake	10	3,379	9
(e) Others	118	118	0
Grand Total		38,722	100

Source: Explorer's Guide - Canada's Arctic 1972, NWT Government, Yellowknife.

POPULATION, SELECTED COMMUNITIES - NORTHWEST TERRITORIES,

CENSUS YEARS 1961, 1966 and 1971 (1)

Community	Number 1961	Number 1966	Number 1971 (2)	Percentage Change 1961-66	Percentage Change 1966-71	Percentage Change 1961-71
Aklavik	599	611	677	2.0	10.8	13.0
Arctic Bay	49	123	269	151.0	118.7	449.0
Arctic Red River	87	86	108	- 1.1	25.6	24.1
Baker Lake	386	596	756	54.4	26.8	95.9
Belcher Islands	169	178	234	5.3	31.5	38.5
Broughton Island	70	201	334	187.1	66.2	377.1
Cambridge Bay	531	511	716	- 3.8	40.1	34.8
Cape Dorset	161	357	597	121.7	67.2	270.8
Cape Parry	214	50	12	- 76.6	- 76.0	- 94.4
Chesterfield Inlet	146	199	258	36.3	29.6	76.7
Clyde River	40	99	274	147.5	176.8	585.0
Colville Lake	57	67	65	17.5	- 3.0	14.0
Coppermine	230	536	637	133.0	18.8	177.0
Coral Harbour	117	298	355	154.7	19.1	203.4
Enterprise	15	25	56	66.7	124.0	273.3
Eskimo Point	168	464	598	176.2	28.9	256.0
Eureka	8	13	10	62.5	- 23.1	25.0
Fort Franklin	238	311	339	30.7	9.0	42.4
Fort Good Hope	292	335	327	14.7	- 2.4	12.0
Fort Liard	154	177	263	14.9	48.6	70.8
Fort McPherson	509	654	679	28.5	3.8	33.4
Fort Norman	189	216	248	14.3	14.8	31.2
Fort Providence	402	378	587	- 6.0	55.3	46.0
Fort Resolution	485	677	623	39.6	- 8.0	28.4
Fort Simpson	563	712	747	26.5	4.9	32.7
Fort Smith	1,591	2,120	2,372	33.2	11.9	49.1
Frobisher Bay	512	1,631	2,014	218.6	23.5	293.4
Gjoa Haven	98	162	276	65.3	70.4	181.6
Grise Fiord	70	98	109	40.0	11.2	55.7
Hay River	1,338	2,002	2,420	49.6	20.9	80.9
Holman Island	98	179	241	82.7	34.6	145.9
Igloolik	133	328	563	146.6	71.7	323.3
Inuvik	1,248	2,040	2,672	63.5	31.0	114.1
Isachsen	6	12	2	100.0	- 83.3	- 66.7
Jean Marie River	44	51	47	15.9	- 7.8	6.8
Lac La Martre	121	125	161	3.3	28.8	33.1
Lake Harbour	90	97	189	7.8	94.8	110.0
Marian Lake Village	82	43	29	- 47.6	- 32.6	- 64.6
Nahanni Butte	76	71	66	- 6.6	- 7.0	- 13.2
Norman Wells	297	199	301	- 33.0	51.3	1.3
Pangnirtung	114	376	690	229.8	83.5	505.3
Pelly Bay	94	171	215	81.9	25.7	128.7
Pond Inlet	53	178	416	235.8	133.7	684.9
Port Burwell	36	105	107	191.7	1.9	197.2
Rae	522	779	1,056	49.2	35.6	102.3
Rankin Inlet	586	429	566	- 26.8	31.9	- 3.4
Repulse Bay	116	146	242	25.9	65.8	108.6
Resolute Bay	153	254	184	66.0	- 27.6	20.3
Resolution Island	21	18	8	- 14.3	- 55.6	- 61.9
Rocher River	58	38	4	- 34.5	- 89.5	- 93.1
Sachs Harbour	76	132	143	73.7	8.3	88.2
Snowdrift	140	176	221	25.7	25.6	57.9
Spence Bay	124	247	209	99.2	- 15.4	68.5
Trout Lake	32	30	48	- 6.2	60.0	50.0
Tuktoyaktuk	409	512	596	25.2	16.4	45.7
Whale Cove	125	181	213	44.8	17.7	70.4
Wrigley	128	136	152	6.3	11.8	18.8
Yellowknife	3,141	3,741	5,867	19.1	56.8	86.8

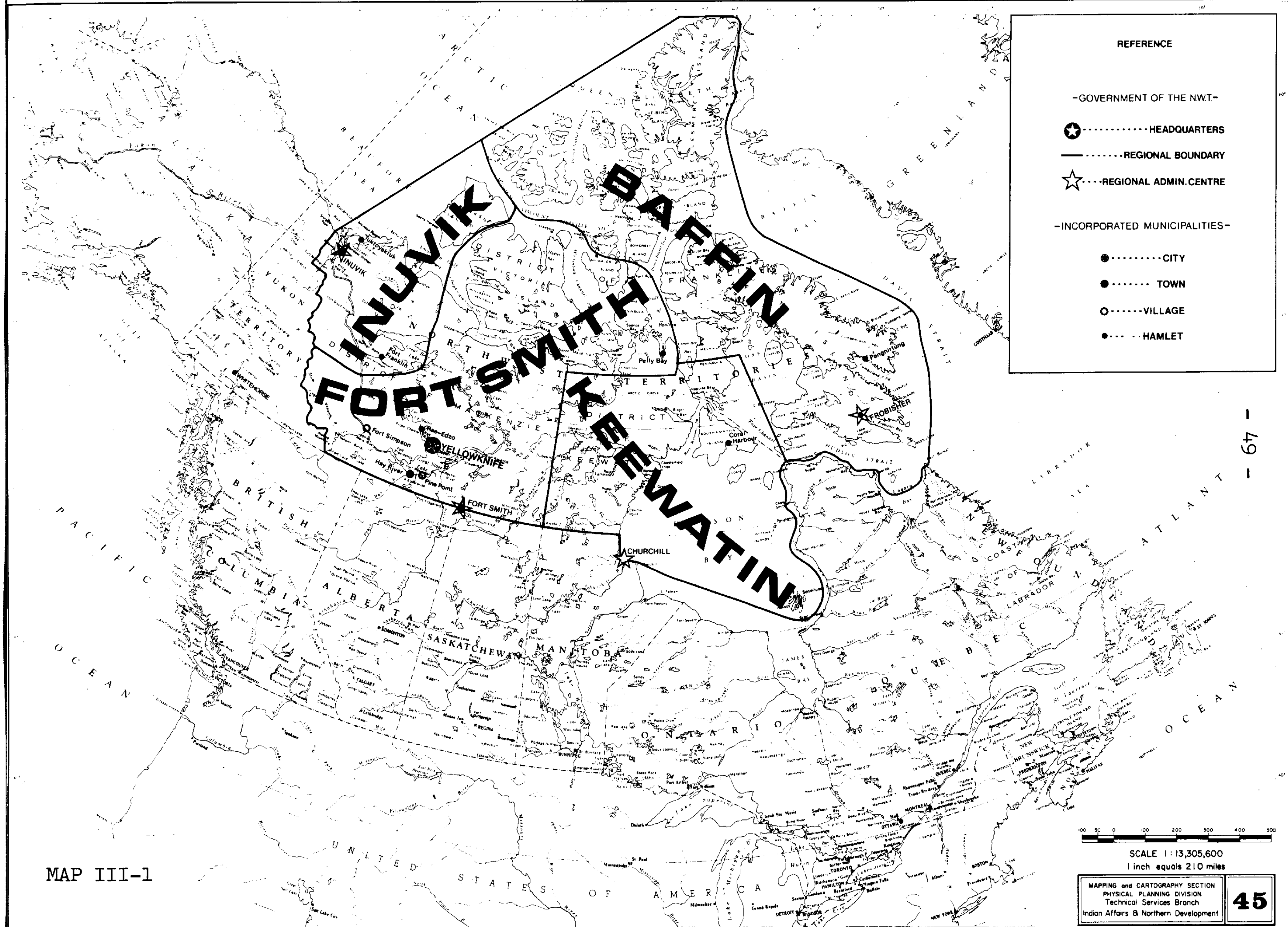
(1) As at June 1.

(2) Preliminary data.

Source: Census Division, Statistics Canada (unpublished data).

Source: Krolewski, A., Northwest Territories Statistical Abstract, 1973 (DINA, August 1973) p. 20.

ADMINISTRATIVE REGIONS



MAP III-1

TABLE III-5

NWT GOVERNMENT ADMINISTRATIVE REGION SETTLEMENTS
DECEMBER 1, 1973

Fort Smith Region Settlement

Fort Wrigley
Fort Simpson
Nahanni Sutte
Fort Liard
Tungsten
Trout Lake
Jean Marie River
Fort Providence
Kakisa Lake
Enterprise
Hay River
Pine Point
Fort Resolution
Rocher River
Fort Smith
Gjoa Haven
Snowdrift
Rellance
Yellowknife
Yellowknife Indian Village
Rae
Lac la Martre
Rae Lakes
Edzo
Echo Bay
Coppermine
Holman
Cambridge Bay
Bathurst Inlet
Spence Bay
Pelly Bay

Total 31

Keewatin Region Settlement

Whale Cove
Eskimo Point
Rankin Inlet
Baker Lake
Repulse Bay
Coral Harbour
Chesterfield Inlet
Belcher Islands

Total 8

Inuvik Region Settlement

Inuvik
Tuktoyaktuk
Fort McPherson
Aklavik
Paulatuk
Sachs Harbour
Reindeer Station
Fort Good Hope
Fort Franklin
Fort Norman
Norman Wells

Total 11

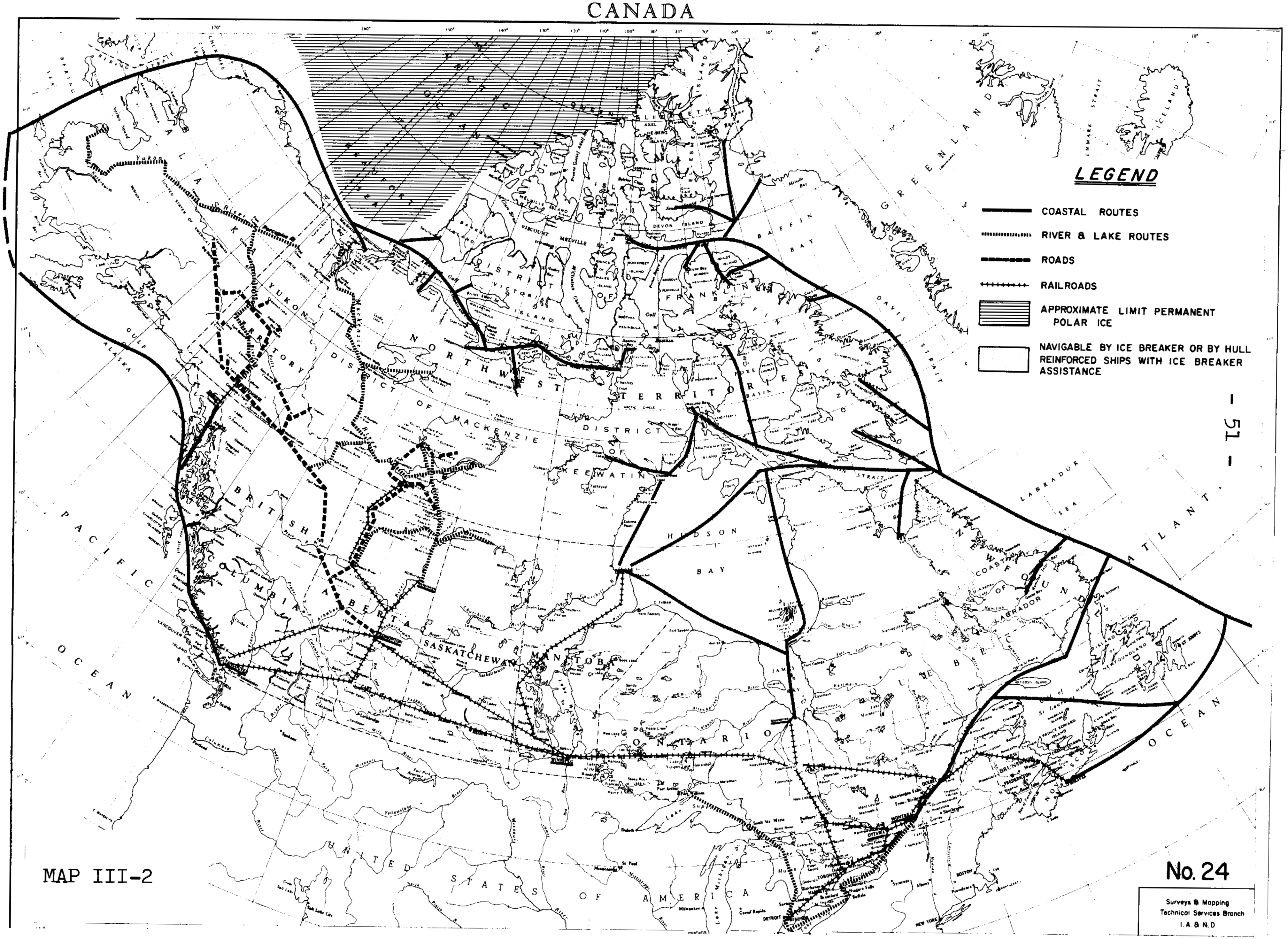
Baffin Region Settlement

Frobisher Bay
Lake Harbour
Cape Dorset
Hall Beach
Igloolik
Arctic Bay
Pond Inlet
Resolute
Clyde River
Pangnirtung
Broughton Island
Port Burwell
Grise Fiord

Total 13

Source: M. Ifill , Regional Planning in Northern Canada (Department of Indian and Northern Affairs, 1972), p. 12.

SHIPPING ROUTES NORTHERN CANADA AS OF APRIL 1, 1969
(SUMMER NAVIGATION ONLY)



MAP III-2

2. Resource Exploration and Development Cargo

In the western Arctic, a large proportion of supplies for oil and gas exploration and drilling is shipped by barge down the Mackenzie River from Hay River to the Delta area. In addition, there is some traffic serving the metallic minerals exploration development sites around Great Slave and Great Bear Lakes. Resupply of oil and gas exploration and drilling sites in the western Arctic Islands is done either by air or by vessels traversing the Northwest Passage from the east, due to ice conditions in the west and central Arctic. Marine resupply of metallic minerals exploration sites around Hudson Bay and Baffin Island is arranged by the private companies concerned.

3. Military Supply Cargo

In the western Arctic supplies for military sites along the Arctic coast are shipped by barge as far east as the Boothia Peninsula. In the eastern Arctic, supplies are shipped by water to sites along the Labrador coast, the east coast of Baffin Island and to sites in the Foxe Basin.

D. NORTHERN CARGO MOVEMENTS

Introduction

There are four marine supply routes into northern Canada: firstly, the eastern Arctic resupply route, from eastern Canada (primarily Montreal) via the Hudson Strait to the Hudson and James Bays, and via Lancaster Sound to Resolute Bay; secondly, the western Arctic resupply route, from Hay River, down the Mackenzie River to Tuktoyaktuk, and then east to the Boothia Peninsula; thirdly, cargo transport by rail to Churchill, Manitoba, and then by vessel to destinations in the Hudson Bay; and fourthly, barge transport north along the coast of British Columbia, around Point Barrow, Alaska, and eastward along the Arctic mainland coast to the Prudhoe Bay and Mackenzie Delta areas. Map III-2 illustrates these four resupply routes.

1. The Ministry of Transport Eastern Arctic Resupply and Private Eastern Arctic Resupply

The annual eastern Arctic resupply operation is characterized by the carriage of relatively small cargo lot sizes, delivered to a large number of destinations by shallow-draft vessels. Table III-6 illustrates the characteristics of the vessels used for the 1973 eastern Arctic resupply. Deadweight tonnage ranges from about 1,500 to about 8,500 dwt and draft from about 14 to 23 feet. Cargo traffic is generally of a one-way nature, with vessels returning in ballast. The resupply vessels anchor offshore (since there are no wharf facilities with the exception of those mentioned on pages 41 to 42) and the cargo is lightered ashore.

TABLE III-6

DATA* ON VESSELS USED IN THE MINISTRY OF TRANSPORT ARCTIC RESUPPLY 1973

Tendering Company	Vessel Owner	Year Built	Ice Class	Tonnage (Summer Deadweight)	Dimension Lgth/Brdth/Draught	Horsepower	Speed (knots)
I Chimo Shipping Ltd St. John's, Nfld							
1. Sir John Crosbie	Crosbie Service Ltd	1962	100A1 Ice Class 1	2175	253'00"/42'02"	2300 bhp	-
2. Chesley A. Crosbie	Leaseback Projects Ltd	1964	100A1 Ice Class 1	2008	253'00"/42'03"/16'03 1/2"	2300 bhp	13.5
3. Andrew C. Crosbie	Chimo Shipping Ltd	1960	100A1 No Ice	3436	355'03"/44'11"/17'08 3/4"	2000 bhp	12.5
4. George Crosbie	-	1956	100A1 Str. Nav. Ice	1465	-	-	-
5. Percy M. Crosbie	Chimo Shipping Ltd	1959	100A1 Str. Nav. Ice	2675	275'00"/42'08"/19'10"	1960 bhp	12.5
6. Bill Crosbie	Chimo Shipping Ltd	1965	100A1 Ice Class 1	2480	307'09"/45'03"/16'07 3/4"	2420 bhp	13.5
II Resolute Shipping Ltd Montreal, Quebec							
1. Aigle D'Ocean		1919	Tug	-	141'00"/29'01"/14'10 1/2"	-	-
2. Thuleland		1955	100A1 Str. Nav. Ice	4525	393'00"/54'00"/21'03 3/4"	4000 bhp	15.0
3. Tundraland		1958	100A1 Str. Nav. Ice	4500	393'00"/54'00"/21'04"	3950 bhp	15.0
III Agence Maritime Inc. Quebec City, Quebec							
1. Fort Lennox	Corp. Maritime Rive-Nord Ltd, Quebec	1944	A1 (River & Gulf of St Lawrence Service)	4200	331'06"/50'02"/15'00 3/4"	1800 bhp	10.5
2. Fort Chambly	Canadian Steamship Lines Ltd, Montreal	1961	100A1 Ice Class 3	8605	462'11"/56'05"/23'07"	7200 bhp	17.5
3. Fort Kent	Corp. Maritime Rive-Nord Ltd, Quebec	1943	A1 (River & Gulf of St Lawrence Service)	4200	327'10"/50'02"/15'00 1/4"	-	10.5
4. Inland	Agence Maritime Inc, Quebec	1950	100A1 Str. Nav. Ice	1507	217'04"/33'01"/16'05 1/4"	1050 bhp	10.0
5. Fort Preuel	Agence Maritime Inc, Quebec	1917	-	-	135'03"/23'06"	-	-
6. Fort Gaspé	Vrac Mar. Inc, Quebec	1943	A1 (River & Gulf of St Lawrence Service)	4200	327'10"/50'02"/15'00 3/4"	1800 bhp	10.5
7. Fort George	-	1951	-	3106	-	-	12.0
IV Branch Lines Ltd Sorel, Quebec							
1. Maplebranch (Tanker)	Branch Lines Ltd, Sorel, Quebec	1958	100A1 Str. Nav. Ice	5798	375'11"/52'02"/22'08"	3200 bhp	13.5
2. Jos. Simard (Tanker)	Branch Lines Ltd, Sorel, Quebec	1964	100A1 Ice Class 1	7153	412'02"/53'08"/22'05 1/4"	5040 bhp	13.5
3. Baffin Transport	Hall Corp Shipping Ltd	Not Registered with Lloyd's					

* Lloyd's Registry of Shipping 1972-73

During the 1969 and 1970 eastern Arctic resupply, the Canadian Coast Guard experimented with the use of a helicopter to transfer cargo from the resupply vessel anchored offshore to the cargo destination on land, rather than lightering cargo ashore. The Sikorsky Sky-Crane, a heavy helicopter with a cargo transfer capacity of 10 tons, was used for destinations in Arctic Quebec.

Results of the experiment showed faster unloading of cargo and less cargo damage. In addition, cargo was delivered to a point inland, either at its ultimate destination or at a pick-up point, rather than being left at the high water mark on the beach. Cost comparisons between using lightering and using helicopters to transfer cargo from the resupply vessel to shore showed a slight cost advantage for the helicopter alternative. However, cargo lots totalling at least 2,000 tons are needed for a "contract area" (ie. a group of destinations, the resupply of which is put up for tender as a group) to make it practical to use the helicopter alternative. Tenders were requested by MOT for the 1972 Arctic Quebec sites for either the lighter or helicopter alternative; however, total cargo for the area was later reduced to only about 1,500 tons, which dictated the use of lighters. Cargo transfer by helicopter is most applicable (given the required cargo levels) in areas characterized by shallow water for a long distance offshore, which demands a long lighter travel time between the main supply vessel and shore.

Up until and including 1971, resupply cargo (both general and oil products) was carried by vessels under charter to MOT, and therefore stevedoring services and marine insurance were arranged directly by the Ministry. Since 1972, general cargo has been delivered to the high water mark on a rate/ton basis. Beginning in 1973, cargo has been delivered on a rate/ton/commodity group basis. Under this arrangement, stevedoring services and marine insurance are taken care of by the shipping company concerned and these charges are reflected in the price/ton delivered offered by the company to MOT.

General cargo going North during each shipping season is divided by groups of destinations into "contract areas", on the basis of cargo tonnage magnitude and ice conditions in the area.* A "contract area" is therefore a set of destinations

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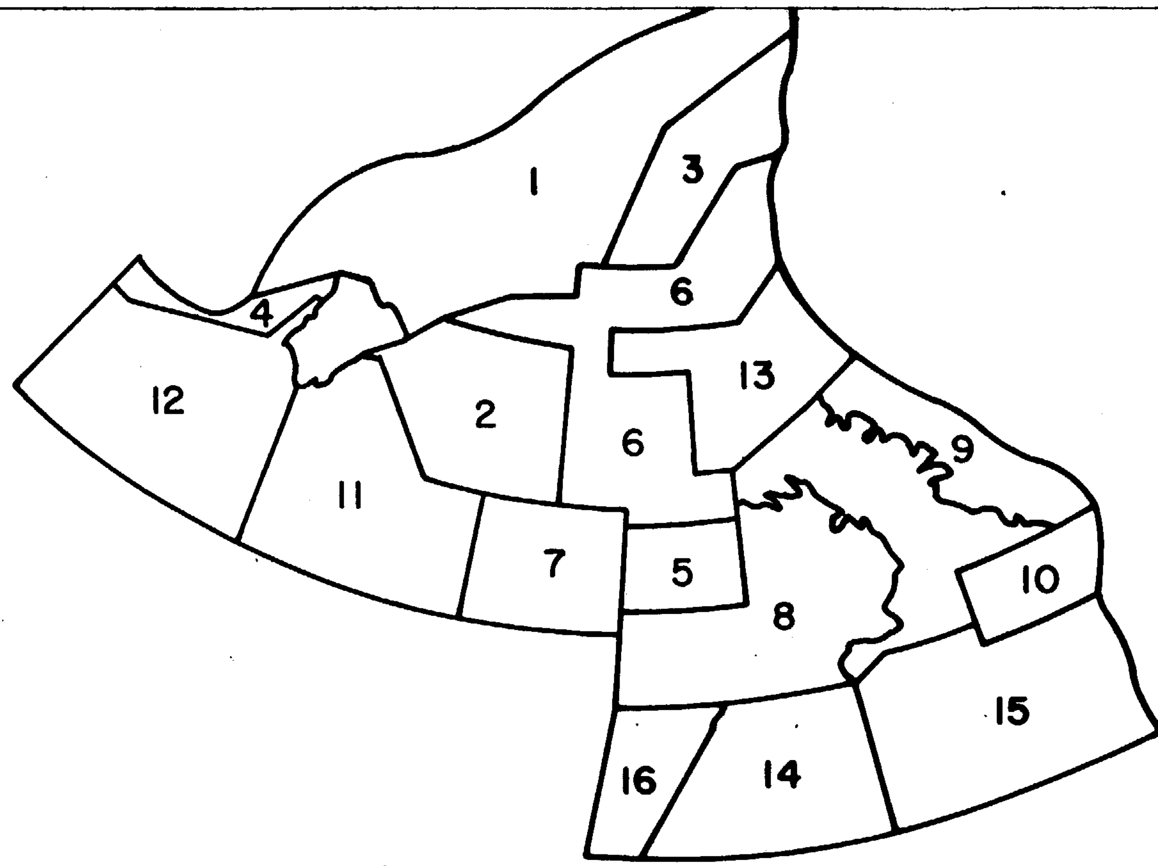
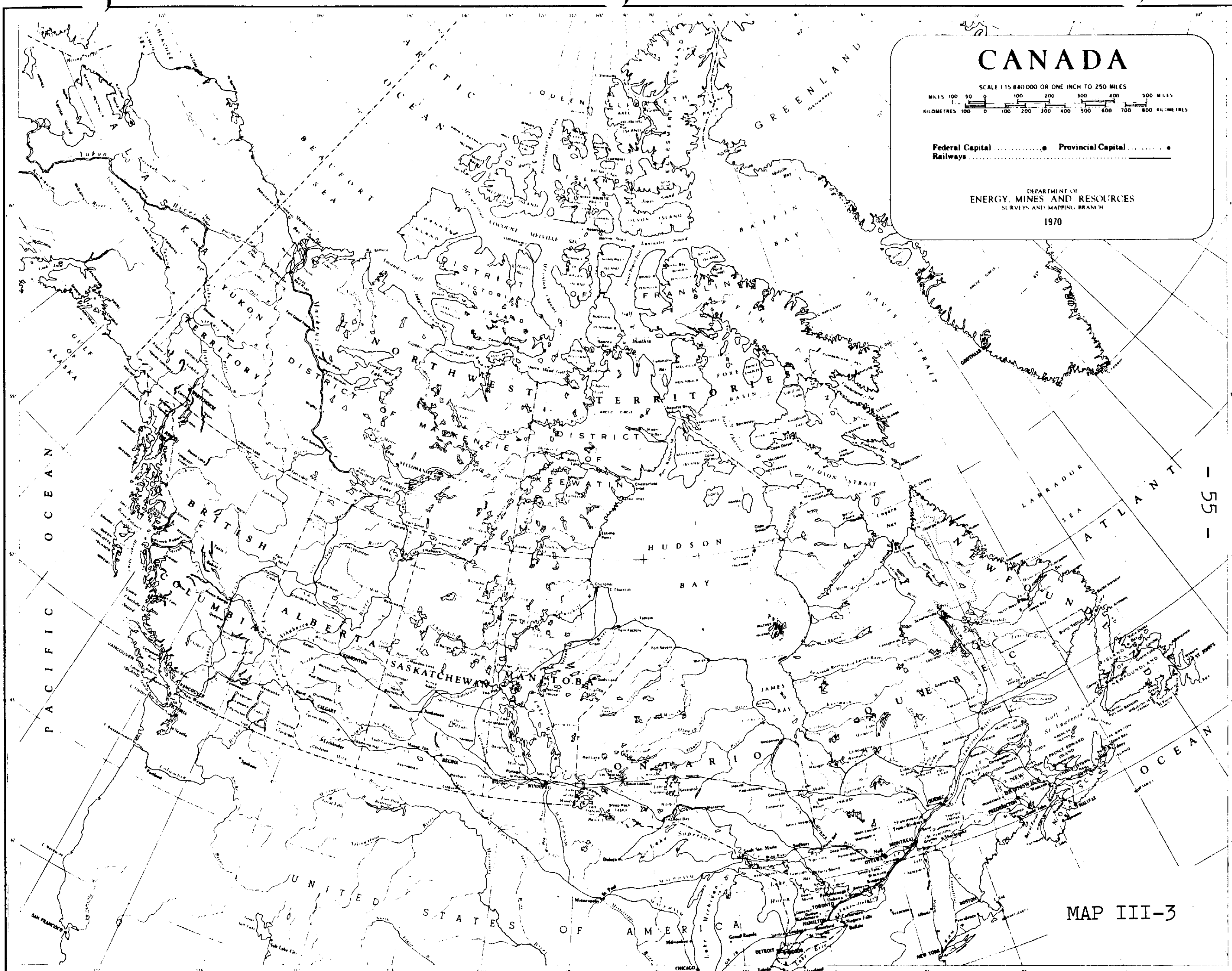
* Ice conditions are reflected in the zonal divisions of the Shipping Safety Control Zones of the Arctic Waters Pollution Prevention Act (AWPPA). The Regulations pursuant to the Act specify required standards of vessel construction and consequent allowable length of the navigation season for each zone. Preference is given for ice-strengthened vessels by MOT when accepting tenders for contracts within guidelines as to the degree of preference given. See Map III-3 for AWPPA Shipping Safety Control Zones and accompaying Table III-7 for allowable navigation season within each zone for differing vessel ice capability.

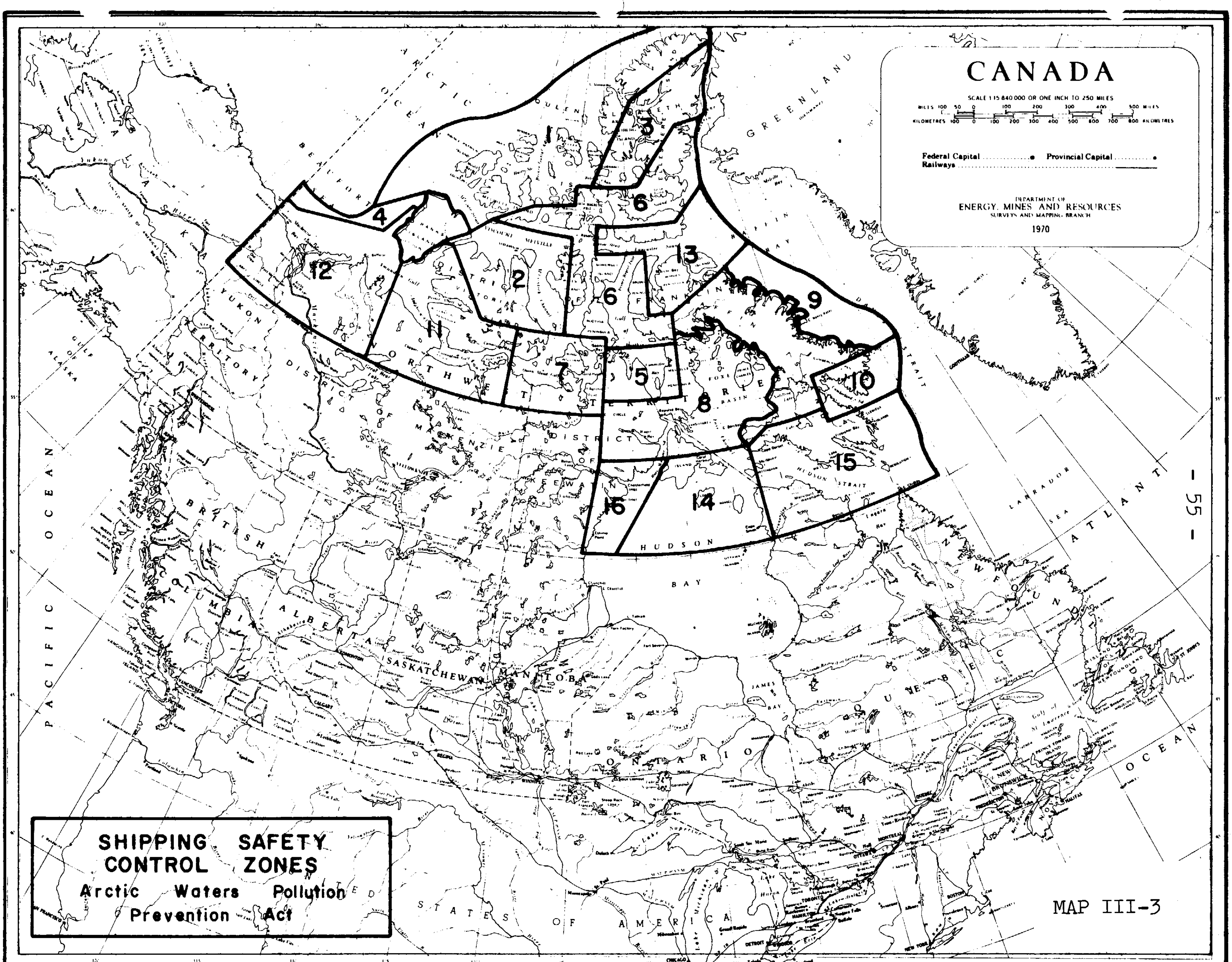


SHIPPING SAFETY CONTROL ZONES

Arctic Waters Pollution Prevention Act


CANADA
SCALE 1:15 840 000 OR ONE INCH TO 250 MILES
Federal Capital
Provincial Capital
Railways
DEPARTMENT OF
ENERGY, MINES AND RESOURCES
SURVEYS AND MAPPING BRANCH
1970
ARCTIC OCEAN
BEAUFORT SEA
GREENLAND
BAFFIN BAY
DAVIS STRAIT
HUDSON STRAIT
LABRADOR SEA
ATLANTIC OCEAN
PACIFIC OCEAN
GULF OF ALASKA
ALASKA
YUKON TERRITORY
NORTHWEST TERRITORIES
DISTRICT OF MACKENZIE
DISTRICT OF KEEWATIN
DISTRICT OF FRANKLIN
VICTORIA ISLAND
FOXE BASIN
HUDSON BAY
JAMES BAY
BRITISH COLUMBIA
ALBERTA
SASKATCHEWAN
MANITOBA
ONTARIO
QUEBEC
NEWFOUNDLAND
NEW BRUNSWICK
NOVA SCOTIA
UNITED STATES OF AMERICA

MAP III-3


CANADA
SCALE 1:15 840 000 OR ONE INCH TO 250 MILES
Federal Capital
Provincial Capital
Railways
DEPARTMENT OF
ENERGY, MINES AND RESOURCES
SURVEYS AND MAPPING BRANCH
1970
SHIPPING SAFETY
CONTROL ZONES
Arctic Waters Pollution
Prevention Act
1
2
3
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14
15
16
ARCTIC OCEAN
BEAUFORT
GREENLAND
PACIFIC OCEAN
ATLANTIC OCEAN
HUDSON BAY
JAMES BAY
HUDSON STRAIT
LABRADOR SEA
YUKON TERRITORY
NORTHWEST TERRITORIES
DISTRICT OF MACKENZIE
DISTRICT OF KEEWATIN
BRITISH COLUMBIA
ALBERTA
SASKATCHEWAN
MANITOBA
ONTARIO
QUEBEC
NEWFOUNDLAND
ALASKA
STATES OF AMERICA

MAP III-3

TABLE III

Arctic Waters Pollution Prevention Act
Arctic Shipping Pollution Prevention Regulations

SHIPPING SAFETY CONTROL ZONES
Allowable Navigation Season According to Vessel Construction

Column I Category	Column II Zone 1	Column III Zone 2	Column IV Zone 3	Column V Zone 4	Column VI Zone 5	Column VII Zone 6	Column VIII Zone 7	Column IX Zone 8	Column X Zone 9	Column XI Zone 10	Column XII Zone 11	Column XIII Zone 12	Column XIV Zone 13	Column XV Zone 14	Column XVI Zone 15	Column XVII Zone 16
Arctic Class 10 1.	All Year	All Year	All Year	All Year	All Year	All Year	All Year	All Year	All Year	All Year	All Year	All Year	All Year	All Year	All Year	All Year
Arctic Class 8 2.	Jul. 1 to Oct. 15	All Year	All Year	All Year	All Year	All Year	All Year	All Year	All Year	All Year	All Year	All Year	All Year	All Year	All Year	All Year
Arctic Class 7 3.	Aug. 1 to Sept. 30	Aug. 1 to Nov. 30	Jul 1 to Dec. 31	Jul. 1 to Dec. 15	Jul. 1 to Dec. 15	All Year	All Year	All Year	All Year	All Year	All Year	All Year	All Year	All Year	All Year	All Year
Arctic Class 6 4.	Aug. 15 to Sept. 15	Aug. 1 to Oct. 31	Jul. 15 to Nov. 30	Jul. 15 to Nov. 30	Aug. 1 to Oct. 15	Jul 15 to Feb. 28	Jul. 1 to Mar. 31	Jul. 1 to Mar. 31	All Year	All Year	Jul. 1 to Mar. 31	All Year	All Year	All Year	All Year	All Year
Arctic Class 4 5.	Aug. 15 to Sept. 15	Aug. 15 to Oct. 15	Jul. 15 to Oct. 31	Jul. 15 to Nov. 15	Aug. 15 to Sept. 30	Jul. 20 to Dec. 31	Jul. 15 to Jan. 15	Jul. 15 to Jan. 15	Jul. 10 to Mar. 31	Jul. 10 to Feb. 28	Jul. 5 to Jan. 15	June 1 to Jan. 31	June 1 to Feb. 15	June 15 to Feb. 15	June 15 to Mar. 15	June 1 to Feb. 15
Arctic Class 3 6.	Aug. 20 to Sept. 15	Aug. 20 to Sept. 30	Jul. 25 to Oct. 15	Jul. 20 to Nov. 5	Aug. 20 to Sept. 25	Aug. 1 to Nov. 20	Jul. 20 to Dec. 15	Jul. 20 to Dec. 31	Jul. 20 to Jan. 20	Jul. 15 to Jan. 25	Jul. 5 to Dec. 15	June 10 to Dec. 31	June 10 to Dec. 31	June 20 to Jan. 10	June 20 to Jan. 31	June 5 to Jan. 10
Arctic Class 2 7.	No Entry	No Entry	Aug. 15 to Sept. 30	Aug. 1 to Oct. 31	No Entry	Aug. 15 to Nov. 20	Aug. 1 to Nov. 20	Aug. 1 to Nov. 30	Aug. 1 to Dec. 20	Jul. 25 to Dec. 20	Jul. 10 to Nov. 20	June 15 to Dec. 5	June 25 to Nov. 15	June 25 to Dec. 10	June 25 to Dec. 20	June 10 to Dec. 10
Arctic Class 1A 8.	No Entry	No Entry	Aug. 20 to Sept. 15	Aug. 20 to Sept. 30	No Entry	Aug. 25 to Oct. 31	Aug. 10 to Nov. 5	Aug. 10 to Nov. 20	Aug. 10 to Dec. 10	Aug. 1 to Dec. 10	Jul. 15 to Nov. 10	Jul. 1 to Nov. 10	Jul. 15 to Oct. 31	Jul. 1 to Nov. 30	Jul. 1 to Dec. 10	June 20 to Nov. 30
Arctic Class 1 9.	No Entry	No Entry	No Entry	No Entry	No Entry	Aug. 25 to Sep. 30	Aug. 10 to Oct. 15	Aug. 10 to Oct. 31	Aug. 10 to Oct. 31	Aug. 1 to Oct. 31	Jul. 15 to Oct. 20	Jul. 1 to Oct. 31	Jul. 15 to Oct. 15	Jul. 1 to Nov. 30	Jul. 1 to Nov. 30	June 20 to Nov. 15
Type A 10. (Ice 1*)	No Entry	No Entry	Aug. 20 to Sept. 10	Aug. 20 to Sept. 20	No Entry	Aug. 15 to Oct. 15	Aug. 1 to Oct. 25	Aug. 1 to Nov. 10	Aug. 1 to Nov. 20	Jul. 25 to Nov. 20	Jul. 10 to Oct. 31	June 15 to Nov. 10	June 25 to Oct. 22	June 25 to Nov. 30	June 25 to Dec. 5	June 20 to Nov. 20
Type B 11. (Ice 1)	No Entry	No Entry	Aug. 20 to Sept. 5	Aug. 20 to Sept. 15	No Entry	Aug. 25 to Sep. 30	Aug. 10 to Oct. 15	Aug. 10 to Oct. 31	Aug. 10 to Oct. 31	Aug. 1 to Oct. 31	Jul. 15 to Oct. 20	Jul. 1 to Oct. 25	Jul. 15 to Oct. 15	Jul. 1 to Nov. 30	Jul. 1 to Nov. 30	June 20 to Nov. 10
Type C 12. (Ice 2)	No Entry	No Entry	No Entry	No Entry	No Entry	Aug. 25 to Sep. 25	Aug. 10 to Oct. 10	Aug. 10 to Oct. 25	Aug. 10 to Oct. 25	Aug. 1 to Oct. 25	Jul. 15 to Oct. 15	Jul. 1 to Oct. 25	Jul. 15 to Oct. 10	Jul. 1 to Nov. 25	Jul. 1 to Nov. 25	June 25 to Nov. 10
Type D 13. (Ice 3)	No Entry	No Entry	No Entry	No Entry	No Entry	No Entry	Aug. 10 to Oct. 5	Aug. 15 to Oct. 20	Aug. 15 to Oct. 20	Aug. 5 to Oct. 20	Jul. 15 to Oct. 10	Jul. 1 to Oct. 20	Jul. 30 to Sep. 30	Jul. 10 to Nov. 10	Jul. 5 to Nov. 10	Jul. 1 to Oct. 31
Type E 14. (No Ice)	No Entry	No Entry	No Entry	No Entry	No Entry	No Entry	Aug. 10 to Sep. 30	Aug. 20 to Oct. 20	Aug. 20 to Oct. 15	Aug. 10 to Oct. 20	Jul. 15 to Sep. 30	Jul. 1 to Oct. 20	Aug. 15 to Sep. 20	Jul. 20 to Oct. 31	Jul. 20 to Nov. 5	Jul. 1 to Oct. 31

Note: Entries in large type refer to equivalent Lloyd's Ice Classes.

for which the cost/ton/commodity group of cargo carried is the same. These contracts are then put up for tender by MOT and generally speaking, the policy is to accept the lowest bid.

Bulk petroleum products (POL)* are carried by vessels under charter to the Ministry, and so marine insurance for these vessels is paid by the Ministry.

Navigation aids** and icebreaker assistance*** are provided as a service by the Ministry, for both vessels carrying cargo organized by MOT and vessels carrying cargo for private concerns.

Table III-8 details total Ministry of Transport eastern Arctic resupply tonnages over the period 1953 to 1972. Tonnages reached a peak of 122,235 short tons in 1970 and have been falling since, to a level of 96,713 short tons in 1972. Cargo carried for private enterprise on commercial vessels not under contract or charter to MOT has been increasing, and was estimated at 175,000 short tons, of which about 75% consisted of bulk petroleum products.**** Total MOT tonnage of 96,713 short tons consisted of about 60% bulk petroleum products.

Tables III-9, "Summary, Ministry of Transport 1972 Eastern Arctic Resupply Cargo Shipments", and Table III-10,"Summary, Ministry of Transport 1973 Eastern Arctic Resupply Cargo Shipments", detail general cargo and POL movements in Canadian Coast Guard ships and vessels under contract (dry cargo) and charter (POL) to the Ministry.

These two tables illustrate the general decrease in resupply tonnages, and the relative increase of POL tonnage carried in comparison to general cargo. POL composed about 66% of total cargo handled in 1972, whereas in 1973, POL was 75% ot total cargo handled.

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* POL consists of: auto gas, aviation gas, heating fuel, diesel fuel and aviation turbine fuel.

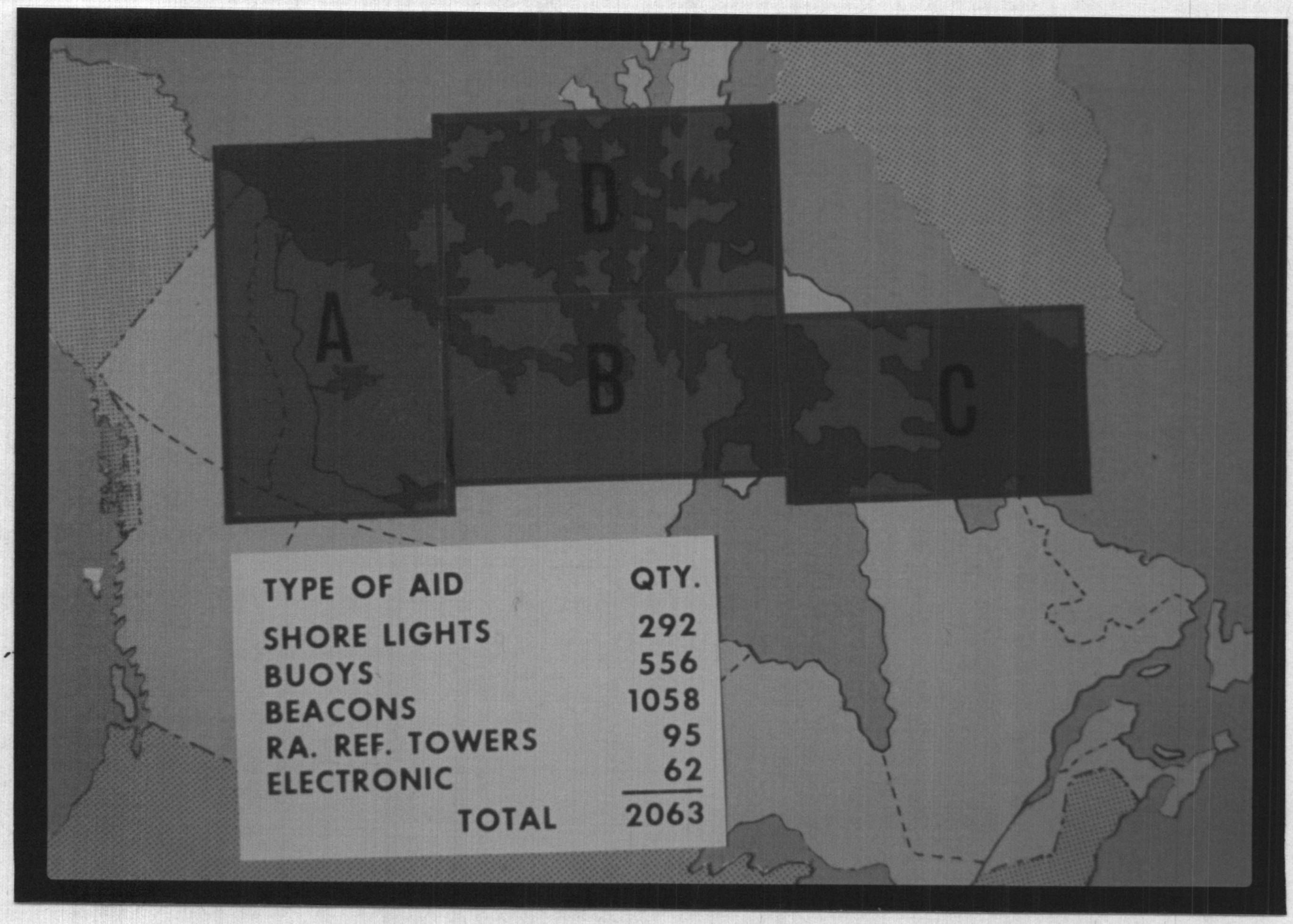
** See Maps III-4 a, b, c and d for quantity and location of navigation aids north of 60°.

*** See Appendix 5, "Vital Statistics of the Canadian Coast Guard Fleet" for details of icebreaker capacity and descriptions of equipment used to lighter cargo ashore. Seven of Canada's 24 icebreakers are capable of operating in Arctic waters during the summer season.

**** Canadian Coast Guard, Operations Branch, Ministry of Transport.

MAP III-4

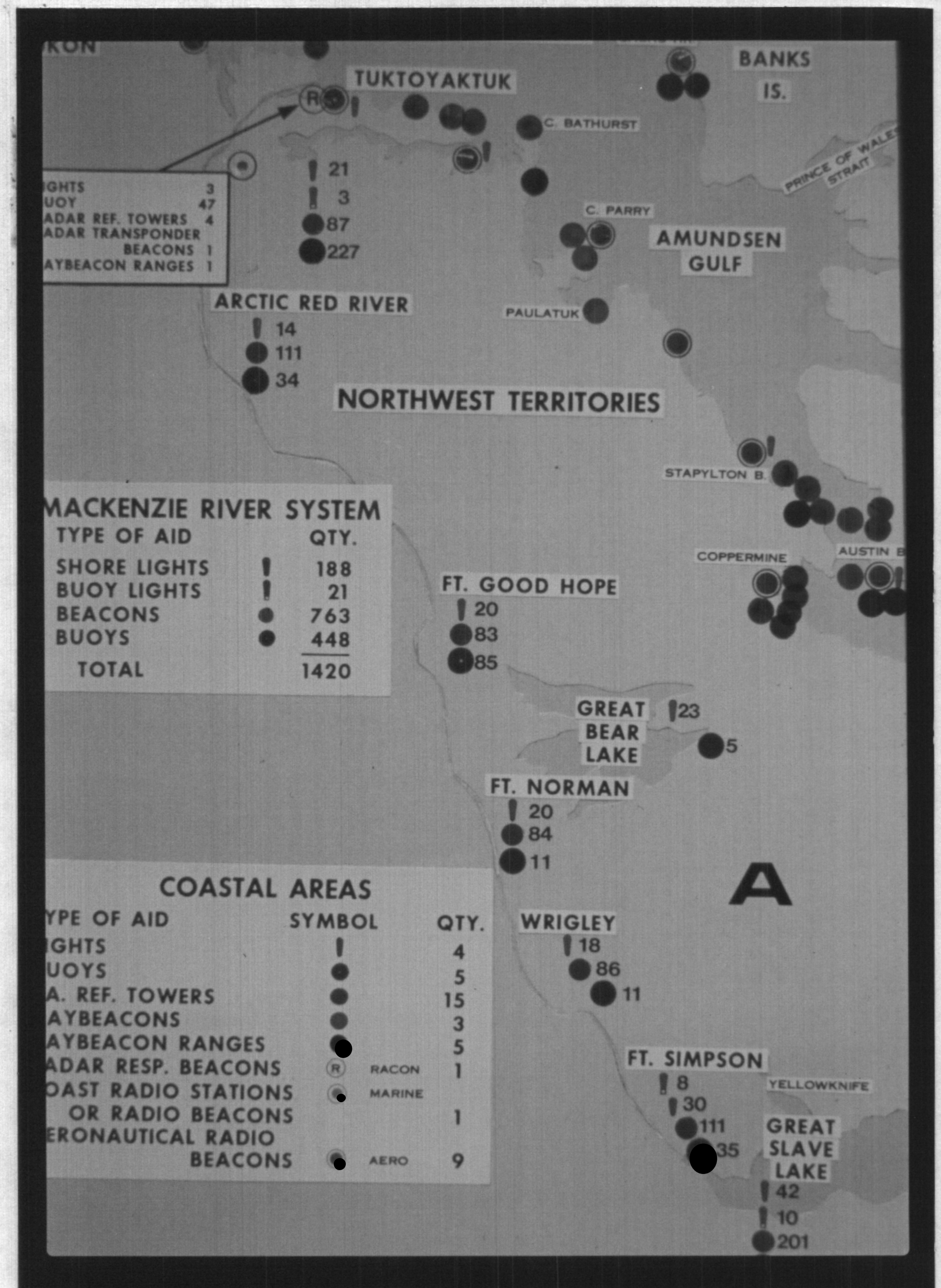
NORTHERN NAVIGATION AIDS - KEY MAP



Source: Ministry of Transport,
Operations Branch.

MAP III - 4a

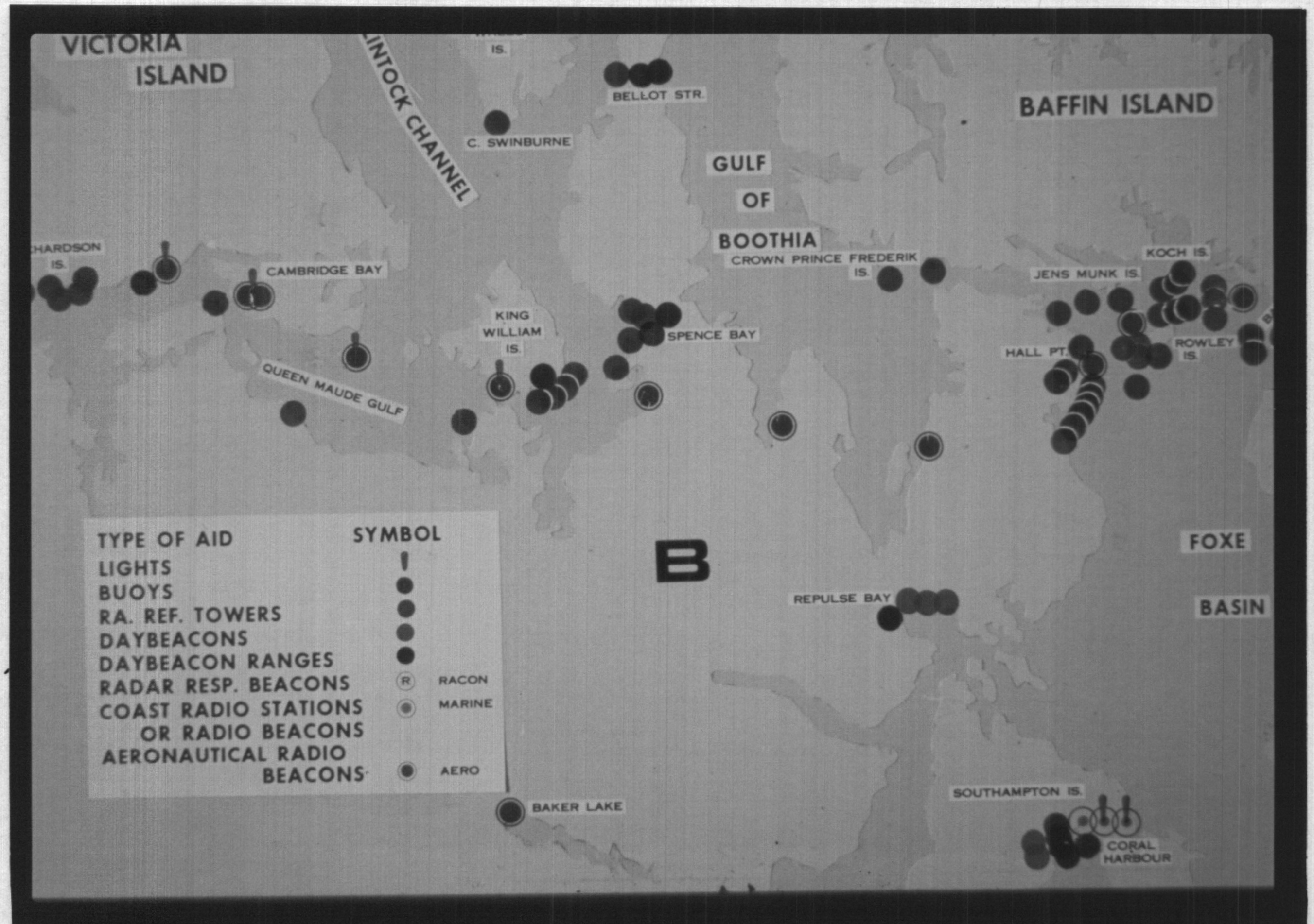
NAVIGATION AIDS - MACKENZIE BASIN AND ARCTIC COAST



Source: Ministry of Transport, Operations Branch.

MAP III - 4b

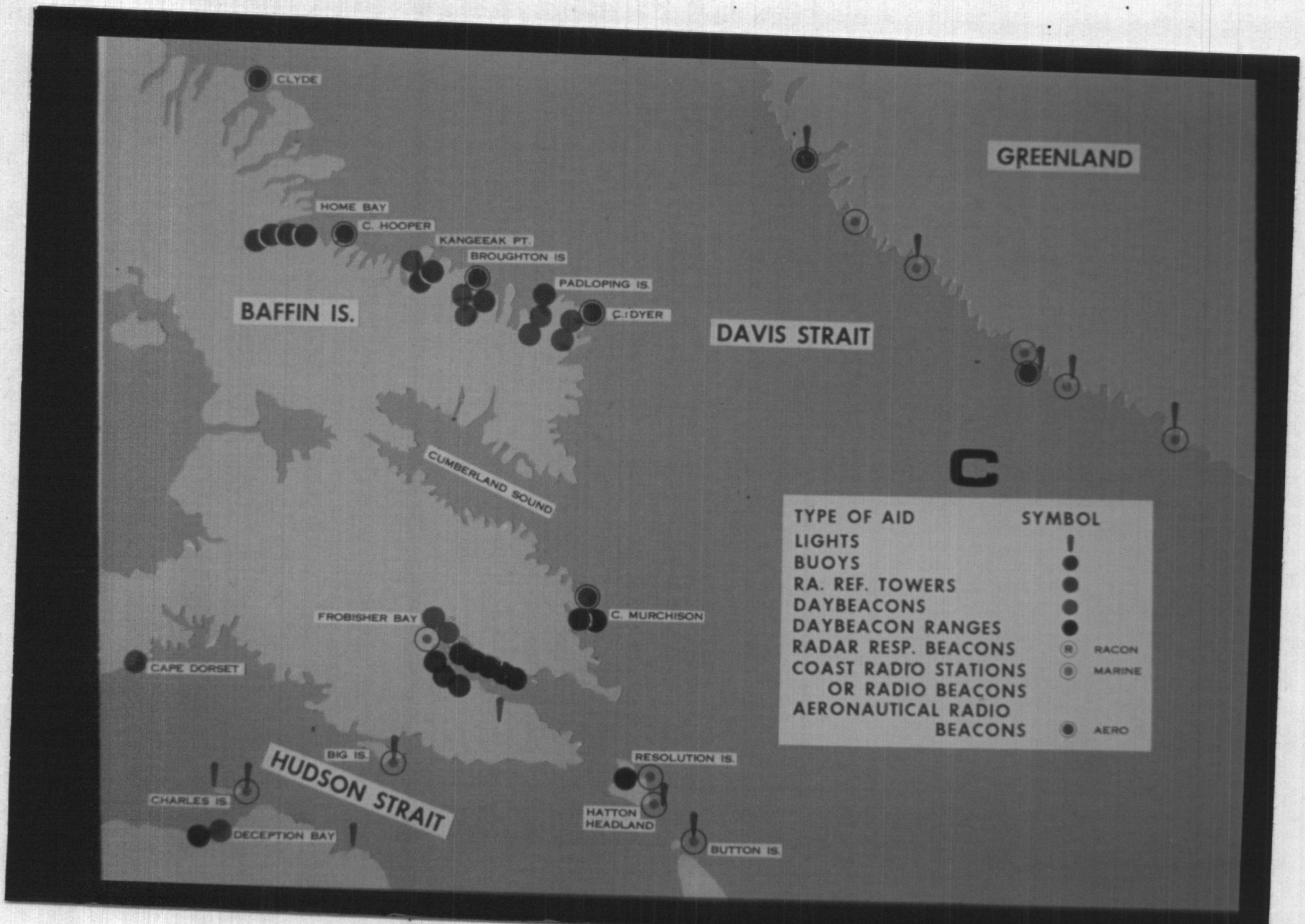
NAVIGATION AIDS - EASTERN MAINLAND



Source: Ministry of Transport, Operations Branch.

MAP III - 4c

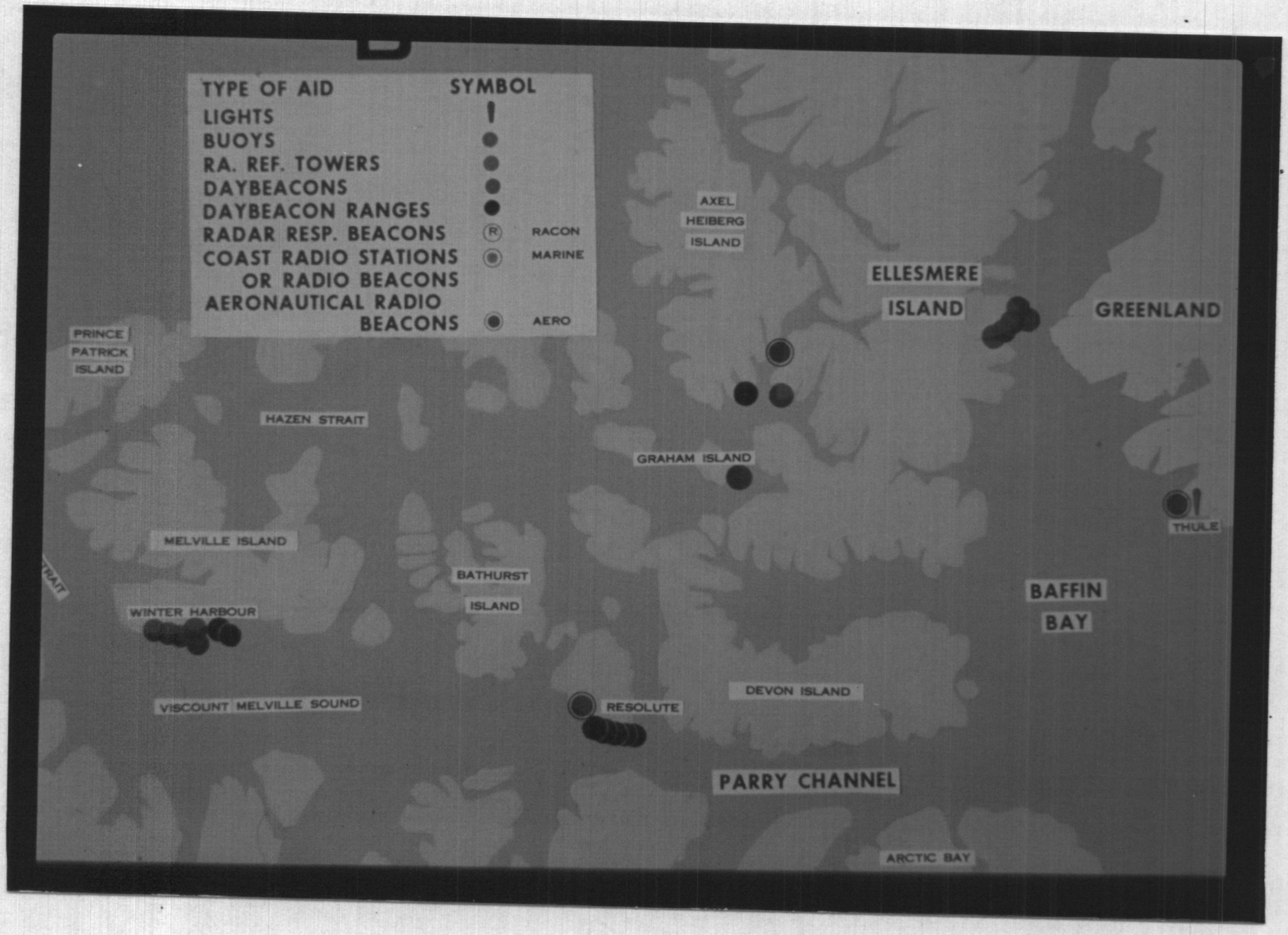
NAVIGATION AIDS - EASTERN BAFFIN



Source: Ministry of Transport,
Operations Branch.

MAP III - 4d

NAVIGATION AIDS - CENTRAL ARCTIC ISLANDS



Source: Ministry of Transport, Operations Branch.

TABLE III-8

EASTERN ARCTIC RESUPPLY

TOTAL TONNAGES 1953-1972

Year	Tons (2,000 lbs)
1953	4,521
1954	8,000
1955	22,000
1956	41,000
1957	60,000
1958	77,000
1959	110,100
1960	108,258
1916	110,118
1962	89,664
1963	112,508
1964	105,000
1965	107,301
1966	98,008
1967	104,649
1968	106,749
1969	117,062
1970	122,235
1971	107,717
1972	96,713

Source: Marine Finance Directorate, Ministry of Transport, <u>1972 Arctic Resupply, Policy Questions, Statistics, Costs</u>, February 1973.

TABLE III-9

SUMMARY, MINISTRY OF TRANSPORT
1972 EASTERN ARCTIC RESUPPLY CARGO SHIPMENTS

PART I - DRY CARGO SHIPMENTS

	C.C.G.SHIPS	COMMERCIAL SHIPS	TOTAL
NORTHERN (N)	1,227.89 s/t	20,544.31 s/t	21,772.20 s/t
LATERAL (L)	148.20	206.12	354.32
RETROGRADE (R)	154.45	154.96	309.41
TRANSFER (T)	306.16	52.00	358.16
GRAND TOTAL	* 1,836.70	*** 20,957.39	22,794.09 s/t

PART II - BULK PETROLEUM SHIPMENTS

NORTHERN (N)	1,026.69 s/t	37,825.67 s/t	38,852.36 s/t
SHUTTLE (S)	13,545.06	543.08	14,088.14
BUNKERS (B)	Nil	7,663.38	7,663.38
GRAND TOTAL	**14,571.75	****46,032.13	60,603.88 s/t

*	Canadian Coast Guard Ships	(Dry Cargo)	1,836.70 s/t	
**		(Bulk POL)	14,571.75	
***	Commercial Ships	(Dry Cargo)	20,957.39	
****		(Bulk POL)	46,032.13	83,397.97 s/t

Northern Transportation Co. Ltd. (Western Arctic)	6,357.64
Goose Bay Operation	4,986.39
Frobisher Bay Operation	5,128.80
TOTAL	99,870.80 s/tons

Note: Cargo tonnage shown for the Northern Transportation Company Limited represent general cargo shipments to Arctic coastal destinations.

Note: Cargo tonnages shown for Goose Bay and Frobisher Bay is cargo handled for all interests, and is not cargo carried under contract to the Ministry of Transport.

Source: Operations Branch, Ministry of Transport, Statement of Tonnage Shipped/Handled to East and West Arctic, 1972, p. 11.

TABLE III-10

SUMMARY, MINISTRY OF TRANSPORT
1973 EASTERN ARCTIC RESUPPLY CARGO SHIPMENTS

PART I - DRY CARGO SHIPMENTS

	C.C.G.SHIPS	COMMERCIAL SHIPS	TOTAL
NORTHERN (N)	785.57 s/t	16,496.92 s/t	17,282.49 s/t
LATERAL (L)	323.43	384.10	707.53
RETROGRADE (R)	27.03	75.56	102.59
TRANSFER (T)	4.03		4.03
GRAND TOTAL	* 1,140.06 s/t	*** 16,956.58 s/t	18,096.64 s/tons

PART II - BULK PETROLEUM SHIPMENTS

NORTHERN (N)	618.27 s/t	45,341.46 s/t	45,959.73 s/t
SHUTTLE (S)	18,620.93		18,620.93
BUNKERS (B)	247.52	12,387.19	12,634.71
TRANSFER (T)		899.30	899.30
GRAND TOTAL	**19,486.72 s/t	****58,627.95 s/t	78,114.67 s/t

* Canadian Coast Guard Ships	(Dry Cargo)	1,140.06 s/t	
**	(Bulk POL)	19,486.72	
*** Commercial Ships	(Dry Cargo)	16,956.58	
****	(Bulk POL)	58,627.95	
	TOTAL		96,211.31 s/tons

Source: Operations Branch, Ministry of Transport, Statement of Tonnage Shipped/Handled to Eastern Arctic, 1973, p. 10.

Map III-7 illustrates destinations by contract area of cargo delivered in 1972 by vessels used under contract to the Ministry under the eastern Arctic resupply. Map III-6 illustrates destinations of cargo delivered by vessels delivering cargo for private enterprises.*

An example of private shipping unloading at Location 6, Rae Point, Melville Island, (Map III-6) is shown on Photo III-1. Deep water is found very close to shore due to the shape of the Arctic delta at this location. Material is bulldozed out, a floating wharf is placed at the end, and the supply vessel draws alongside. The vessel is unloaded with a shipboard crane onto the wharf, and trucks then transport the cargo to its inland destination.

Table III-11,"1972 Eastern Arctic Resupply Dry Cargo Contract Area Ports of Discharge, Contracted Rate/Ton and Tonnage Shipped",details 1972 price/ton and total tonnage of cargo shipped to each contract area. Table III-12,"1973 Eastern Arctic Resupply Dry Cargo Contract Area Ports of Discharge, Contracted Rate/Ton/Commodity Grouping and Contracted Tonnage", details 1973 price/ton/cargo commodity grouping and total tonnage shipped to each contract area. Composition of each cargo commodity group is shown in Table III-13. Composition of contract areas changes from year to year, dependent upon the amount of cargo to be shipped to individual destinations; however, cost/ton of delivered cargo to individual destinations over 1972 and 1973 is available through comparison of the two tables.

Table III-14 details inward/outward cargo shipments by port for the 1973 eastern Arctic resupply. POL shipments to Arctic Quebec sites do not appear on this table because the area is serviced by Shell Canada Limited under contract to the Department of Indian and Northern Affairs; nor do POL shipments to Frobisher Bay, which is serviced by Imperial Oil Limited, under contract to the Government of the Northwest Territories.

Table III-14 also illustrates the origin port of Arctic cargo shipments. Most general cargo is shipped ex Montreal. Bulk oil products originate at Quebec (St. Romuald), Goose Bay (military POL resupply) and Churchill. Due to shallow water conditions prevalent on the west coast of Hudson Bay, POL is lightered to adjacent settlements from Churchill. Beginning in 1975, resupply of the six Keewatin communities on the west side of Hudson Bay will be provided from Churchill by The Northern Transportation Company Limited.

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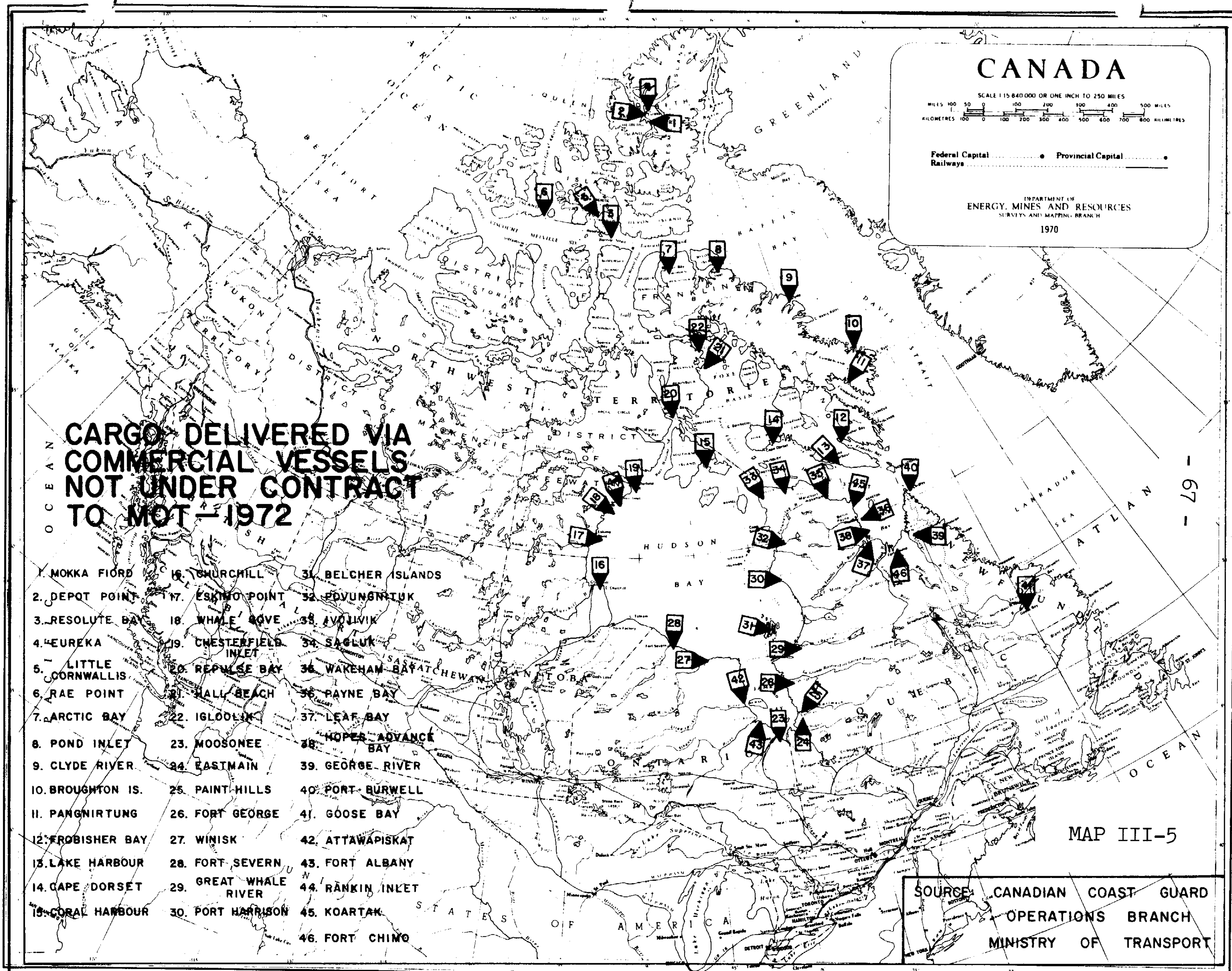
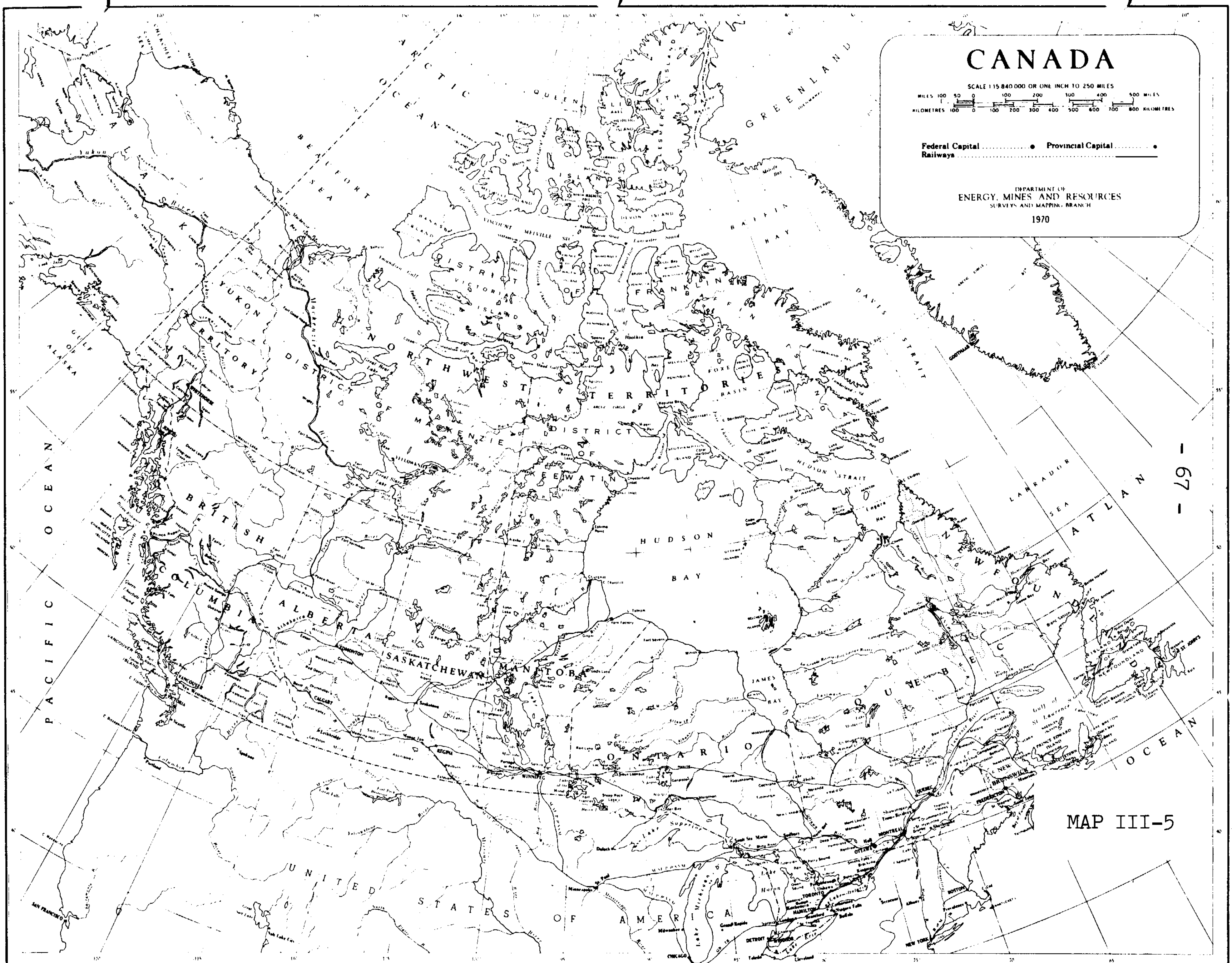
* This differentation is made between MOT public resupply and private resupply, because the majority of MOT cargo is carried for military installations and the Department of Indian and Northern Affairs. See Appendix 3, "1972 Ministry of Transport Arctic Resupply , List of Customers".


CARGO DELIVERED VIA COMMERCIAL VESSELS NOT UNDER CONTRACT TO MOT — 1972
1. MOKKA FIORD
2. DEPOT POINT
3. RESOLUTE BAY
4. EUREKA
5. LITTLE CORNWALLIS
6. RAE POINT
7. ARCTIC BAY
8. POND INLET
9. CLYDE RIVER
10. BROUGHTON IS.
11. PANGNIRTUNG
12. FROBISHER BAY
13. LAKE HARBOUR
14. CAPE DORSET
15. CORAL HARBOUR
16. CHURCHILL
17. ESKIMO POINT
18. WHALE COVE
19. CHESTERFIELD INLET
20. REPULSE BAY
21. HALL BEACH
22. IGLOOLIK
23. MOOSONEE
24. EASTMAIN
25. PAINT HILLS
26. FORT GEORGE
27. WINISK
28. FORT SEVERN
29. GREAT WHALE RIVER
30. PORT HARRISON
31. BELCHER ISLANDS
32. POVUNGNITUK
33. IVUJIVIK
34. SAGLUK
35. WAKEHAM BAY
36. PAYNE BAY
37. LEAF BAY
38. HOPES ADVANCE BAY
39. GEORGE RIVER
40. PORT BURWELL
41. GOOSE BAY
42. ATTAWAPISKAT
43. FORT ALBANY
44. RANKIN INLET
45. KOARTAK
46. FORT CHIMO
CANADA
SCALE 1:15 840 000 OR ONE INCH TO 250 MILES
Federal Capital
Provincial Capital
Railways
DEPARTMENT OF ENERGY, MINES AND RESOURCES
SURVEYS AND MAPPING BRANCH
1970
HUDSON BAY
MAP III-5
SOURCE: CANADIAN COAST GUARD OPERATIONS BRANCH MINISTRY OF TRANSPORT

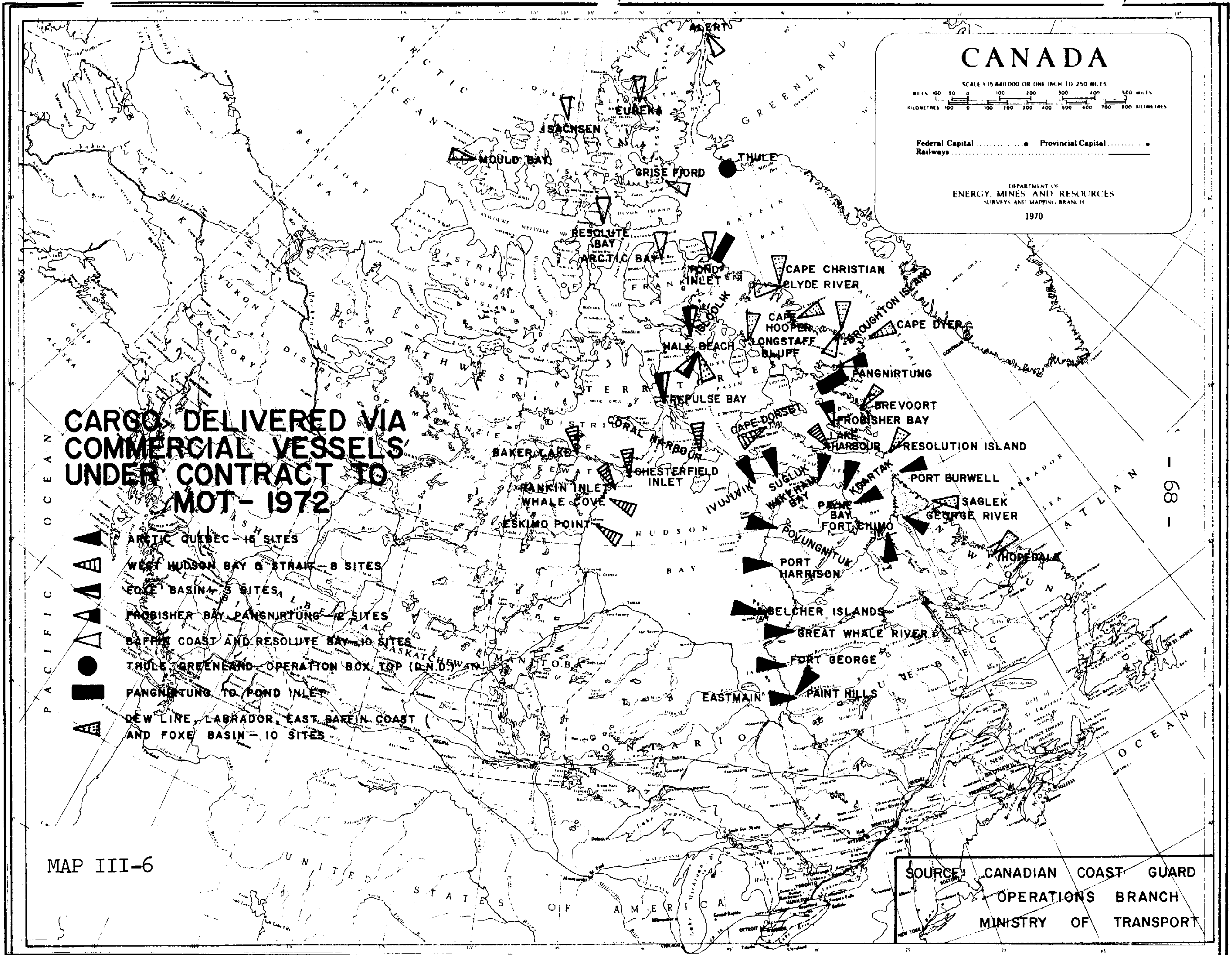
CARGO DELIVERED VIA COMMERCIAL VESSELS NOT UNDER CONTRACT TO MOT—1972

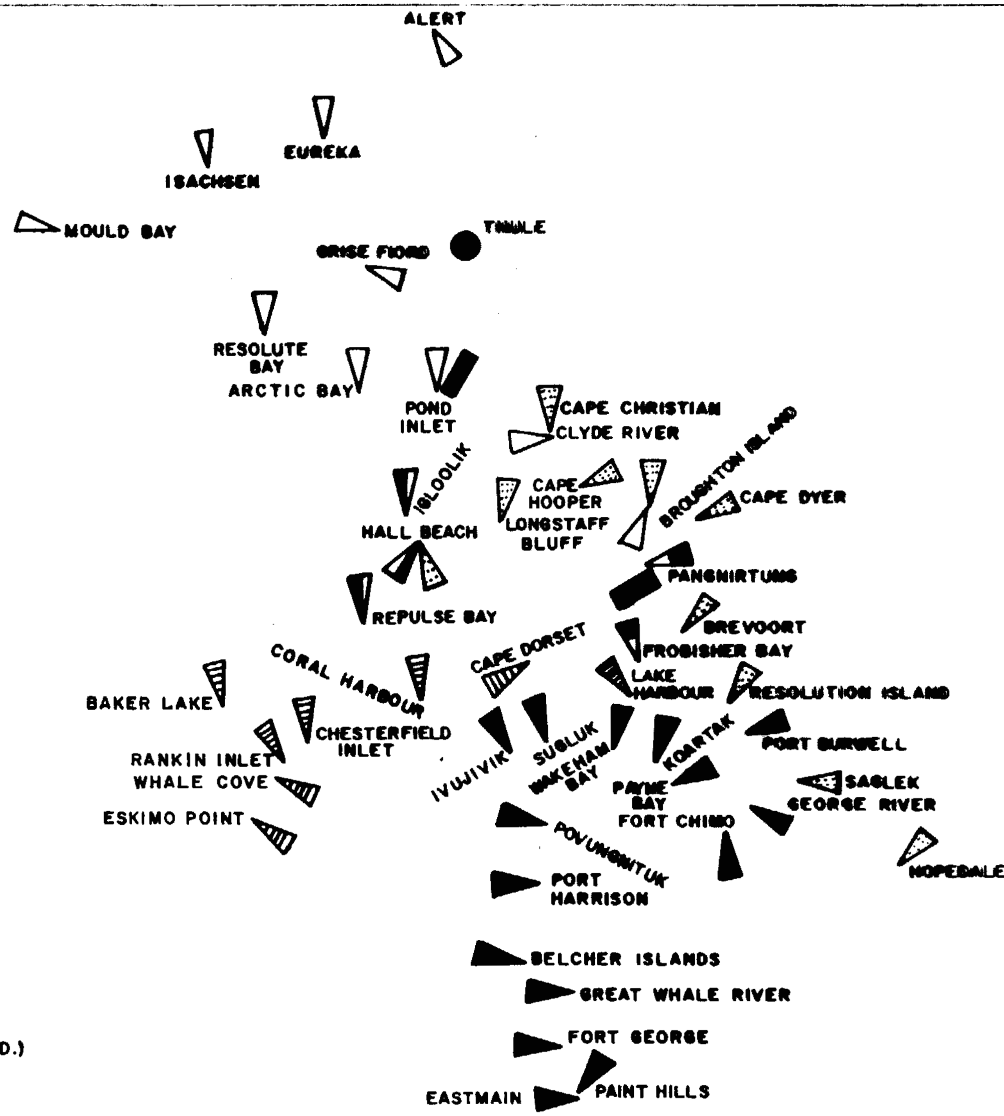
1. MOKKA FIORD
2. DEPOT POINT
3. RESOLUTE BAY
4. EUREKA
5. LITTLE CORNWALLIS
6. RAE POINT
7. ARCTIC BAY
8. POND INLET
9. CLYDE RIVER
10. BROUGHTON IS.
11. PANGNIRTUNG
12. FROBISHER BAY
13. LAKE HARBOUR
14. CAPE DORSET
15. CORAL HARBOUR
16. CHURCHILL
17. ESKIMO POINT
18. WHALE COVE
19. CHESTERFIELD INLET
20. REPULSE BAY
21. HALL BEACH
22. IGLOOLIK
23. MOOSONEE
24. EASTMAIN
25. PAINT HILLS
26. FORT GEORGE
27. WINISK
28. FORT SEVERN
29. GREAT WHALE RIVER
30. PORT HARRISON
31. BELCHER ISLANDS
32. POVUNGNITUK
33. IVUJIVIK
34. SAGLUK
35. WAKEHAM BAY
36. PAYNE BAY
37. LEAF BAY
38. HOPES ADVANCE BAY
39. GEORGE RIVER
40. PORT BURWELL
41. GOOSE BAY
42. ATTAWAPISKAT
43. FORT ALBANY
44. RANKIN INLET
45. KOARTAK
46. FORT CHIMO

SOURCE: CANADIAN COAST GUARD
OPERATIONS BRANCH
MINISTRY OF TRANSPORT


CANADA
SCALE 1:15 840 000 OR ONE INCH TO 250 MILES
Federal Capital
Provincial Capital
Railways
DEPARTMENT OF
ENERGY, MINES AND RESOURCES
SURVEYS AND MAPPING BRANCH
1970
ARCTIC OCEAN
BEAUFORT SEA
GREENLAND
BAFFIN BAY
DAVIS STRAIT
HUDSON STRAIT
LABRADOR SEA
HUDSON BAY
JAMES BAY
PACIFIC OCEAN
ATLANTIC OCEAN
GULF OF ALASKA
ALASKA
YUKON TERRITORY
NORTHWEST TERRITORIES
DISTRICT OF MACKENZIE
DISTRICT OF KEEWATIN
DISTRICT OF FRANKLIN
BRITISH COLUMBIA
ALBERTA
SASKATCHEWAN
MANITOBA
ONTARIO
QUEBEC
NEWFOUNDLAND
NEW BRUNSWICK
PRINCE EDWARD ISLAND
UNITED STATES OF AMERICA
WINNIPEG
REGINA
EDMONTON
CALGARY
VANCOUVER
VICTORIA
TORONTO
OTTAWA
MONTREAL
QUEBEC
FREDERICTON
HAMILTON
DETROIT
CHICAGO
NEW YORK
BOSTON
SAN FRANCISCO

MAP III-5

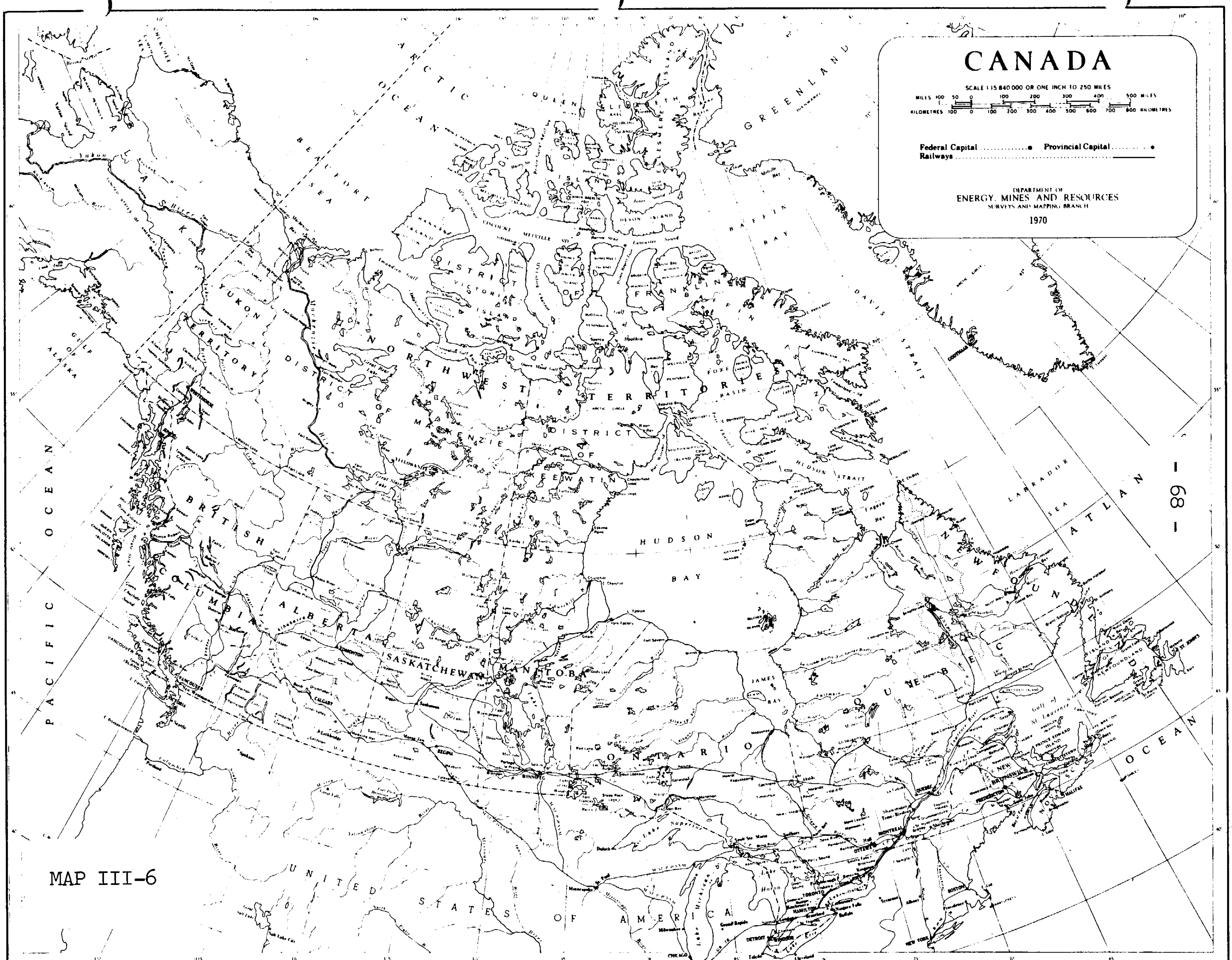

CARGO DELIVERED VIA COMMERCIAL VESSELS UNDER CONTRACT TO MOT - 1972
ARCTIC QUEBEC - 15 SITES
WEST HUDSON BAY & STRAIT - 8 SITES
FOXE BASIN - 3 SITES
FROBISHER BAY PANGNIRTUNG - 12 SITES
BAFFIN COAST AND RESOLUTE BAY - 10 SITES
THULE, GREENLAND - OPERATION BOX TOP (D.N.D.)
PANGNIRTUNG TO POND INLET
DEW LINE, LABRADOR, EAST BAFFIN COAST AND FOXE BASIN - 10 SITES
CANADA
SCALE 1:15 840 000 OR ONE INCH TO 250 MILES
Federal Capital
Provincial Capital
Railways
DEPARTMENT OF ENERGY, MINES AND RESOURCES
SURVEYS AND MAPPING BRANCH
1970
ALERT
EUREKA
ISACHSEN
MOULD BAY
THULE
GRISE FIORD
RESOLUTE BAY
ARCTIC BAY
POND INLET
CAPE CHRISTIAN
CLYDE RIVER
IGLOOLIK
CAPE HOOPER
BROUGHTON ISLAND
CAPE DYER
HALL BEACH
LONGSTAFF BLUFF
PANGNIRTUNG
REPULSE BAY
BREVOORT
FROBISHER BAY
CAPE DORSET
CORAL HARBOUR
LAKE HARBOUR
RESOLUTION ISLAND
BAKER LAKE
CHESTERFIELD INLET
IVUJIVIK
SUGLUK
WAKEHAM BAY
KOARTAK
PORT BURWELL
RANKIN INLET
WHALE COVE
PAYNE BAY
SAGLEK
FORT CHIMO
GEORGE RIVER
ESKIMO POINT
POVUNGNITUK
HOPEDALE
PORT HARRISON
BELCHER ISLANDS
GREAT WHALE RIVER
FORT GEORGE
EASTMAIN
PAINT HILLS
HUDSON BAY
PACIFIC OCEAN
ARCTIC OCEAN
ATLANTIC OCEAN
GREENLAND
UNITED STATES OF AMERICA
MAP III-6
SOURCE: CANADIAN COAST GUARD OPERATIONS BRANCH MINISTRY OF TRANSPORT



CARGO DELIVERED VIA COMMERCIAL VESSELS UNDER CONTRACT TO MOT - 1972

- ARCTIC QUEBEC - 15 SITES
- WEST HUDSON BAY & STRAIT - 8 SITES
- FOXE BASIN - 3 SITES
- FROBISHER BAY PANGNIRTUNG - 2 SITES
- BAFFIN COAST AND RESOLUTE BAY - 10 SITES
- THULE, GREENLAND - OPERATION BOX TOP (D.N.D.)
- PANGNIRTUNG TO POND INLET
- DEW LINE, LABRADOR, EAST BAFFIN COAST AND FOXE BASIN - 10 SITES

SOURCE: CANADIAN COAST GUARD
OPERATIONS BRANCH
MINISTRY OF TRANSPORT


CANADA
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DEPARTMENT OF
ENERGY, MINES AND RESOURCES
SURVEYS AND MAPPING BRANCH
1970
ARCTIC OCEAN
BEAUFORT SEA
GREENLAND
BAFFIN BAY
DAVIS STRAIT
QUEEN ELIZABETH ISLANDS
DISTRICT OF FRANKLIN
VICTORIA ISLAND
ALASKA
GULF OF ALASKA
YUKON TERRITORY
NORTHWEST TERRITORIES
DISTRICT OF MACKENZIE
DISTRICT OF KEEWATIN
FOXE BASIN
HUDSON STRAIT
LABRADOR SEA
HUDSON BAY
JAMES BAY
BRITISH COLUMBIA
ALBERTA
SASKATCHEWAN
MANITOBA
ONTARIO
QUEBEC
NEWFOUNDLAND
NEW BRUNSWICK
NOVA SCOTIA
PRINCE EDWARD ISLAND
PACIFIC OCEAN
ATLANTIC OCEAN
UNITED STATES OF AMERICA
MAP III-6

PHOTO III-1

PRIVATE RESUPPLY VESSEL UNLOADING AT REA POINT, MELVILLE ISLAND

AUGUST 1973

Source: Department of Energy, Mines and Resources.

TABLE III- 11

1972 EASTERN ARCTIC RESUPPLY DRY CARGO
CONTRACT AREA PORTS OF DISCHARGE
CONTRACTED RATE/TON AND TONNAGE SHIPPED

Area	Contracted Rate/Ton (2,000 lbs)	Total Tonnage
ARCTIC QUEBEC AREA		
1. George River	$140	6,569
2. Fort Chimo		
3. Payne Bay		
4. Koartak		
5. Wakeham Bay		
6. Sugluk		
7. Ivujivik		
8. Povungnituk		
9. Port Harrison		
10. Great Whale River		
11. Fort George		
12. Paint Hills		
13. Eastmain		
AREA "A" KEEWATIN		
1. Baker Lake	$127	3,916
2. Coral Harbour		
3. Eskimo Point		
4. Whale Cove		
5. Belcher Island		
6. Chesterfield Inlet		
7. Rankin Inlet		
8. Port Burwell		
9. Lake Harbour		
10. Cape Dorset		
AREA "B" FOXE BASIN		
1. Igloolik	$185	1,208
2. Repulse Bay		
3. Hall Beach		
AREA "C"		
1. Frobisher Bay	$125	1,911
2. Pangnirtung		

. . . . 2

Area	Contracted Rate/Ton (2,000 lbs)	Total Tonnage
AREA "D" HIGH ARCTIC		
1. Grise Fiord	$160	2,971
2. Pond Inlet		
3. Arctic Bay		
4. Clyde River		
5. Broughton Island		
6. Resolute Bay		
7. Alert) via aircraft		
8. Isachsen) from Resolute		
9. Mould Bay) Bay		
DND OPERATION BOXTOP		
1. Thule, Greenland (cargo delivered via aircraft to Alert)	$292.39	270
USAF & USCG SITES		
1. Saglek	$378	851
2. Resolution Island		
3. Breevort		
4. Cape Dyer		
5. Broughton Island		
6. Cape Hooper		
7. Cape Cristian		
8. Hall Beach		
9. Rowley Island		
MISCELLANEOUS SITES		
1. Eureka	$175	909
2. Greely Fiord		
3. Tanquary Fiord		
4. Truelove Lowland		
5. Alexandria Fiord		
6. Cape Christian	$160	
7. Battle Harbour	$105	
8. Cartwright		
9. Saglek	$270	
10. Resolution Island		
11. Cape Dyer		
12. Cape Hooper		

Source: Marine Finance Directorate, Ministry of Transport, 1972 Arctic Resupply Policy Questions, Statistics, Costs, Feb 1973; and Status of 1972 Resupply Operation as of September 15, 1972.

TABLE III-12

1973 EASTERN ARCTIC RESUPPLY DRY CARGO
CONTRACT AREA PORTS OF DISCHARGE
CONTRACTED RATE/TON PER COMMODITY GROUPING AND CONTRACTED TONNAGE*

Ports of Discharge	Freight Rate $/Short Ton EX Montreal		Average Vol. Cubic Feet/ Short Ton	Contracted Tonnage
AREA "A" ARCTIC QUEBEC				3,366
1. George River	Commodity Group A	$ 121	80 cu. ft.	
2. Fort Chimo	B	100	65 "	
3. Payne Bay	C	180	120 "	
4. Koartak	D	230	150 "	
5. Wakeham Bay	E	380	250 "	
6. Sugluk	F	450	85 "	
7. Ivujivik	G	450	85 "	
8. Port Harrison	H	365	243 "	
9. Povungnituk	J	1,080	720 "	
10. Great Whale River				
11. Belcher Islands				
12. Fort George				
13. Eastmain				
14. Paint Hills				
AREA "B" FOXE BASIN				1,279
1. Igloolik	Commodity Group A	$ 128	70 cu. ft.	
2. Repulse Bay	B	111	60 "	
3. Hall Beach	C	219	120 "	
	D	274	150 "	
	E	712	400 "	
	F	150	100 "	
	G	183	100 "	
	H	732	400 "	
	J	732	400 "	
AREA "C" FROBISHER BAY				1,552
1. Frobisher Bay	Commodity Group A	$ 125	80 cu. ft.	
	B	125	60 "	
	C	125	100 "	
	D	250	200 "	
	E	375	300 "	
	F	300	120 "	
	G	300	120 "	
	H	375	300 "	
	J	375	300 "	

* Note: Contracted tonnage may be less than tonnage actually shipped (as shown on Table III-) due to tonnage added after contract was awarded.

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Ports of Discharge	Freight Rate $/Short Ton EX Montreal		Average Vol: Cubic Feet/ Short Ton	Contracted Tonnage
AREA "D" PANGNIRTUNG				856
1. Pangnirtung	Commodity Group A	$ 125	80 cu. ft.	
	B	125	60 "	
	C	125	100 "	
	D	250	200 "	
	E	375	300 "	
	F	300	120 "	
	G	300	120 "	
	H	375	300 "	
	J	375	300 "	
AREA "E" HUDSON BAY & STRAIT				4,581
1. Port Burwell	Commodity Group A	$ 90	80 cu. ft.	
2. Lake Harbour	B	100	65 "	
3. Cape Dorset	C	183	120 "	
4. Coral Harbour	D	230	150 "	
5. Chesterfield Inlet	E	385	250 "	
6. Baker Lake	F	450	85 "	
7. Rankin Inlet	G	450	85 "	
8. Whale Cove	H	600	392 "	
9. Eskimo Point	J	540	333 "	
AREA "F" BAFFIN COAST AND RESOLUTE BAY				2,729
1. Resolute Bay	Commodity Group A	$ 111	70 cu. ft.	
2. Isachsen	B	95	60 "	
3. Mould Bay) via aircraft	C	190	120 "	
4. Alert) from Resolute	D	230	150 "	
5. Arctic Bay) Bay	E	600	400 "	
6. Pond Inlet	F	158	100 "	
7. Clyde River	G	158	100 "	
8. Broughton Island	H	632	400 "	
9. Cape Christian	J	632	400 "	
AREA "G" HIGH ARCTIC				614
1. Eureka	Commodity Group A	$ 323	70 cu. ft.	
2. Grise Fiord	B	276	60 "	
	C	550	120 "	
	D	700	150 "	
	E	1,840	400 "	
	F	511	100 "	
	G	476	100 "	
	H	1,840	400 "	
	J	1,840	400 "	

. . . . 3

3.

Ports of Discharge	Freight Rate $/Short Ton EX Montreal			Average Vol. Cubic Feet/ Short Ton	Contracted Tonnage
AREA "H" BOXTOP					341
1. Thule, Greenland (cargo delivered via aircraft to Alert)	Commodity Group	A	$ 217	70 cu. ft.	
		B	184	60 "	
		C	367	120 "	
		D	462	150 "	
		E	Nil	Nil "	
		F	Nil	Nil "	
		G	Nil	Nil "	
		H	1,232	400 cu. ft.	
		J	Nil	Nil	

Source: Operations Branch,
Ministry of Transport.

TABLE III-13

CARGO COMMODITY GROUPING
1973 EASTERN ARCTIC RESUPPLY

GROUP 'A'

1. ELECTRICAL MATERIAL
2. ELECTRICAL CABLE
3. PLUMBING MATERIAL
4. HARDWARE
5. NAILS
6. GLASS
7. SHINGLES (ROOFING)
8. ROOFING PAPER
9. PAINTS, VARNISHES, ETC
10. FLOOR TILE
11. TOOLS AND IMPLEMENTS
12. ANTIFREEZE
13. WELDING RODS
14. AMMUNITION
15. BATTERIES
16. CEMENT
17. CEMENT BLOCKS
18. REPAIR PARTS FOR EQUIPMENT
19. STEEL, REINFORCING
20. EDUCATIONAL WORKSHOP EQUIPMENT
21. JANITORIAL SUPPLIES
22. STAPLE FOOD
23. OTHER ITEMS OF APPROXIMATELY THE SAME STOWAGE FACTOR

GROUP 'B'

1. GASOLINE (DRUM)
2. PROPANE GAS (CYLINDER)
3. WELDING GAS (CYLINDER)
4. OIL, HEATING (DRUM)
5. OIL, DIESEL (DRUM)
6. OIL, LUBRICATING (DRUM)
7. CHEMICALS (DRUM)
8. ASPHALT (DRUM)
9. OTHER ITEMS OF APPROXIMATELY THE SAME STOWAGE FACTOR

GROUP 'C'

1. LUMBER
2. PLYWOOD
3. DOORS
4. WINDOWS
5. ASBESTOS BOARD
6. PLASTIC BOARD
7. CUPBOARDS
8. CARPETS, LINOLEUM
9. DRY GOODS
10. PERSONAL AND HOUSEHOLD EFFECTS (EXCLUDING HOME FURNISHINGS)
11. PAPER PRODUCTS
12. FARM WAGONS (KNOCK-DOWN)
13. METAL PIPING
14. PLASTIC PIPE
15. BUILDINGS, STEEL SHELL (KNOCK-DOWN)
16. DIESEL GENERATING PLANT (UNDER 5 TONS)
17. MACHINERY, AIR COMPRESSOR, CEMENT MIXER
18. SKIDOO
19. OUTBOARD MOTOR
20. OTHER ITEMS OF APPROXIMATELY THE SAME STOWAGE FACTOR

GROUP 'D'

1. FURNITURE (HOUSEHOLD)
2. ELECTRICAL APPLIANCES (HOUSEHOLD)
3. OIL STOVE
4. OIL FURNACE
5. OFFICE FURNITURE
6. OFFICE EQUIPMENT
7. POWER POLES (Maximum length 50 ft.)
8. OTHER ITEMS OF APPROXIMATELY THE SAME STOWAGE FACTOR

GROUP 'E'

1. CANOE (24 Ft. Max.)
2. SMALL BOAT (24 Ft. Max.)
3. PREFABRICATED PANELS - KNOCK-DOWN (Walls, Roof, Floor)
4. UTILIDOOR CASINGS
5. CHIMNEYS, PREFABRICATED
6. DOMESTIC TANKS (WATER, SEWAGE & OIL)
7. CHEMICAL TOILETS
8. METAL DUCTS
9. ROOF TRUSSES
10. CULVERTS
11. OTHER ITEMS OF APPROXIMATELY THE SAME STOWAGE FACTOR

GROUP 'F'

1. CHILL FOOD

GROUP 'G'

1. FREEZE FOOD

GROUP 'H'

1. CARS
2. VANS
3. UTILITY TRAILERS
4. TRUCK - UNDER 7 TONS (DUMP, WATER, SEWAGE, ETC)
5. TRACTORS (FARM OR EQUIVALENT)
6. FARM WAGONS (SET UP)
7. TRACKED VEHICLES - UNDER 7 TONS (Dimensions and Weight to be shown)

GROUP 'J'

1. BULLDOZER/SNOWBLOWER
2. GRADER
3. COMPACTORS
4. AIR COMPRESSOR
5. TRUCKS (OFF HIGHWAY)
6. MOBILE HOME, OFFICE, CLINIC (SET UP)
7. BULK STORAGE TANKS (SET UP)
8. INSULATION (FIBERGLASS & STYROFOAM)
9. ALL ITEMS OF A HEAVY AND/OR BULKY NATURE NOT OTHERWISE INCLUDED IN THE COMMODITY GROUPING (Dimensions and Weight to be shown)

Source: Operations Branch, Ministry of Transport.

TABLE III-14

1973 EASTERN ARCTIC RESUPPLY
INWARD/OUTWARD CARGO SHIPMENTS BY PORT

	INWARD SHIPMENTS		OUTWARD SHIPMENTS	
	DRY CARGO (s/tons)	BULK PETROLEUM (s/tons)	DRY CARGO (s/tons)	BULK PETROLEUM (s/tons)
ALERT (via Thule)	419.142			
ALEXANDRA FIORD	71.010			
ARCTIC BAY	197.787			
BAKER LAKE	909.805	3,597.832	21.662	
BATTLE HARBOUR	3.008	224.067		
BAYONNE, New Jersey, U.S.A.			1,000.469	
BELCHER ISLANDS	258.269		6.370	
BREVOORT	40.030	706.000	.420	
BROUGHTON ISLAND	321.825	745.000	10.259	
CAPE CHRISTIAN	113.155	375.000	12.840	
CAPE DORSET	600.533		12.000	
CAPE DYER	249.648	4,885.996	3.652	
CAPE HOOPER	77.905	694.000	2.385	
CARTWRIGHT	2.218	124.488		
CHESTERFIELD INLET	190.050	1,842.185		
CHURCHILL	8.000		1,455.121	18,834.797
CLYDE RIVER	260.620			
COBOURG ISLAND	5.220			
CORAL HARBOUR	822.778	1,956.751	2.000	
DARTMOUTH	11.050		168.345	469.961
ESKIMO POINT	778.441	2,108.074	2.500	
EUREKA	348.637	248.961	69.360	
FORT CHIMO	750.654			
FORT GEORGE	306.682			
FROBISHER BAY	1,726.891		18.160	
GEORGE RIVER	95.567			
GJOA HAVEN	56.500			
GOOSE BAY	1,029.629		187.896	16,520.730
GREAT WHALE RIVER	805.745		2.615	
GREELY FIORD	85.497		2.500	
GRISE FIORD	202.878		.262	
HALIFAX	30.633			
HALL BEACH	611.132	8,990.719	8.685	
HAT ISLAND			56.500	
HOPEDALE		2,267.751		
IGLOOLIK	553.855	2,187.734	.440	
ISACHSEN	114.969			
IVUJIVIK	68.318		9.000	
KOARTAK	289.437			
LAKE HARBOUR	89.685			
LONGSTAFF BLUFF	85.360	968.000	.741	
MONTREAL	59.144		14,611.057	14,855.569
MOOSONEE			18.000	
MOULD BAY	81.830			
PAINT HILLS	18.000			
PANGNIRTUNG	850.793	2,338.669	21.000	
PAYNE BAY	39.150			
POND INLET	327.281			
PORT BURWELL	50.019			
PORT HARRISON	183.686		.200	
POVUNGNITUK	260.143		1.401	
QUEBEC	12.160		67.053	
RAE POINT	45.537			
RANKIN INLET	1,391.013	3,957.979	.700	
REPULSE BAY	409.447	1,169.502	.700	
RESOLUTE BAY	975.749		24.313	
RESOLUTION ISLAND	120.600	2,825.000	8.502	
SAGLEK	146.449	2,814.999		
ST. ROMAULD				7,886.996
SUGLUK	63.373		.439	
TANQUARY FIORD	77.478			
TRUELOVE LOWLAND			6.550	
WAKEHAM BAY	261.774		26.646	
WHALE COVE	128.084	911.153	253.000	
SHIP'S BUNKERS				
M.V. AIGLE MARIN		25.743		
CSS BAFFIN		105.200		
CCGS BERNIER		488.200		
M.V. P.M. CROSBIE		221.000		
CCGS D'IBERVILLE		3,766.500		
CCGS EIDER		29.050		
CCGS LABRADOR		851.200		
CCGS J. A. MACDONALD		1,109.900		
CCGS N.B. McLEAN		1,179.300		
M. V. JOS SIMARD		843.300		
CCGS LOUIS ST. LAURENT		3,999.800		
GRAND TOTAL	18,0[illegible].773	[illegible],568.053	18,031.773	58,568.053

Source: Operations Br, Ministry of Transport, Statement of Tonnage Handled to Eastern Arctic 1973, p. 9.

Booking for Ministry of Transport eastern Arctic resupply tonnages for 1974 is anticipated to be about the same as in 1973. Preliminary estimates of equipment, materials and fuels shipments to the Arctic Islands in support of oil and gas exploration is expected to be about the same as 1973 at about 20,000 tons of equipment and materials and some 20,000 tons of fuel. These cargo shipments estimates are exclusive of restocking the tank farm at Resolute Bay, as well as cargo shipments in support of mining exploration and development.

Possible return cargo shipments may be made of one or even two drilling rigs, due to a decrease in the exploration rate as a result of a disappointing discovery record, together with governmental delay in promulgating new lease and royalty rules. Another possible source of return cargo which becomes more attractive as scrap prices rise, are crushed steel oil drums, of which some 1,500 tons may be shipped from the Islands in 1974.*

2. The Mackenzie Basin Resupply**

The Mackenzie Basin resupply involves cargo carriage from the upper Mackenzie River, at the rail terminus at Hay River on Great Slave Lake, to Tuktoyaktuk on the Arctic coast, a water distance of some 1,100 miles. As well, cargo is carried to locations on Great Slave and Great Bear Lakes, as well as eastward and westward along the Arctic coast. Under the Transport Act, the Water Transport Committee of the Canadian Transport Commission is responsible for the licencing of vessels for use in the transport of goods and passenger by water in the Mackenzie watershed.

The Northern Transportation Company Limited (NTCL) is the principal carrier on the River. See Map III-5 for NTCL resupply routes. KAPS Transport was granted a licence in 1969, and is the second largest carrier. See Table III-15 for details on vessel capacity of the two companies.

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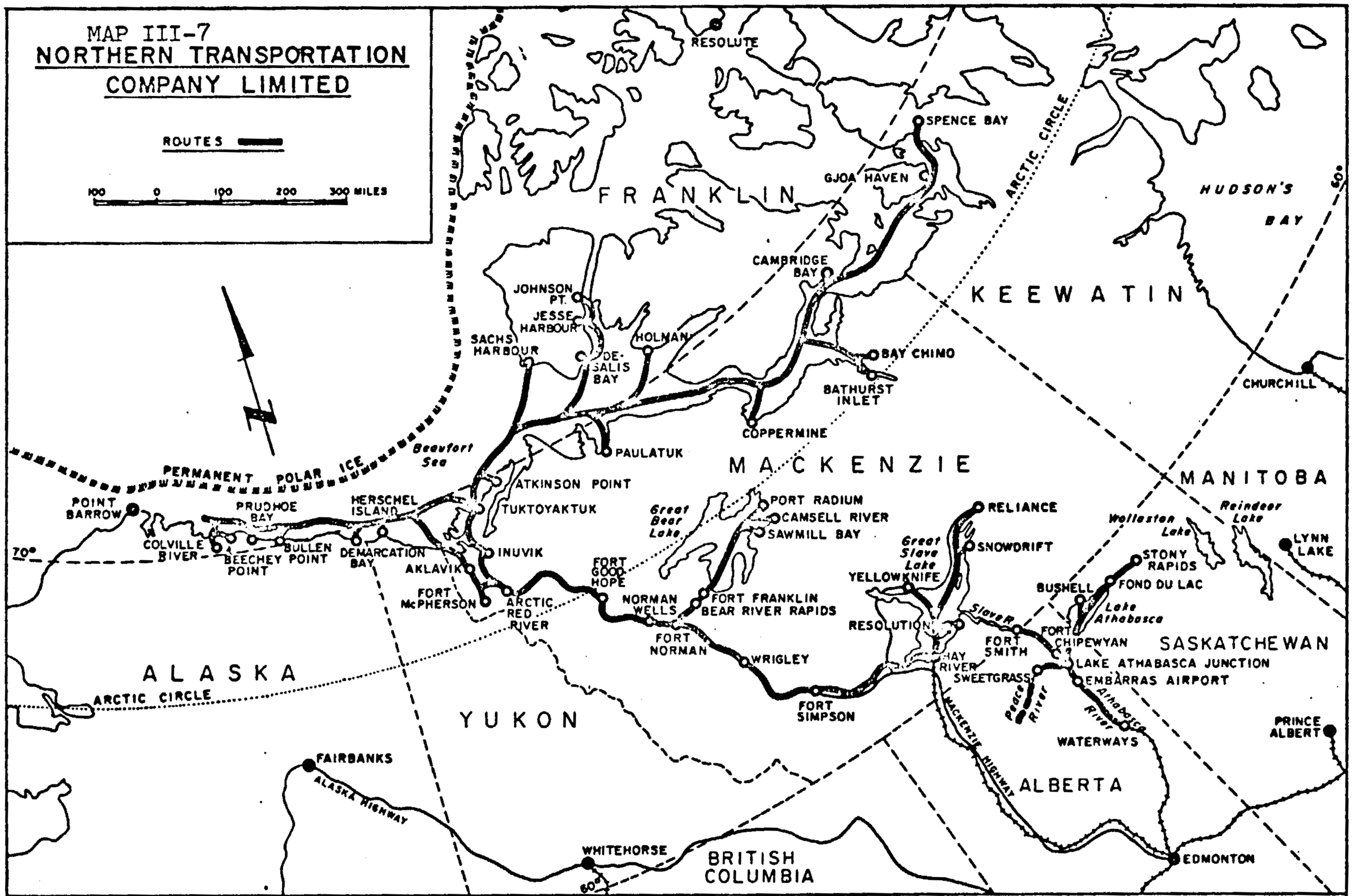
* "Big Arctic Sealift in '74", Oilweek, March 4, 1974, p. 42 and 50.

** The general source for this sub-section is: Swan Wooster Engineering Company Limited, Mackenzie Valley Water Transportation Study, prepared for the Canadian Transport Commission, Economics Branch, November 1972.

MAP III-7
NORTHERN TRANSPORTATION COMPANY LIMITED



SAILING — MILEAGES

ARCTIC - AREA

EASTWARD		WESTWARD	
TUKTOYAKTUK	MILE 0	TUKTOYAKTUK	MILE 0
ATKINSON POINT	81	HERSCHEL ISLAND	135
SACHS HARBOUR	269	DEMARCATION BAY	185
PAULATUK	322	BULLEN POINT U.S.A.	343
DE SALIS BAY	334	PRUDHOE BAY U.S.A.	387
HOLMAN ISLAND	396	COLVILLE RIVER U.S.A.	420
JESSE BAY	417	BEECHEY POINT U.S.A.	* 446
JOHNSON POINT	456		
COPPERMINE	638		
BAY CHIMO	715		
BATHURST INLET	715		
CAMBRIDGE BAY	785		
GJOA HAVEN	1042		
SPENCE BAY	1135		

*(SHALLOW APPROACHES REQUIRE CIRCUITOUS ROUTE)

HAY RIVER - NORTHWARD

HAY RIVER	MILE 0
FORT SIMPSON	238
WRIGLEY	390
FORT NORMAN	540
NORMAN WELLS	591
FORT GOOD HOPE	711
ARCTIC RED RIVER	925
FORT McPHERSON	980
AKLAVIK	1025
INUVIK	1042
TUKTOYAKTUK	1122

MACKENZIE AREA

GREAT SLAVE LAKE		GREAT BEAR LAKE	
HAY RIVER	MILE 0	FORT NORMAN	MILE 0
RESOLUTION	74	BEAR RIVER RAPIDS	74
YELLOWKNIFE	126	FORT FRANKLIN	77
SNOWDRIFT	212	SAWMILL BAY	165
FORT RELIANCE	282	CAMSELL RIVER	175
		PORT RADIUM	247

ATHABASCA - AREA

WATERWAYS	MILE 0
EMBARRAS AIRPORT	115
LAKE ATHABASCA JUNCTION	180
FORT CHIPEWYAN	200
SWEETGRASS	250
FORT SMITH	318
BUSHELL	273
FOND DU LAC	329
STONY RAPIDS	379

TABLE III-15

SUMMARY OF TOWBOAT POWER AND BARGE CARGO DWT FOR LICENCED CARRIERS ON THE MACKENZIE RIVER AS OF 1972*

(by area of operation)

	Towboats		Barges	
	No. in Service	Power (hp)	No. in Service	Cargo DWT
1. Northern Transportation				
(Mackenzie River)	11	16,335	96	60,570
(Mackenzie River and Arctic)	3	12,600	8	11,000
(Arctic)	-	-	2	3,120
(Great Bear River and Lake)	3	1,735	10	2,490
	17	30,670	116	77,120
2. KAPS Transport				
(Mackenzie River)	2	2,985	6	2,400
(Arctic and Mackenzie Rivers)	1	2,250	14	12,080
(Liard and Mackenzie Rivers)	2	1,770	3	NA
	5	7,005	23	14,480
3. Streeper Bros. Marine Transport				
Keen Industries (Nelson, Liard & Mackenzie Rivers)	1	295	3	250
Fort Nelson Marine Transport (Nelson, Liard & Mackenzie Rivers)	1	460	2	175
4. Cooper Barging Services (Nelson, Liard & Mackenzie Rivers)	2	1,210	4	620
5. Lindberg Transport (Mackenzie River)	2	610	1	50

Note: Four main companies will be operating on the Mackenzie during 1974. NTCL capacity has increased to 33 tugs and 176 barges. KAPS Transport capacity has increased to 10 tugs and 26 barges and Keen Industries to 7 tugs and 15 barges. A new company as of 1973 is Arctic Navigation and Transportation with 3 tugs and 10 barges. In addition three air cushion vehicles are currently operating in the area. (Source: "Big Arctic Sealift in '74", Oilweek, March 4, 1974.)

Source: Swan Wooster Engineering Company Limited, Mackenzie Valley Water Transportation Study, prepared for the Canadian Transport Commission, November 1972, p. 12.

The two companies have followed different patterns since 1969. Over the 1970 and 1971 seasons, NTCL transported about 80% of the total ton/mile volume of traffic carried by licenced carriers on the River. The NTCL carries most of the general cargo transported, serving river communities and transporting supplies for oil and gas exploration.

KAPS handles nearly all the remaining 20% of total ton/mile volume of barge traffic, of which about 75% moves to the Mackenzie Delta to supply oil and gas exploration. The smaller licenced operators generally operate in special areas, usually under contract.

Since 1968, the NTCL has made or planned investments in marine equipment and shoreside facilities totalling nearly $21 million. In contrast, KAPS has not invested to a large extent in shoreside facilities, instead utilizing public and private docks where available, or offloading onto the river bank.* Most of KAPS cargo is destined for oil and gas exploration sites, which shift with each drilling program. Table III-16 details NTCL and KAPS shoreside cargo transfer equipment. As can be seen in Table III-16, NTCL is now equipped to handle containers (8' x 8' cross section, 20' and 40' lengths) at Hay River and Inuvik. Cargo traffic moving down the Mackenzie, ultimately destined for Arctic mainland coastal destinations, has generally been transshipped at Tuktoyaktuk. This will decrease if the trend to containerize cargo to coastal destinations increases.

Variations in river level present problems in cargo transference. Barge decks drop below wharf level at low water, leading to more double handling, and thus slower cargo throughput. This is not a problem at the terminals with movable ramps, where forklift trucks can drive directly on and off the barge at any river level. Loading of bulk petroleum products is not affected by changing river levels, since flexible hoses are used. Maximum draft of barges operating on the Mackenzie is about five feet.

The volume of freight handled by the NTCL over the years 1950 to 1972 is listed in Table III-17. Tonnages have been increasing in an uneven fashion since 1968, the year of the Prudhoe Bay oil strike and the beginning of an exploratory surge on the Canadian side on the Delta. Table III-19 contains a breakdown of Mackenzie Basin resupply cargo for 1972.

Approximately 62% of total barge traffic in 1972 (including

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* Temporary barge docks are used in moving oil exploration camps and drilling rigs. The usual method of construction is to moor a barge as close as possible to shore using deadman anchors on shore, and bulldoze a ramp of river bank material out against the side of the barge. This first barge is unloaded and used as a wharf by the remainder of the barges in tow.

TABLE III-16

MACKENZIE BASIN NTCL & KAPS TRANSPORT SHORESIDE GENERAL CARGO TRANSFER EQUIPMENT AS OF 1972*

NTCL

Hay River

1 mobile crane, 10,000 lb @ 50' radius
1 mobile crane, 44,000 lb @ 50' radius (for container handling)
1 front end top loader (80,000 lb) (for container handling)
25 yard forklifts
22 warehouse forklifts

Norman Wells

2 yard forklifts
1 warehouse forklift

Great Bear River and Lake

6 yard forklifts
8 warehouse forklifts

Inuvik

1 mobile crane, 44,000 lb @ 50' radius (for container handling)
1 front end top loader (80,000 lb) (for container handling)
5 yard forklifts
5 warehouse forklifts

Tuktoyaktuk

1 mobile crane, 22,000 ob @ 50' radius
8 yard forklifts
7 warehouse forklifts
3 track forklifts

KAPS

Hay River

2 mobile crane, 25 ton capacity
1 forklift, 8 ton capacity
2 forklifts, 3 ton capacity
2 forklifts, 2 ton capacity

Inuvik

1 mobile crane, 35 ton capacity
1 mobile crane, 25 ton capacity
2 forklifts, 11 ton capacity

* Swan Wooster Engineering Company Limited, Mackenzie Valley Water Transportation Study, op. cit., p. 64,65.

TABLE III-17

NORTHERN TRANSPORTATION COMPANY LIMITED
VOLUME OF FREIGHT HANDLED
1950 TO 1972

Year	Freight (tons)	Percentage Change From Previous Year (per cent)
1950	42,953	
1951	53,359	24.2
1952	69,828	30.9
1953	79,270	13.5
1954	90,264	13.9
1955	122,713	35.9
1956	187,240	52.6
1957	188,642	0.7
1958	192,066	1.8
1959	174,058	- 9.4
1960	142,632	-18.1
1961	128,234	-10.1
1962	113,598	-11.4
1963	119,300	5.0
1964	127,903	7.2
1965	191,500	49.7
1966	171,065	-10.7
1967	166,214	- 2.8
1968	206,970	24.5
1969	256,354	23.9
1970	280,736	9.5
1971	283,321	0.9
1972	398,650	40.7

Source: A. Krolewski, Northwest Territories Statistical Abstract, 1973, (Department of Indian and Northern Affairs, August 1973), p. 142.

TABLE III-18

NORTHERN TRANSPORTATION COMPANY LIMITED
RATES FOR CLASS 5 - GENERAL FREIGHT, MACKENZIE RIVER SYSTEM AND WESTERN ARCTIC POINTS, NORTHWEST TERRITORIES

(Northern Transportation Company Limited Freight Tariff, Edmonton, June 1973)

From Hay River to:	Miles	Rate per 100 lbs (dollars)	Cost per Ton/Mile (cents)
Aklavik	1,025	2.60	5.1
Arctic Red River	925	2.47	5.3
Cambridge Bay	1,907	6.85	7.2
Cape Parry	1,372	4.21	6.1
Coppermine	1,760	6.32	7.2
Fort Franklin	617	3.45	11.2
Fort Good Hope	711	2.04	5.7
Fort Norman	540	1.69	6.3
Fort Simpson	238	1.30	10.9
Fort Wrigley	390	1.56	8.0
Holman Island	1,520	6.32	8.3
Inuvik	1,042	2.60	5.0
Normal Wells	591	1.69	5.7
Port Radium	787	4.88	12.4
Sachs Harbour	1,391	4.40	6.3
Spence Bay	2,257	8.72	7.7
Tuktoyaktuk	1,122	2.93	5.2

From Norman Wells to:	Miles	Rate per 100 lbs (dollars)	Cost per Ton/Mile (cents)
Aklavik	434	1.95	8.9
Arctic Red River	334	1.30	7.8
Cambridge Bay	1,316	6.38	9.7
Cape Parry	781	3.46	8.9
Coppermine	1,169	5.80	9.9
Holman Island	929	5.80	12.5
Inuvik	451	1.95	8.6
Sachs Harbour	800	3.58	9.0
Spence Bay	1,666	8.14	9.8
Tuktoyaktuk	531	2.18	8.2

Source: A. Krolewski, <u>Northwest Territories Statistical Abstract, 1973</u> (Department of Indian and Northern Affairs, August 1973), p. 143.

both oil and gas and settlement resupply) was bulk fuel. The only producing crude oil field and refinery operating north of 60° is located at Norman Wells. The refinery is operating at maximum capacity of 1,500 barrels/day.* Production is consumed in the lower Mackenzie and Delta areas, but will not be transported to upriver destinations, since the cost of pushing the product upstream is too great. Capacity at Norman Wells is not expected to increase, since the cost of upgrading the existing refinery would exceed the additional transport costs of barging fuel from Hay River. For these two reasons, increased demands for bulk fuels along the Mackenzie will be met by barge shipments from Hay River.

In addition to the movement of settlement and oil and gas resupply cargo on the Mackenzie, ore concentrate moves by water between Port Radium and Hay River. The tonnage involved is about 3,000 tons per year.

Several future trends for water transport are emerging. Firstly, as the number of drilling rigs in the Delta area becomes larger, the proportion of settlement resupply cargo to total traffic volume will tend to increase. It is projected that rig movements and resupply traffic will continue to move by barge even after the construction of the all-weather Mackenzie Highway, since the River will continue to provide the lowest cost transport. An exception will be made if time is the most important factor, or if the cost of stockpiling a drilling rig for long periods is greater than the additional cost of highway transport.

Construction of a highway will create a tendency for high volume/weight general cargo to be diverted to road transport, the propensity for diversion decreasing as the length of voyage increases. There will be a lower propensity for low volume/weight cargo to be diverted, and none for bulk fuel.

Expansion of the transport network in the Mackenzie Region by the addition of all-weather roads and increased air facilities could lead to a greater trend to intermodal transport. Potential exists through NTCL's interest in Eldorado Aviation and KAPS Mackenzie Air Services and truck fleet. As well, an all-weather highway coupled with the trend to containerize general cargo will tend to extend the effective navigation season. Goods which are shipped by barge to key destination points can move by all-weather road to their final destination after freeze-up.

The main pressures on current marine transport facilities on the Mackenzie during the 1970's will be the accelerating pace of oil and gas exploration on the Delta, the possible construction of the Arctic Gas pipeline from the Delta southward along the Mackenzie Valley, and the construction of the Mackenzie Highway.

The Swan Wooster Report estimated marine cargo flows on the

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* DINA, North of 60° Oil and Gas Activities 1972, (Ottawa: Information Canada, 1973), p. 9.

Mackenzie up to 1980 (summarized in Table III-19) for six categories of traffic flows as follows:

- settlement resupply traffic
- ore concentrate traffic
- oil and gas exploration traffic
- highway construction traffic
- gas pipeline construction traffic
- passenger traffic.

Each cargo traffic category was further divided into three commodity classes: general freight - high volume/weight, general freight - low volume/weight, and bulk fuels.

Origin and destination points within the study area for these cargo traffic categories and commodity sub-categories were rationalized to six sub-regions: Great Slave Lake, the upper Mackenzie, the central Mackenzie, Great Bear Lake, the lower Mackenzie, and the Arctic coastal settlements.

Settlement resupply traffic was calculated on the basis of population projections, estimated at 29,000 by 1975 and 36,000 by 1980. In 1972, settlement resupply traffic ex Hay River was estimated to be 42,000 tons of general cargo and 63,000 tons of bulk fuels. Cargo traffic levels were projected to rise to 60,000 tons of general cargo and 109,000 tons of bulk fuels by 1975, and 78,000 tons of general cargo and 157,000 tons of bulk fuels by 1980.

Methodology used to estimate oil and gas exploration traffic was related to forecasting the number of drilling rigs used by sub-regions to the annual tonnage of bulk fuel and general cargo required to support each rig in use. Forecasts are based on: 10,000 foot well representative of drilling depth in area, two wells/drill rig/year, a new rig move requiring 4,000 tons of bulk fuel and 6,000 tons of general cargo, and a resupply rig move requiring 4,000 tons of bulk fuel and 4,000 tons of general cargo.

Oil and gas exploration traffic was estimated to be 150,000 tons in 1972, of which 78,000 tons was general cargo and 72,000 was bulk fuel. By 1975, the Report projected this tonnage to rise to 326,000 tons, (170,000 tons general freight and 156,000 tons bulk fuel).

Highway construction was estimated by the Department of Public Works to require movement of about 5,000 tons of construction equipment and 50,000 tons of bulk fuels over the period 1973-76.

Supply traffic for pipeline construction will consist of: pipe, bulk fuels, construction equipment and camp, compressor stations, and other supplies. The Report estimated that total pipeline

TABLE III-19

1972 MACKENZIE BASIN RESUPPLY CARGO BREAKDOWN AND CARGO TRAFFIC PROJECTIONS TO 1980*

	1972 General/Bulk Petroleum Cargo /	1975 General/Bulk Petroleum Cargo /	1980 General/Bulk Cargo / Petro.
Settlement Resupply	42,000/63,000 (total 105,000)	60,000/109,000 (total 169,000)	78,000/157,000 (total 235,000)
Oil & Gas Exploration	78,000/72,000 (total 150,000)	170,000/156,000 (total 326,000)	-
Mackenzie Valley Highway Construction (DPW Estimate)	Require 5,000 tons construction equipment and 50,000 tons bulk fuel over the period 1973-1976.		
Pipeline Construction	Estimated 975,000 tons 718,000 pipe, 102,000 bulk fuel, 39,000 construction equipment and camp, 19,000 compressor stations, 97,000 other.		
Ore Concentrate (Port Radium to Hay River)	3,000	3,000	3,000

* Swan Wooster Engineering Company Limited, Mackenzie Valley Water Transportation Study, op. cit., p. ES 9-13.

construction supply traffic to the upper, central and lower Mackenzie sub-regions will be 975,000 tons, consisting of:

718,000 tons	pipe
102,000 tons	bulk fuel
39,000 tons	construction equipment and camp
19,000 tons	compressor stations
97,000 tons	other

Stockpiling stations chosen along the Mackenzie for pipeline construction materials could have a large impact on some of the smaller destination points. The proportion of pipeline materials which will travel by water will depend on the comparative costs of alternate transport networks, and origins and destinations of cargo.

Both oil from Norman Wells to the lower Mackenzie, concentrate traffic from Port Radium to Hay River were projected to remain constant until 1980.

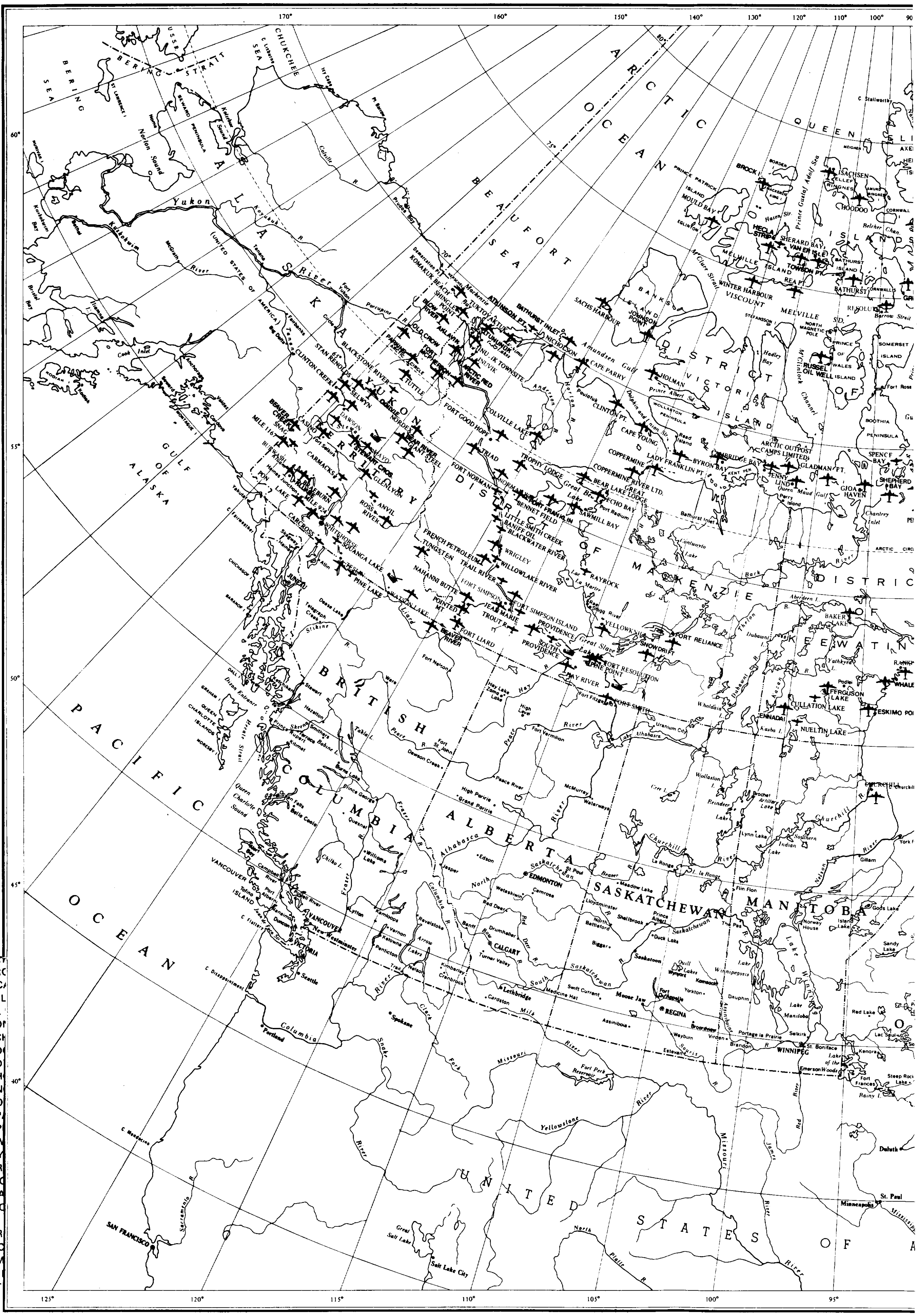
In the event that pipeline and highway construction take place simultaneously, the Report concludes that present shoreside facilities will be capable of handling projected tonnages. It is estimated that Hay River, the main origin point for northbound traffic will be able to handle one million tons of freight per season. New facilities at Inuvik have considerable expansion capacity which should be capable of handling foreseeable levels of traffic.

3. Air Cargo Movements

Air cargo link flows for Arctic Canada are illustrated on Map III-11. The map shows 1969 cargo flows and needs to be brought up to date; however, it illustrates the main distribution points for air cargo at Frobisher Bay, Churchill, Yellowknife and Resolute Bay. Cargo tonnage in 1969 appears to be in the range of 5,000 tons from this map, and will have risen greatly since then due to accelerated oil and gas exploration after Prudhoe Bay in 1968.

Map III-8 details existing Ministry of Transport and private airstrips in northern Canada. Map III-9 shows airline services by route and company name to northern destinations in 1973.

At present, the only year-round major airport in the high Arctic is at Resolute Bay. On March 7, 1974, the Minister of Transport and the Minister of Indian and Northern Affairs jointly announced a new policy to provide improved air transportation facilities to a large number of communities in the Yukon and Northwest Territories. Under the new policy, Arctic airports are divided into three categories, depending on the length of runway and the



•CAMBR
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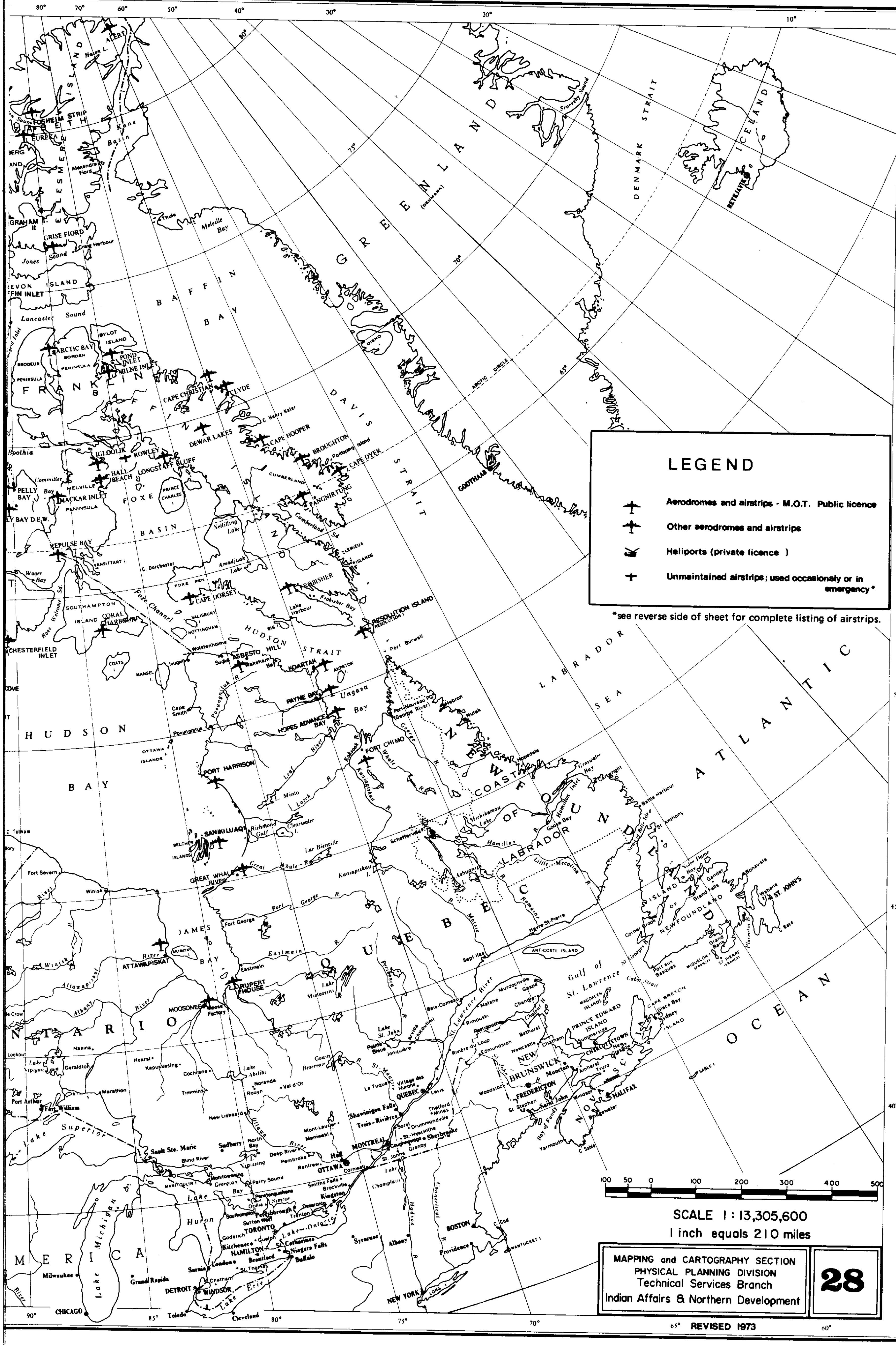
CHAR
•CHEST

TRIPS – Northern Canada



AERODROMES AND AIRSTRIPS IN NORTHERN CANADA :

(• SHOWN ON MAP)

	LAT.	LONG.
AIRPORT CREEK	6628	12910
AISHIHIK	6139	13729
•AKLAVIK	6813	13501
•ALBERT EDWARD BAY	6938	10335
•ALERT	8231	6218
ALLISON RIVER	7512	9830
ANDERSON POINT	6813	8755
•ANVIL (FARO)	6222	13328
•ARCTIC BAY	7302	8507
•ARCTIC OUTPOST CAMPS LIMITED (ALBERT EDWARD BAY)	6938	10335
•ARCTIC RED RIVER	6726	13346
ARROWHEAD RIVER	6045	12228
•ASBESTO HILL	6149	7357
•ATKINSON POINT	6944	13144
ATKINSON POINT	6956	13125
ATLAS #2	6256	13214
•ATTAWAPISKAT	5256	8225
AUBRY LAKE	6716	12625
AXEL HEIBERG	79	90
AYLMER LAKE	6416	10830
BAFFIN ISLAND WEST	6837	7315
BAKER LAKE	6418	960
•BAKER LAKE	6418	960
BALD HILL	6548	13239
•BANFF OIL (CLOVERLEAF)	6400	12423
BANKS ISLE WEST	7316	12348
BASIL	6815	11423
•BATHURST INLET LODGE	6650	10801
•BATHURST ISLAND	7536	9837
BEAR ISLANDS	5422	8105
•BEAR RIVER	6450	13418
BEAR RIVER	6511	12331
BEAULIEU RIVER	6227	11302
•BEAVER CREEK	6223	14044
•BEAVER RIVER	6000	12419
BELCHER ISLANDS	5632	7913
•BELLIN (PAYNE BAY)	6001	7000
•BENNETT FIELD	6502	12438
BENOIT CREEK	6719	13212
BERNARD HARBOUR	6847	11450
BIG LAKE	6853	9638
BIRCH CREEK	6203	11622
BIRCH CREEK	6045	11517
BLACK FLAT	7851	9620
BLACKIE	6557	13704
BLACKLEAD ISLAND	6458	6613
•BLACKSTONE RIVER	6456	13817
•BLACKWATER RIVER	6355	12407
•BLOW RIVER	6845	13728
BOFFA LAKE	6940	11612
BONNET PLUME (GIANT STAD)	6455	13319
BORDEN ISLAND	7833	11055
BOUNDARY	6622	10130
BRACEBRIDGE	7545	9955
•BRAEBURN	6129	13545
BRAY ISLAND	6916	7721
BREVOORT ISLAND	6321	6410
•BROCK ISLAND I.	7745	11410
BROCK ISLAND II.	7749	11417
•BROUGHTON ISLAND	6733	6402
BURNT HILL	6642	13830
•BURWASH	6122	13903
•BYRON BAY	6845	10904
CALLISON	6402	13921
•CAMBRIDGE BAY	6906	10508
CAMERON BAY	6604	11752
CAMP CANOL	6514	12706
CAMSEL RIVER	6536	11755
CANOL ROAD (MILE 275)	62	130
CANYON CITY	6150	14050
•CAPE CHRISTIAN	7131	6818
•CAPE DORSET	6414	7633
•CAPE DYER	6636	6135
•CAPE HOOPER	6828	6650
CAPE NOREM	7727	11055
CAPE O'BRIEN	7729	9523
•CAPE PARRY	7010	12442
CAPE PEEL	6903	10719
CAPE WARWICK (RES ISLAND)	6139	6436
•CAPE YOUNG	6856	11656
•CARCROSS	6011	13442
CARIBOU	6620	13517
•CARMACKS	6206	13618
•CASINO	6245	13848
CATH	6603	13843
CENTRE DOME	7819	9616
CHANCE #1	6610	13736
CHAPMAN LAKE	6453	13817
CHAR LAKE	6938	10336
•CHESTERFIELD INLET	6320	9042

	LAT.	LONG.
•CHURCHILL	5844	9404
CHICK LAKE	6545	12754
CHRISTOPHER BAY		
CLARENCE LAGOON	6938	14050
CLEAR CREEK	6347	13734
CLIFTON POINT	6914	11836
•CLINTON CREEK	6428	14044
•CLINTON POINT	6936	12044
•CLYDE RIVER	7027	6822
COBURG ISLAND	7554	7905
COFFEE CREEK	6245	13915
•COLVILLE LAKE	6702	12605
COLVILLE LAKE	6703	12606
CONTWOYTO	6529	11020
•COPPERMINE	6749	11508
•COPPERMINE RIVER LTD	6727	11626
•CORAL HARBOUR	6412	8322
CORNWALLIS ISLAND	7509	9445
CORNWALLIS ISLAND WEST	7746	9747
CRANSWICK	6531	13148
CROOKED LAKE I.	7240	9830
CROOKED LAKE II.	7235	9815
•CULLATON LAKE	6118	9829
CUNNINGHAM	7407	9409
DALHOUSIE	6958	13035
•DAWSON CITY	6403	13905
DEER BAY	7859	10413
DEVON ISLAND	7510	9130
DEVON ISLAND	7502	9157
•DETOUR LAKE (GLENN LYON)	6241	13440
•DEWAR LAKES	6837	7107
DEZADFASH	6027	13702
DISCOVERY MINE	6311	11354
DISRAELI INLET	8245	7300
•DOLORES CREEK (NORDEX)	6400	13300
DRAKE POINT	7628	10846
DUMBELL	7829	10040
DUMBELL DOME	7827	9958
DUNDAS	7437	11347
DUNDEE	7556	9925
EAGLE I.	6620	13515
EAGLE II.	6605	13654
EAGLE III. (TUTTLE)	6625	13645
EAST ELBOW	7025	10711
EASTER	7119	8419
•ECHO BAY	6616	11756
EKBLAW PASS	8131	7440
ELLEN	6631	13758
ELSA	6353	13538
ELVIN TOP	7322	8349
•ENNADAI	6105	10050
•ESKIMO POINT	6107	9403
•EUREKA	7959	8549
•FARO (ANVIL)	6222	13328
•FERGUSON LAKE	6252	9651
FINLAYSON	6141	13050
FIRTH FLAT	6841	14054
FISHER	6214	9755
•FORT CHIMO	5806	6825
•FORT FRANKLIN	6511	12325
•FORT GOOD HOPE	6616	12837
•FORT LIARD	6014	12327
•FORT McPHERSON	6726	13453
•FORT NORMAN	6455	12534
•FORT PROVIDENCE	6119	11736
FORT RAE	6249	11604
•FORT RELIANCE	6242	11910
•FORT RESOLUTION	6111	11341
FORT SELKIRK	6247	13724
FORT SELKIRK	6001	11152
•FORT SIMPSON	6145	12114
•FORT SIMPSON (WEST ISL.)	6152	12122
•FORT SMITH	6001	11158
•FOSHEIM STRIP	7939	8447
FREEMAN'S COVE	7506	9753
•FRENCH PETROLEUM	6209	12306
•FROBISHER BAY	6345	6833
FURY	7245	9237
GARNIER BAY	7341	9037
GARNIER HIGH	7403	9223
GARNIER LOW	7404	9223
•GIANT STEEL(BONNET PLUME)	6455	13319
•GJOA HAVEN	6838	9553
GLACIER CREEK	62	109
GLACIER LAKE	6606	11756
•GLADMAN POINT	6840	9748
•GLENN LYON (DETOUR LAKE)	6241	13440
GODLIN LAKE	6346	12845
GRAHAM	7720	9100
GRAHAM ISLAND I.	7714	9037

•GRAHAM ISLAND II.
GRANT POINT
•GREAT BEAR LAKE LODGE
•GREAT BEAR TROPHY LODGE
•GREAT WHALE RIVER
GREELY FIORD
•GRIFFIN INLET
•GRISE FIORD
•HALL BEACH
HART RIVER
HAT ISLAND
•HAY RIVER
HAZEN LAKE
HAZEN LAKE CAMP
•HECLA STRIP
HENIK LAKE SOUTH
HERSHEL ISLAND
HIGH INLET
HIGHLAND LAKE
•HOLMAN ISLAND
•HOODOO DOME
HOOK'S END
•HOPES ADVANCE BAY
HORTON RIVER
HUME RIVER
HUNGRY CREEK
HYLAND
•IGLOOLIK
•INOUCDJOUAC (PORT HARRISON)
•INUVIK
•INUVIK TOWNSITE
•ISACHSEN
JAMISON BAY
•JEAN MARIE RIVER
•JENNY LIND ISLAND
•JOHNSON POINT
KEITH BAY (EAST SIMPSON)
KELLET
KETZA RIVER
KING BAY
KING CHRISTIAN
KIVITOO
KLEMKE
•KLUANE
•KOARTAK
•KOMAKUK BEACH
KRISTOFFER BAY
LA BICHE RIVER
LAC BELOT
LAC LA MARTRE
•LADY FRANKLIN POINT
LAKE HARBOUR
LANDRY CREEK
LANG
LANGLEY ISLAND
LEFFINGWELL
LIARD CONSTRUCTION
LITTLE CHICAGO
LITTLE SALMON
•LITTLE SMITH CREEK
LIVINGSTONE CREEK
LONG LAKE
LONG POINT
LONGSTAFF BLUFF
LOUGHEED ISLAND
•MACKAR INLET
MACKINSON
MAGDA LAKE
MAGUNDY
MALLOCK DOME
MARIAN LAKE
MARIE BAY
MARY INLET
MATHESON POINT
•MAYO
McCLINTOCK HILL
McMILLAN PASS
McMILLAN SOUTH
McPHERSON II.
McQUESTERN
MILE 275 (CANOL ROAD)
MILE 123 (MACKENZIE HWY)
•MILE 924 (PORTER CREEK)
•MILE 1167 (WHITE RIVER)
MILLS LAKE
•MILNE INLET
MINK CREEK
MINTO
MOLAR

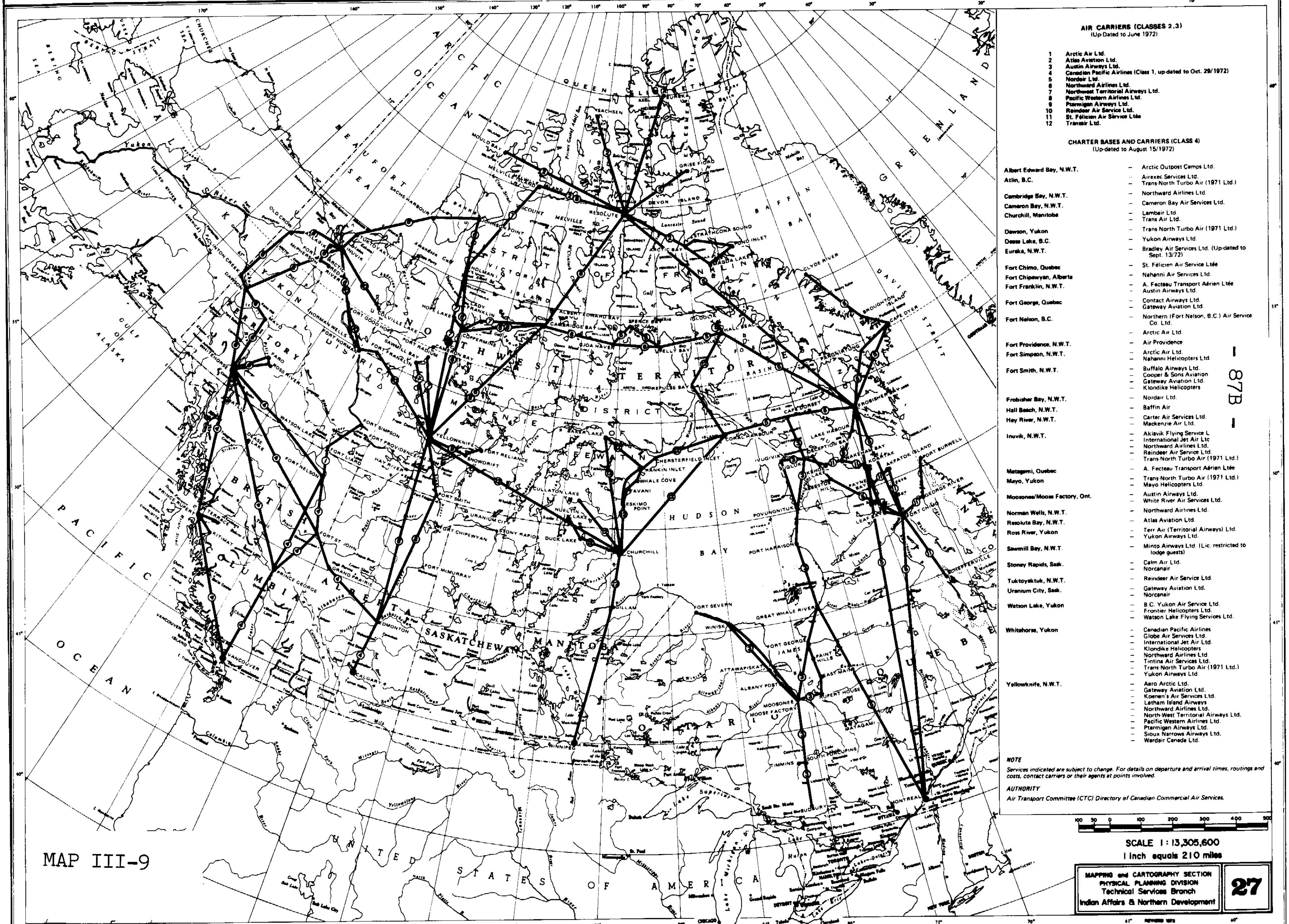
MAP III-8

LAT.	LONG.
7721	9038
6826	9838
6640	11951
6603	12438
5517	7746
8037	7940
7502	9157
7625	8257
6847	8115
6440	13650
6819	10004
6051	11546
8145	7130
8150	7125
7623	11020
6139	9723
6935	13855
7523	8547
6249	12258
7043	11743
7811	9927
7304	10516
5920	6946
7001	12657
6535	12927
6535	13529
6131	12815
6923	8149
5827	7807
6818	13329
6822	13340
7847	10335
7633	11653
6131	12037
6839	10144
7246	11829
6815	8809
7158	12553
6151	13218
7754	11023
7747	10108
6756	6452
6545	13805
6101	13824
6102	6937
6935	14011
7816	10227
6010	12406
6700	12616
6309	11715
6829	11313
6254	6950
6245	12456
7218	9351
6854	13506
7738	11203
6506	13821
6710	13010
6211	13450
6426	12444
6123	13422
6819	13337
7611	11236
6856	7517
7727	10500
6821	8545
7707	8107
7225	8225
6211	13404
7815	10112
6303	11616
7609	11525
7400	9100
6849	9517
6337	13552
7245	10613
6311	13012
6254	13207
6723	13456
6335	13740
6200	13000
6228	11630
6047	13508
6159	14030
6116	11840
7220	8030
6243	13118
6236	13653
6704	13840

	LAT.	LONG.
•MOOSONEE	5117	8036
•MOULD BAY	7614	11920
MOUNT NANSEN	6201	13704
MUSKOX	7141	11310
•NAHANNI BUTTE	6102	12324
NAN LAKE	8115	7235
NANUK	7305	12323
NEEDLEROCK CREEK	6247	13600
NEIL PENINSULA	8046	8257
•NICHOLSON POINT	6957	12854
NONACHO LAKE	6145	10930
•NORDEX (DOLORES CREEK)	6400	13300
•NORMAN WELLS	6517	12648
•NUELTIN LAKE	60	99
N.W. PROJECT STUDY GROUP	6541	12848
OFFSHORE	6948	13151
•OGILVIE	6522	13828
•OLD CROW	6734	13950
OVAL LAKE	7233	10606
PADLOPING ISLAND	6703	6244
•PANGNIRTUNG	6609	6549
•PARKINS	6630	13725
PATRICK FLAT	7648	11602
PAULATUK	6949	12359
•PAYNE BAY (BELLIN)	6001	7000
PAYNE CREEK	6650	12950
PEARCE POINT	6948	12240
•PELLY BAY	6832	8947
•PELLY BAY	6826	8936
PELLY LAKE	6604	10105
PHILPOTS	7456	7940
•PINE LAKE	6006	13056
•PINE POINT	6051	11422
PISTOL LAKE	6724	11510
•POINTED MOUNTAIN	6020	12348
POLARUS	6242	13900
•POND INLET	7240	7800
•PON LAKE	6047	13733
POPLAR RIVER	6115	12147
•PORTER CREEK	6047	13508
•PORT HARRISON(INOUCDJOUAC)	5827	7807
PRARIE CREEK	6133	12445
PROCTOR	6352	13543
PROJECT STUDY GROUP N.W.	6541	12848
RABBIT CREEK	62	140
RADSTOCK	7456	9040
RAE	6249	11604
RAE LAKES	6410	11720
RAMPARTS RIVER I.	6542	13023
RAMPARTS RIVER II.	6601	13038
•RANKIN INLET	6249	9207
•RAYROCK	6326	11633
•REA POINT	7521	10543
REINDEER STATION	6840	13407
RELIEF	7935	8852
•REPULSE BAY	6631	8615
RES ISLAND (CAPE WARWICK)	6139	6436
•RESOLUTE	7443	9458
•RESOLUTION ISLAND	6135	6437
ROB CAMBELL-PELLY	6143	13118
ROCHER RIVER	6124	11245
ROMULUS LAKE	7953	8434
ROSAMOND	7440	8338
ROSS POINT	6836	11108
•ROSS RIVER	6158	13226
ROSS RIVER SOUTH	6151	13208
•ROWLEY ISLAND I.	6904	7905
ROWLEY ISLAND II.	6923	7948
•RUPERT HOUSE	5129	7845
•RUSSEL OIL WELL	7353	9913
•SACHS HARBOUR	7200	12516
SAND HILL	7259	9905
SANDY POINT	7625	11518
•SANIKILUAQ	5632	7913
SATAH RIVER	6654	13412
SATAH II.	6645	13352
SATELLITE BAY I.	7720	11620
SATELLITE BAY II.	7718	11657
•SAWMILL BAY	6544	11855
SCARPA LAKE	6833	8320
SCORESBY	7548	9910
•SELWYN	6400	14000
SET HILL	7330	9228
SHELDON LAKE	6240	13107
SHELL OIL STRIP	6111	12212
•SHEPHERD BAY	6848	9324
•SHERARD BAY	7605	10825
•SHINGLE POINT	6856	13714
SILVER BAY	6535	11804

	LAT.	LONG.
SILVER KEY	6133	13210
SIMPSON EAST (KEITH BAY)	6815	8809
SIMPSON LAKE	6835	9157
SIXTY MILE	6402	14046
SKRAELING DELTA	8004	8740
SKYBATTLE BAY II.	7714	10506
SLIDRE	7955	8508
•SNAG	6222	14024
SNAKE	6521	13320
SNARE RIVER	6326	11611
•SNOWDRIFT	6225	11043
SOUTH HENIK LAKE	6139	9723
SOUTH McMILLAN	6254	13207
•SOUTH PROVIDENCE	6107	11812
SOUTH ROSS RIVER	6151	13208
•SPENCE BAY	6932	9332
•SQUANGA LAKE	6029	13329
STAGG RIVER	6240	11540
•STAN RENALDS	6400	14000
•STEWART CROSSING	6322	13643
STEWART LAKE	6423	12516
STOKES POINT	6920	13845
STORKERSON BAY	7257	12430
STORM	7624	8730
STURT POINT	6848	10320
SUBJECT	7918	10333
SYLVIA MOUNTAIN	8141	6613
TALTSON RIVER	6023	11121
TALTHEILEI NARROWS	6233	11132
TANQUARY FIORD CAMP	8125	7651
TATONDUK RIVER	6456	13952
TAYLOR LAKE	6552	13302
•TESLIN	6010	13245
THIN LAKE	6334	10607
THOMPSON LANDING	6256	11040
THREE POINTS	7622	8552
THUNDER RIVER	6729	13048
TIEDA RIVER	6636	12913
TINNEY COVE	6645	10745
TINTINA	6104	13114
•TOWSON POINT	7552	10624
TRAFALGAR N.E.	7445	9440
TRAFALGAR S.E.	7444	9445
TRAIL RIVER	6631	13445
•TRAIL RIVER	6210	12155
TRAVAILLANT LAKE	6744	13138
•TRIAD	6547	12849
TROUT LAKE	6026	12115
•TROUT RIVER	6108	11945
•TUKTOYAKTUK	6926	13302
TUNDRA	6404	11109
•TUNGSTEN (CANTUNG)	6159	12815
•TUNUNUK	6901	13440
TUO GRATERS	7020	9215
TURNER'S STRIP	6103	12321
•TUTTLE (EAGLE III.)	6625	13645
VANGORDA CREEK	6214	13313
VAN HAUEN PASS	8103	8546
•VANIER ISLE	7608	10402
VANIER POINT	7615	10330
VICTORIA ISLAND	7307	11435
WALES LAKE	7234	9856
WARD HUNT ISLAND	8305	7407
•WATSON LAKE	6007	12849
WEST AMUD RINGNES	7823	9754
WEST BAFFIN ISLAND	6837	7316
WEST BANKS ISLE	7316	12348
WEST CORNWALLIS ISLAND	7746	9747
WESTERN MINERALS	6632	13825
•WHALE COVE	6209	9235
WHITEFISH RIVER	6535	12430
WHITE FLAT	7026	10726
•WHITEHORSE	6043	13504
•WHITE RIVER (MILE 1167)	6159	14030
WHITESTONE	6606	13818
WILKINS STRAIT	7758	11115
•WILLOWLAKE RIVER	6240	12303
WIND RIVER	6446	13439
•WINTER HARBOUR	7448	11031
WOLF VALLEY	7941	8216
•WRIGLEY	6312	12325
•YELLOWKNIFE	6228	11427
YOUNG INLET	7520	9842
YOUNG POINT	7216	10130
ZERO BEACH	7126	9914

COMMERCIAL AIRLINE SERVICES - Northern Canada



MAP III-9

size of the community served. MOT will continue to operate and maintain the eleven major Arctic airports, and under the new policy the Ministry will have responsibility for the maintenance and construction of new or approved facilities at over 50 other communities. Map III-10 illustrates proposed locations of present and future air terminal facilities. The locations of facilities in this Arctic air system are of great interest with respect to Arctic port development, since any major port will need an associated major airport to redistribute goods brought in by sea, transfer personnel quickly and for year-round transport of supplies and equipment.

Arctic airports will be provided at communities in the Yukon and the Northwest Territories according to the following criteria (which are flexible due to changing circumstances of resource exploration and exploitation, types of aircraft used, etc.). Communities are classified according to population, community role (growth prospects, economic development, governmental activity), air services route structure and availability of other means of transportation. Minimum standards of facilities and services are established for three classes of airports, Arctic "A", "B" and "C".

Arctic "A" (Major) Airports

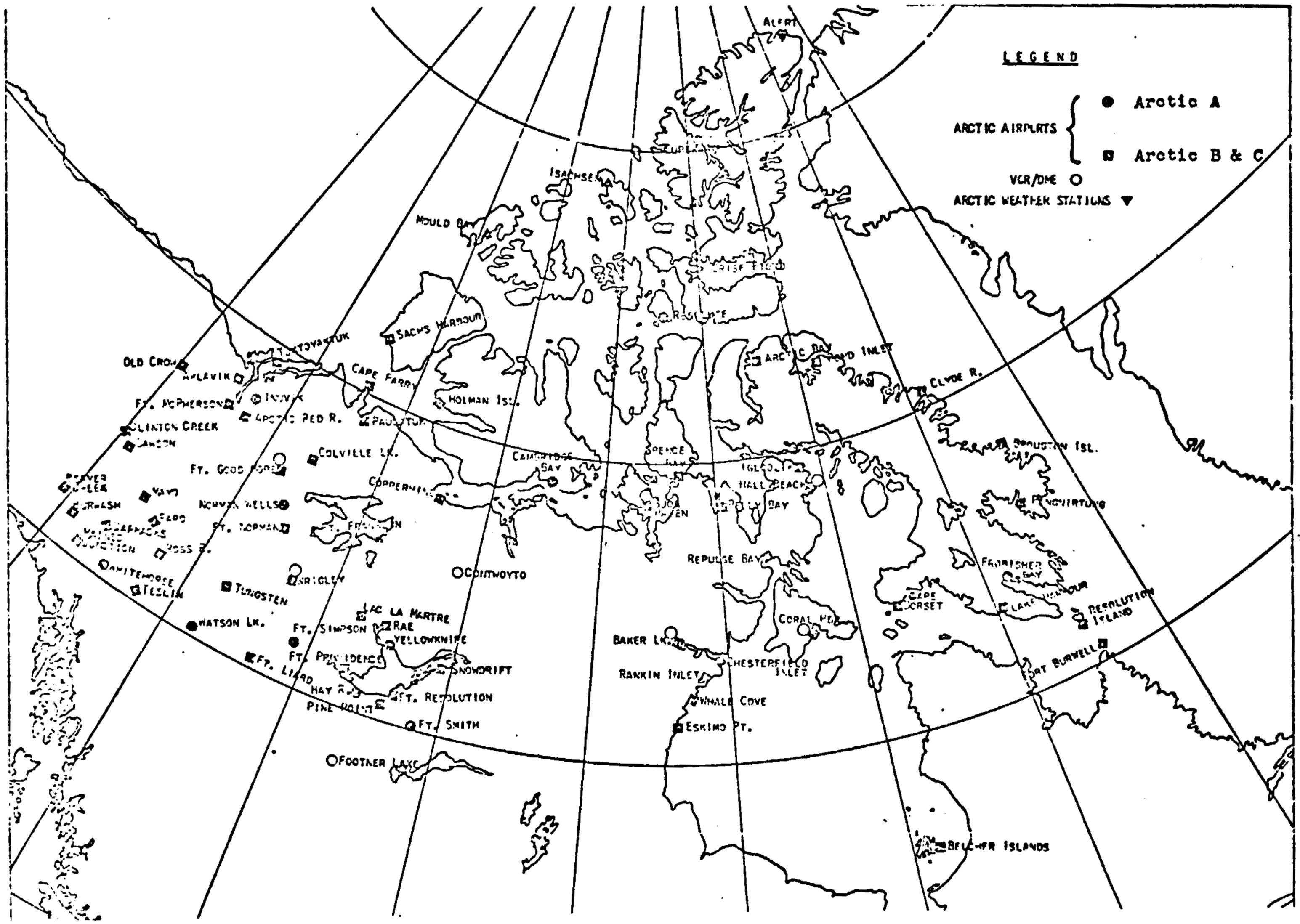
Those airports serving population centers which have the following characteristics:
- served by an air carrier on a regular scheduled basis
- no means of regular transportation other than air
- major distribution center
- strategic location
- a capital or regional administrative center
- an extensive continuing resource development role

Arctic "B" (Area) Airports

Those airports serving population centers which have the following characteristics:
- a population of more than 400
- no means of regular transportation other than air
- served by a regular reliable air service
- a growing community
- an area administrative center
- an active role in resource development

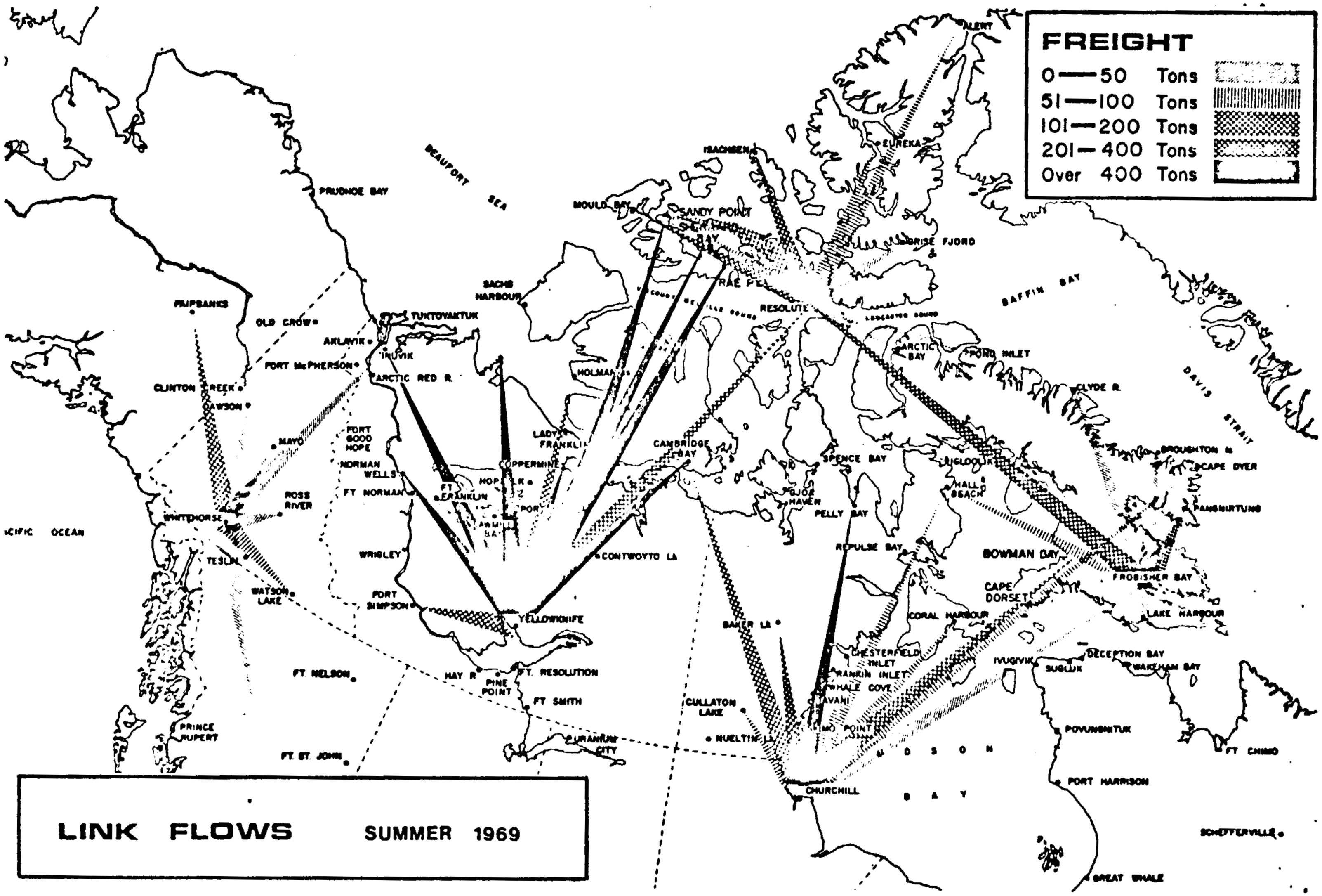
MAP III-10

PROPOSED SYSTEM OF ARCTIC AIRPORTS
MOT/DINA JOINT PROGRAM TO IMPROVE AIR TRANSPORTATION IN THE CANADIAN ARCTIC



MAP III-11

AIR CARGO LINK FLOWS



Source: J. Courtney, "Air Transport In The Canadian North", Proceedings of the Arctic Transportation Conference, Yellowknife, NWT, Dec. 8&9, 1970, Vol. 3, (Ottawa: Information Canada, 1971).

Arctic "C" (Community) Airports

Those airports serving population centers which have the following characteristics:
- a population of more than 100
- no means of regular transportation other than air.

Past programs* for providing air terminal facilities are as follows:

The Financial Assistance Airport Construction and Operation Policy confirmed by Cabinet on December 2, 1971, groups Canadian airports into two main categories and establishes the responsibility for their operation and maintenance. National Airports are a Federal responsibility while responsibility for Community Airports is on a cost sharing basis with a local municipality or other authority. The Minister of Transport on December 10, 1971, in informing the House of Commons of the new policy, stated that airports in the National category will be classified as primary, secondary, Arctic and satellite airports. Arctic airports are defined as airports in the Yukon and Northwest Territories, which can be justified on the basis of their importance to the development of the Arctic and the well-being of its inhabitants.

Only six airports in the Territories meet the criteria for a national airport. The airports serving the balance of the communities fall within the Community category. In this category, considerable financial responsibility would fall on the local community and/or the Territorial Government. Neither these communities, of which there are approximately sixty, nor the Territorial Governments have resources at their disposal to participate in the required program.

This present policy does not provide the air navigation, communications and meteorological facilities and services required.

Airport development has been carried out at Arctic communities under the Remote Airports Program** confirmed by Cabinet on April 3, 1969, administered by the Department of Indian and Northern Affairs and undertaken jointly with the Ministry of Transport and the Department of

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* Arctic Transportation Agency, Ministry of Transport.
** See also Section IV.A.4.b.i.

National Defence. This program provides for the construction of 3,300' airstrips at eleven communities in the Yukon and Northwest Territories. Airstrips have been completed at four locations and are under construction at four more.

The effectiveness of this program has been outmoded by changes in aircraft type and increasing community requirements. Further, the program does not provide for airport lighting, passenger, navigation, communication or meteorological and other air transportation facilities required.

E. POTENTIAL MARINE TERMINAL DEVELOPMENTS

1. Centers of Marine Cargo Movements and Federal Government Departmental Controls on Wharf Construction North of 60°

Present centers of marine activity in the North are Frobisher Bay in the east, Resolute Bay in the central Arctic and Hay River, Inuvik and Tuktoyaktuk on the Mackenzie River in western Canada. Marine cargo has been generated by construction of the James Bay Hydro Quebec project.

Discussion has been ongoing for about ten years on the subject of Federal Government policy and/or participation in the provision of wharf facilities at Frobisher Bay and Resolute Bay. Major airports are located at both locations. The two centers perform different functions: Frobisher Bay is a Government of the Northwest Territories Administrative Center, and Resolute Bay is the site of an MOT weather station and serves as a transshipment point for both government and industry cargoes destined for the high Arctic.

In 1973, a request was received by MOT from the Province of Quebec for a wharf at Fort George, to support supply cargo shipments for the James Bay Hydro project. In the same area, studies are ongoing for provision of a wharf at Moosonee, Ontario, from which cargo destined for the Hydro Quebec project could be shipped by barge to the proposed Fort George wharf.

Since 1968, marine cargo traffic on the Mackenzie River has been increasing the degree of commercial activity and the multi-user nature of these ports. A study is currently underway which will develop and assess information on the role of Hay River harbour facilities in northern development, and the role of MOT in the operation of Hay River as a viable port.

Any commercial enterprise wishing to construct a private wharf facility in waters north of 60° is subject to the following Federal Government Departmental procedures.

Under the Navigable Waters Protection Act, administered by the Ministry of Transport, approval must be granted for construction of a wharf facility, on the basis of whether or not the structure would interfere substantially with navigation. Submission of suitable drawings of the site plan and wharf facility are required by Marine Services, MOT.

The Department of Indian and Northern Affairs, Northern Natural Resources and Environment Branch, Water, Land, Forests and Environment Division, require site and wharf facility information for issuance of a lease for Crown land such as: sketches to scale of waterlot and upland boundaries, proposed route of access roads, an estimate of the amount of granular material required and the location of supply sources, specifications regarding the type of installation proposed and methods of construction.

In addition, although not a requirement under law, Environment Canada approval is requested with respect to the following conditions: that provision is made for stable dry ground storage of any hazardous materials not shipped to their destinations immediately; an effective contingency plan is prepared for the clean-up of any spills of fuels, chemicals or any hazardous materials that could occur during on and off loading; and notification be given to the Environmental Protection Service if any bulk fuel handling facilities are handled on the facility. Requirements of the AWPPA deal with vessels and vessel equipment and do not concern themselves with terminal facilities.

2. Specific Development Proposals

a. Frobisher Bay

During 1958, the Civil Aviation Branch of the Department of Transport constructed a causeway with a mooring head at Frobisher Bay. The exact location is shown on Map III-14. The causeway is about 750 feet long and provided 10-12 feet of water alongside at low water. Ice has eroded the top of the causeway, and it is in a state of disrepair.

An interdepartmental report was prepared in 1963 by MOT and DPW, on the feasibility of either repairing this wharf or constructing a new wharf. The report recommended the construction of a new wharf; however, due to the closing of the USSAC Air Base in 1963 and its consequent unknown implications on future growth, a pre-engineering study for the proposed wharf was not undertaken.

Since 1963, when the U.S. Air Force withdrew from Frobisher Bay, the population number remained stable for a time, but in recent years began to increase steadily. Settlement population in 1971 was 2,014 and is projected to increase to 2,497 by 1975. (See

Table III-20.)* Frobisher is the administrative, medical and educational center of the eastern Arctic, and as such can be expected to have a steady growth.

Estimates** have been prepared on the potential magnitude of savings on cargo transport to Frobisher if cargo were delivered over a wharf rather than lightered from the main supply vessel to the beach area. On the basis of discussions with Chimo Shipping and the Marine Operations Branch, MOT, an estimated 50% saving could be effected on stevedoring and bulk petroleum vessel chartering costs, as well as an eventual 15% reduction in the general freight rate with the construction of a permanent wharf facility at Frobisher.

Up until 1972, MOT provided a vessel assistance service operated by the Operations Branch, in the form of a barge and stevedoring service in support of vessels unloading at Frobisher. Personnel prepared the landing beach, vehicles and landing craft prior to each season, and during the season cargoes were unloaded via landing craft and carried to the high water mark. The same personnel handled lines and hoses to discharging bulk petroleum tankers.

Beginning in 1972, annual sealift cargo carried by commercial vessels for MOT was carried on a rate/ton basis, which included delivery to the high water mark. In 1971, dry cargo handled at Frobisher totalled 5,775 tons, and MOT support costs were $107,109. In 1972, cargo handled was 6,578 tons, and MOT support costs were $46,902.***

The 1972 freight rate was $125/ton for Frobisher. In 1973, cargo was carried on a rate/ton/commodity basis and the rate for Frobisher varied from $125 to $375, (average rate/ton $176), depending on the volume/weight factor of the different commodity groups. An increase of $125/ton to $176/ton is a percentage increase of about 40% in the freight rate of goods destined for Frobisher. Support costs to MOT were more than halved between 1971 and 1972, a saving continuing in 1973, but the increased freight rates were passed on by the carrier to the consumer through the rate/ton mechanism.

Provision of a wharf at Frobisher would effectively extend the navigation season, since during the season specified by the Arctic Waters Pollution Prevention Act, it is often not possible

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* See also Table III-4 for Frobisher population figures 1961, 1966 and 1971 and percentage change.

** Captain J.E.R. Seck, "Frobisher Bay, Proposed Wharf Facility", unpublished report, Ministry of Transport, Harbours and Ports Division, May 1973, p. 5-6.

***Ibid., p. 5.

TABLE III-20

POPULATION PROJECTIONS TO 1975*
SELECTED COMMUNITIES - NORTHWEST TERRITORIES

Name	1971 Pop Figs		% Change 1966-71	Est Growth % 1971-75	Est Change 1971-75	Est Pop 1975	
Aklavik	677	(1)	10.8 +	16	108	785	
Arctic Bay	269	(1)	119	24	65	334	
Arctic Red River	108	(1)	25.6 +	24	26	134	
Bathurst Inlet	50	(4)	31.5 -	-	-	50	
Broughton Island	334	(1)	66	16	53	387	
Cambridge Bay	716	(1)	40.1 +	16	115	831	
Cape Dorset	597	(1)	67	16	96	693	
Cape Perry	-		100 -	-	-	-	
Clyde River	274	(1)	117	16	44	318	
Coral Harbour	355	(1)	19	16	57	412	
Dewar Lakes (Mid-Baffin)	10	(3)	100	-	-	10	
Fort Franklin	339	(1)	9	16	54	393	
Fort Good Hope	327	(1)	2.4 -	16	52	379	
Fort McPherson	679	(1)	3.8 +	24	163	842	
Fort Norman	248	(1)	15	16	40	288	
Fort Providence	587	(1)	55.3	16	94	681	
Fort Reliance	15	(3)	36.4	-	-	15	
Fort Simpson	747	(1)	4.9	96.7	723	1,470	(2)
Fort Smith	2,364	(1)	11.5	16	378	2,742	
Frobisher Bay	2,014	(1)	23.5	24	483	2,497	
Grise Fiord	109	(1)	11.2	16	17	126	
Hall Beach	263	(1)	163	16	42	305	
Hay River	2,406	(1)	20.2	552	1,328	3,734	
Igloolik	563	(1)	72	16	90	653	
Inuvik	2,669	(1)	30.8 +	52.3	1,398	4,067	(2)
Jean-Marie River	47	(1)	7.9	8	4	51	
Lake Harbour	189	(1)	95	16	30	219	
Mould Bay	6	(1)	89.3 -	-	-	6	
Norman Wells	301	(1)	51	38.2	115	416	(2)
Pangnirtung	690	(1)	83.5	16	110	800	
Paulatuk	95	(1)	137.5 +	16	16	111	
Pond Inlet	416	(1)	134	16	67	483	
Port Burwell	107	(1)	27	8	9	116	
Rankin Inlet	566	(1)	32	32	181	747	
Repulse Bay	242	(1)	65.8	16	39	281	
Resolute Bay	184	(1)	27.6 -	253	466	650	(5)
Sachs Harbour	143	(1)	8.3 +	16	23	166	
Snowdrift	221	(1)	25.5	16	35	256	
Tuktoyaktuk	596	(1)	16.4 +	16	95	691	
Whale Cove	213	(1)	17.7	16	34	247	
Wrigley	152	(1)	11.8	16	24	176	
Yellowknife	6,122		63.64	28	1,714	7,836	
Total Community Statistics	34,795		33.9	27.8	9,680	44,475	

Legend:
(1) Census Statistics
(2) Gemini North
(3) Other Statistics
(4) G. Warner
(5) J.H. Parker

Source: Government of the Northwest Territories, Department of Administration, 1974.

to land cargo by barges due to ice conditions on the beach. The facility would increase the turnaround time of both tankers and general cargo vessels, decrease stevedoring costs, lower the general freight rate*, lessen cargo damage costs and possibly regain some of the traffic probably being presently shipped by air at greater cost. MOT and DPW are proposing to undertake a pre-engineering study of the proposed wharf at Frobisher for 1974 or 1975.

Total cargo tonnage to Frobisher Bay has hovered around the 30,000 ton level over the period 1970 to 1973. See Table III-21, "Frobisher Bay, Vessel Calls and Cargo Tonnages, 1970, 1971, 1972 and 1973". Of this total tonnage, the proportion of bulk petroleum products to total tonnage was about 80% in 1972 and 1973. The proportion of general cargo to total cargo is decreasing, and fewer vessels are bringing larger cargo lot sizes. Petroleum products are landed on a floating sea-line from tankers moored off Innuit Head at the entrance to Koojesse Inlet. Tankers maintain their position using their anchors and stern lines connected to bollards on Innuit Head.

It has been suggested that an advantage of a permanent wharf facility at Frobisher would be its potential role as a marine transshipment center to nearby settlements and resource exploration activities. A regular service could be established between eastern Canada and Frobisher using a main supply vessel, and a smaller vessel could supply a feeder service from Frobisher to smaller nearby communities. Alternatively, onward target movement from Frobisher Bay could be carried out by aircraft during the closed navigation season.

Reference to Map III-7, which illustrates cargo contract areas for 1972, and Map III-3, "Shipping Safety Control Zones, Arctic Waters Pollution Prevention Act", illustrates potential cargo destinations and their position with respect to navigation zones as determined by the AWPPA. Potential nearby destination sites for cargo transshipped from Frobisher are: the Arctic Quebec sites, the Foxe Basin sites, the west Hudson Bay and Strait sites, and the Baffin coast sites. Of these the Foxe Basin and Hudson Strait destinations appear to be more likely candidates for cargo transshipment from Frobisher, since destinations in Arctic Quebec are generally offered as a package, the Baffin coast sites are primarily military, and the six west Hudson Bay sites will be supplied from Churchill beginning in 1975.

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* The influence of a wharf on the magnitude of marine insurance (paid by the shipping company when cargo is shipped on a rate/ton basis) and thus on the general freight rate would probably be principally effected through reduced cargo insurance, and only secondly through reduced hull insurance. Danger to the cargo is primarily during unloading, whereas danger to the vessel is present both en route and at the destination in ice infested waters.

TABLE III-21

FROBISHER BAY
VESSEL CALLS AND CARGO TONNAGES* - MOT AND PRIVATE
1970, 1971, 1972 AND 1973

YEAR	DRY CARGO			BULK CARGO		TOTAL TONNAGE
	Vessel Calls (Both Cargo Carrying & Non-Cargo Carrying)	Total Tonnage (Short Tons)	Tonnage Size Range and Average Size	Vessel Calls	Total Tonnage (Short Tons)	(Short Tons)
1970 Sept 25 to Oct 25	25	7,147 tons delivered by 12 vessels	11-1,090 tons Average size 595 tons	2	29,370 tons delivered by 2 ships (26,302 & 3,068 tons)	36,517
1971 July 20 to Oct 28	14	5,775 tons delivered by 7 vessels	15-1,588 tons Average size 785 tons	1	22,116 tons	27,891
1972 July 22 to Nov 3	12	6,466 tons delivered by 8 vessels	10-1,605 tons Average size 812.5 tons	1	27,938 tons	34,404
1973 July 26 to Oct 14	16	4,036 tons delivered by 6 vessels	120-1,600 tons Average size 666.6 tons	1	26,212 tons	30,248

Source: Olford, H.R., After Action Reports 1970, 1971, 1972, 1973, Ministry of Transport.

TABLE III-22

SHIPPING SEASON AND 1973 CARGO TONNAGE TO DESTINATIONS NEAR FROBISHER BAY

- For vessels strengthened to Lloyd's Ice 1, the strongest degree of vessel ice strengthening held by any commercial vessel entering the Arctic to date.

- Zones are the Shipping Safety Control Zones of the Arctic Waters Pollution Prevention Act.

Zone 8	Zone 10	Zone 15
Foxe Basin Igloolik Repulse Bay	Cumberland Sound Pangnirtung	Hudson Strait Frobisher Bay Lake Harbour Cape Dorset
August 10 to October 31	August 1 to October 31	July 1 to November 30

		General	POL
1973 Cargo Tonnage to:	Igloolik	554	2,188
	Repulse Bay	409	1,189
	Pangnirtung	851	2,339
	Lake Harbour	90	-
	Cape Dorset	600	-
	Total	2,504	5,716

Table III-22, "Shipping Season and 1973 Cargo Tonnage to Destinations Near Frobisher Bay", details the magnitude of potential cargo transshipments to Igloolik, Repulse Bay, Lake Harbour, Cape Dorset and Pangnirtung from Frobisher. Total potential tonnage could be in the range of 8,200 tons of which about 60% is bulk petroleum. The table also illustrates that the allowable navigation season under the AWPPA is longer at Frobisher than in surrounding communities, a factor in favour of Frobisher's potential as a transshipment center, particularly for sea-air transshipment.

Reference to Maps IV-1, "Mineral, Oil and Gas Exploration and Development - Northern Canada", and Map IV-2, "Major Known Arctic Mineral Ore Deposits", illustrate the lack of mineral exploration activity at locations nearby to Frobisher. Closest significant exploration activity is co per exploration on the west coast of Hudson Bay near Rankin Inlet. The closest major deposits are located on the north shore of Quebec in the Ungava Bay, Deception Bay area and consist principally of iron and asbestos deposits. There are several major mineral deposits relatively near Frobisher in the Foxe Basin area, and consisting mainly of high grade iron deposits. The probability of the development of these major iron deposits in the near future is not high due to world market conditions, and the size of the deposits probably necessitating year-round outward shipments (due to the large size of the deposit) in ice-strengthened or icebreaking cargo vessels, the designs for which have not been fully developed.

b. Resolute Bay/Radstock Bay

Resolute Bay began as one of the Joint Arctic Weather Stations, jointly set up by Canada and the United States, after World War II. Resolute is now the site of the only year-round airport in the high Arctic, and serves as the major marine/air transshipment center for cargoes from eastern Canada destined for oil and gas exploration sites. Resolute is generally used as a demercation point between the eastern and western Arctic due to ice conditions eastward and westward.*

For the past fifteen years, a debate has existed over the relative merits of Resolute versus Radstock Bay as a principal central Arctic transshipment center. In 1959, the (then) Department of Northern Affairs pressed for the transfer of facilities from Resolute to Radstock Bay. At that time, the Department of Transport did not support the transfer, since Radstock Bay was unproven as a harbour, and the surrounding terrain presented problems for airport construction.

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* Map IV-5, "Principal Boundary Between First-Year and Multi-Year Ice", illustrates Resolute's position. Map III-3, "Shipping Safety Control Zones of the AWPPA", reflects this position as well. Resolute forms the boundary between Zones 13 and 6.

Since then the debate has continued. The main problems identified with respect to Resolute have been firstly, the relatively shallow depths at the Bay entrance, and the propensity for pack ice to drift into the Bay under the influence of tidal currents and/or southeasterly winds, the prevailing wind direction for much of the year. See Figure III-1, "Resolute Bay Climatic Data".

The controlling depth at the entrance to Resolute Bay is 35 feet, which is ample for the drafts of the vessels which have been and are currently being used for Arctic resupply. Maximum draft of vessels used during the 1973 MOT Arctic Resupply was 23 feet. (See Table III-6.) Generally, when Resolute Bay is full of ice, Allan Bay to the west is free of ice and vessels may be unloaded there. A road exists which connects Allan Bay to the "North Camp" at Resolute Bay. The topography and relative location of facilities at Resolute Bay is illustrated in Map III-12.

Advantages claimed at Radstock Bay are a much deeper depth, 60 fathoms of water, and better ice conditions: In fact the Bay is so deep, that small resupply vessels could not have a safe anchor and could not use the Bay unless a wharf facility were provided. Erebus Bay adjoining Radstock has been suggested as an anchorage for small vessels.

Two factors are working against a transfer of facilities from Resolute to Radstock in the near future. Firstly, Resolute Bay is suitable for marine cargo transfer for oil and gas activities at the exploration stage. At the exploitation and transport out phase of Arctic oil and gas development, for instance the construction of an inter-island gas pipeline gathering system, it is possible that the limiting water depths at Resolute would present a problem, specifically with respect to tankers bringing bulk fuel. As yet, the exploitation phase of oil and gas activity in the Arctic Islands has not been reached. Estimates are that exploitation will not take place for about 10 years, due to low discovery rates, and pipeline technology problems. (See Section IV.B.2.)

Secondly, in 1972 the Government of the Northwest Territories submitted a proposal to DINA on the development of a new town site at Resolute Bay. It appears that a site has been chosen for the new town site, located at the head of the Bay. Although further details are needed on the site of the proposed town, construction schedule, projected population, etc., the decision to construct a new town on the Bay puts a stamp of permanence on Resolute Bay with respect to cargo tonnage implications. Even if future developments demand a permanent marine terminal facility elsewhere in the central or western Arctic, location of a town site at Resolute guarantees future cargo flows.

Cargo tonnages to Resolute Bay over the period 1970 to 1973 inclusive are detailed in Table III-23. Total tonnage to Resolute Bay (both MOT and private) was 53,827 tons of which about 75% was bulk petroleum products. Total tonnage has risen from 32,378 tons in 1970 to 53,827 tons in 1973, with the largest share in tonnage increase attributable to bulk fuels. Tankers are unloaded by means of a sea-line similar to the system used in Frobisher Bay. This sea-line is located on the west side of Resolute Bay, near a berm built by MOT. Imperial Oil has a large tank farm a short distance inland.

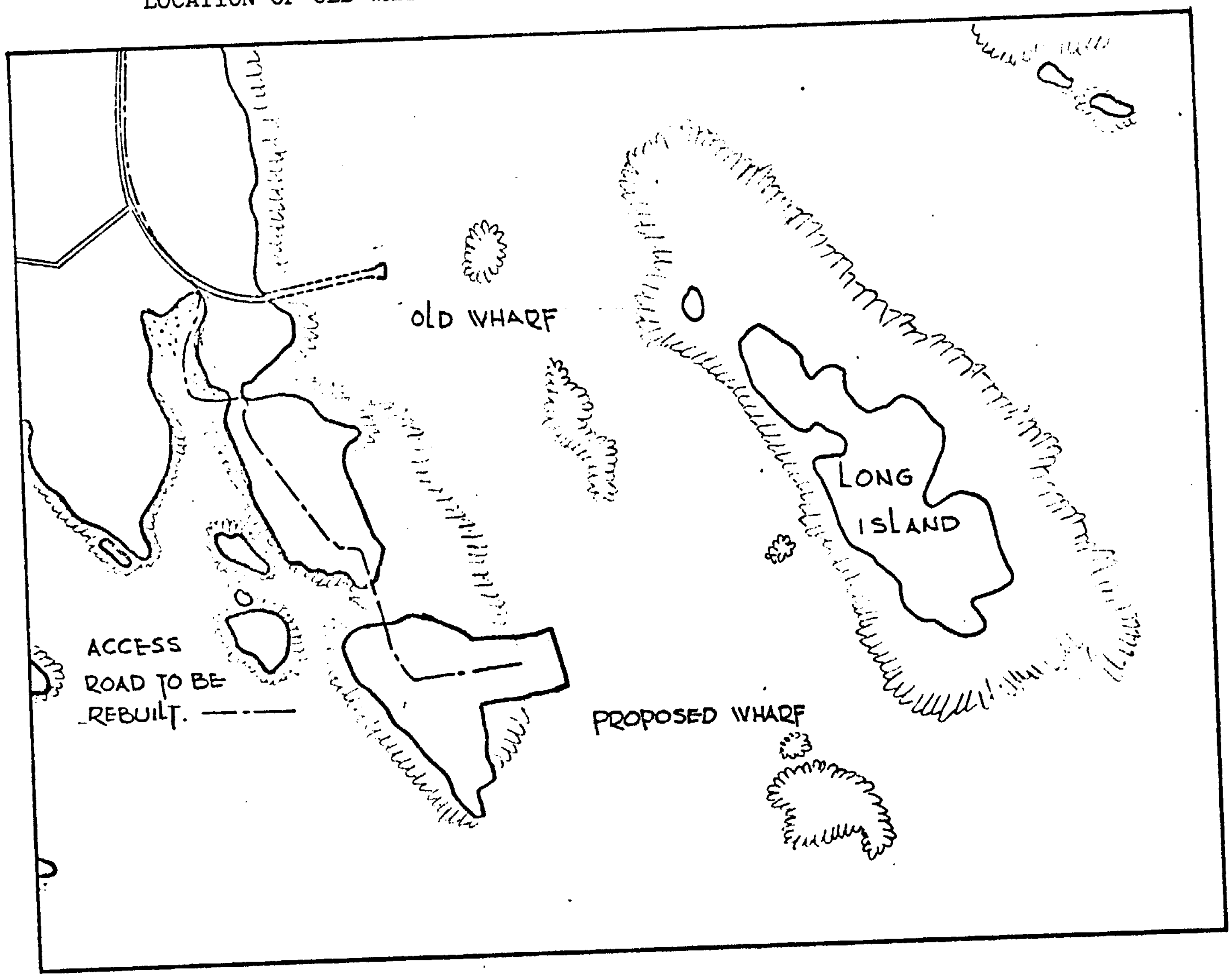
Currently, cargo is unloaded at beach areas all around the shoreline, wherever open water has permitted operations. To aid unloading, private companies and MOT have dumped and pushed gravel out to deeper water and attempted to retain these "jetties" with old oil drums and wire cable. The land areas behind the "jetties" are used as marshalling areas for unloaded cargo, prior to being trucked to the ultimate consignees. Storage areas are situated near the airstrip, about four miles away.

There is one main jetty at Resolute Bay, first constructed during the 1972 season by Cardwell Supply Company Limited, in the northeast corner of the Bay. The facility is used to offload oilfield supplies, which are then redistributed during the balance of the year. Jetty construction is of gravel, welded oil drums, cable, pipe joints and 12" x 12" timbers, and has 35 feet of water alongside. This facility is extensively damaged each year by ice movement, and major reconstruction must be carried out annually.

Resolute Shipping Limited have requested a lease for Crown land, and exemption from the Navigable Waters Protection Act, to construct a jetty in the same corner of the Bay. See Map III-13 for approximate relative location of the two wharves. Construction would be similar to that of the Cardwell jetty, with the possible addition of concrete slabs on the face to deflect ice flows. Total estimated cost is about $30,000. A Declaration of Exemption has been issued under the Navigable Waters Protection Act. DINA has not yet granted a lease to Resolute Shipping.

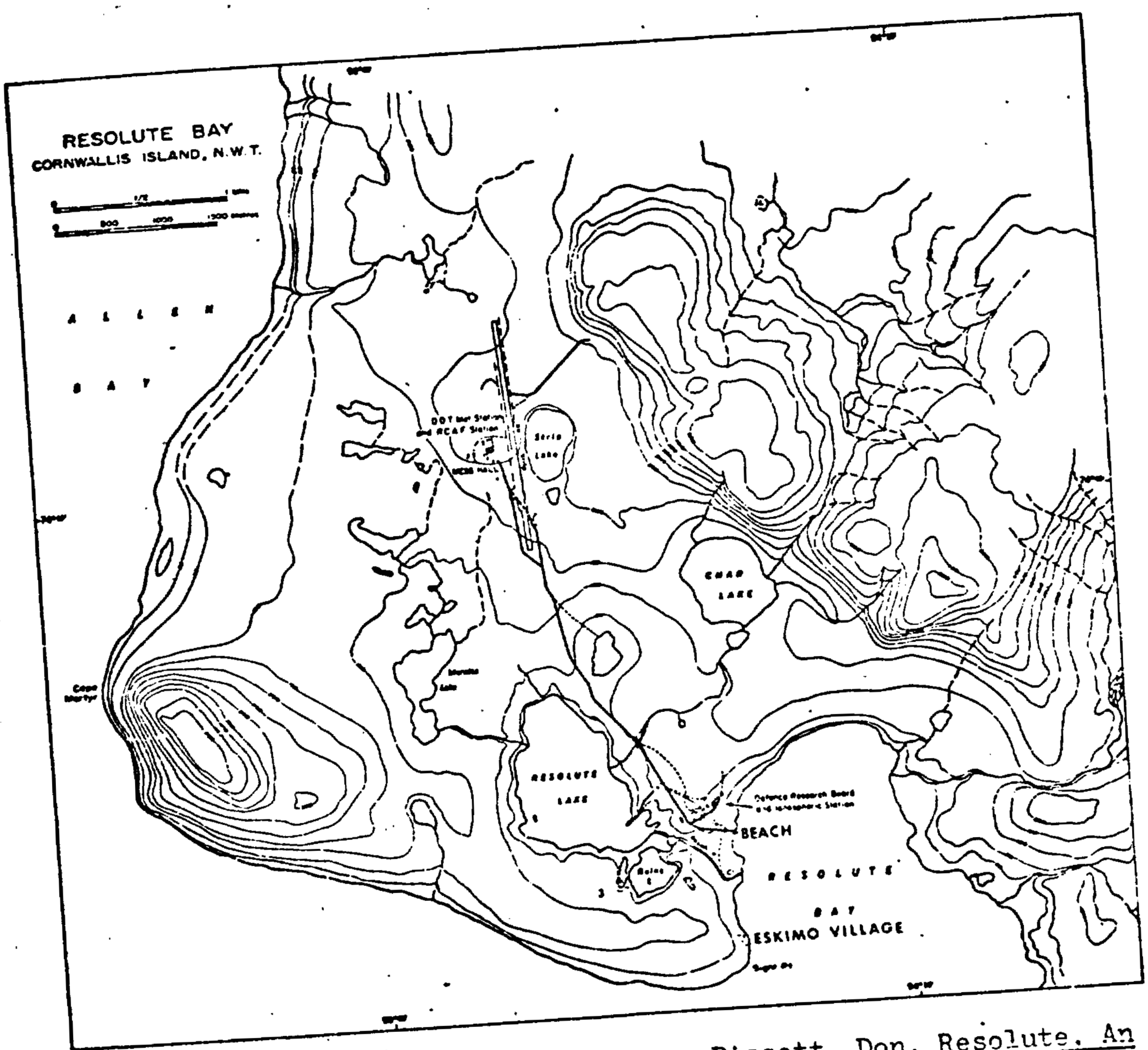
The matter of wharf facilities is complicated by the decision to build a town site at Resulute Bay. The Advisory Committee on Northern Development (ACND) is involved in the Resolute Bay Townsite Project through its Co-ordinating Committee. However, MAP III-

FROBISHER BAY
LOCATION OF OLD WHARF AND PROPOSED LOCATION OF A NEW WHARF



MAP III-13

RESOLUTE BAY
CORNWALLIS ISLAND



Source: Bissett, Don, Resolute, An Area Economic Survey (Department of Indian Affairs and Northern Development, 1972) p. 37.

MAP III-14

RESOLUTE BAY LOCATION OF CARDWELL SUPPLY CO. JETTY &
PROPOSED LOCATION OF THE RESOLUTE SHIPPING CO. JETTY

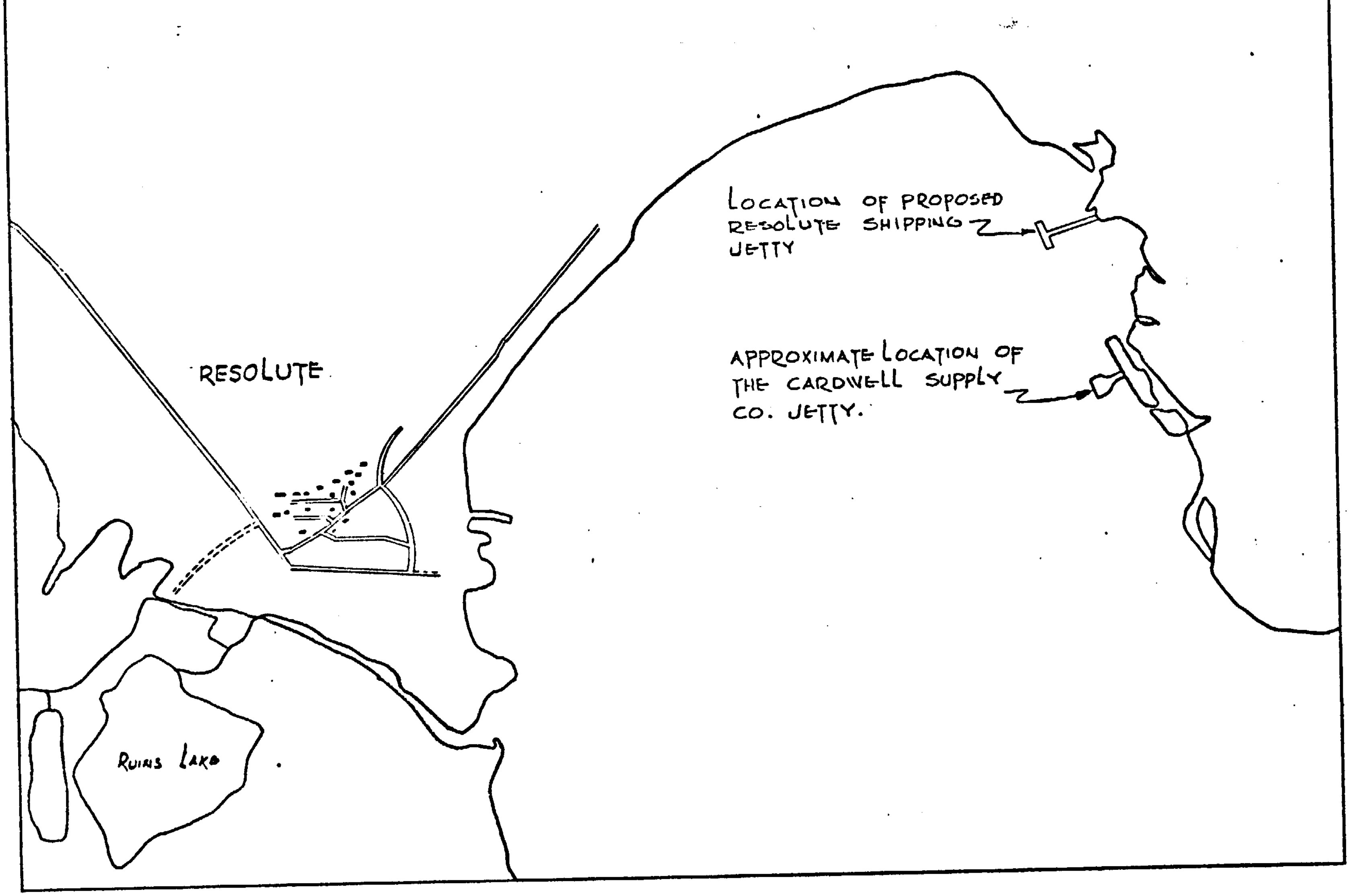
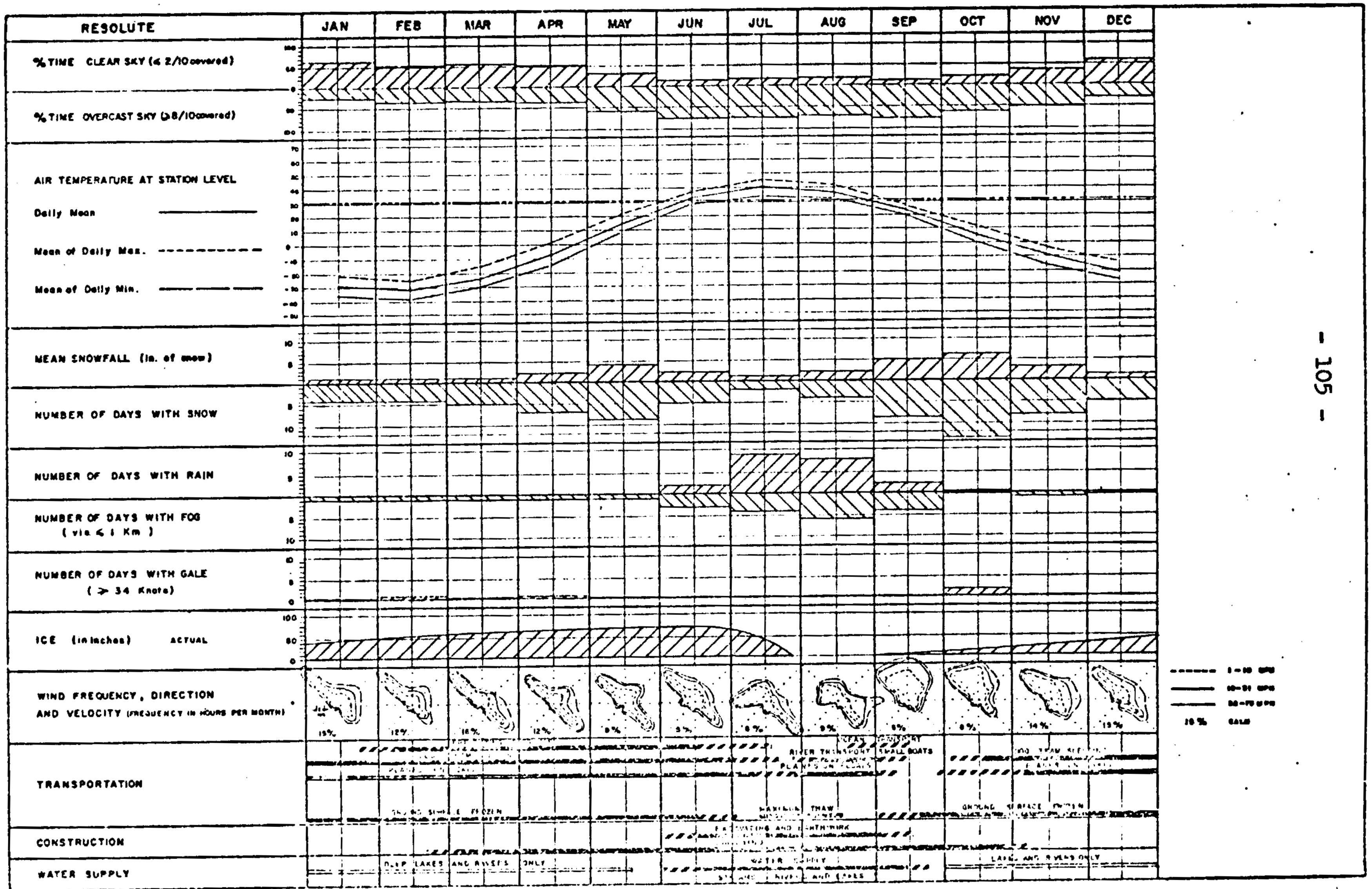


FIGURE III-1
RESOLUTE BAY CLIMATIC DATA



Source:Warnock Hersey, Int. Ltd., Arctic Transportation Study, 1970.

TABLE III-23

RESOLUTE BAY CARGO TONNAGES - MOT AND PRIVATE
1970, 1971, 1972* AND 1973**

	1970	1971	1972	1973	
DRY CARGO					30 vessel calls, 8 vessels brought 11,330 tons of cargo. Cargo size range 20-4,300 s/tons. Average size 1,416 s/tons.
MOT	1,232	1,577	1,691		
Exploration (Estimated)	5,000	7,000	10,000		
	6,232	8,577	11,691	11,330	
BULK CARGO (POL)	26,146	30,000	38,000	42,497	4 vessels brought 42,497 s/tons. Average shipment size 11,000 s/tons.
TOTAL CARGO TONNAGE	32,378	38,577	49,691	53,827	

Note: Cargo: Operations - maintenance material for Government Agencies
Exploration Cargo: Oil drilling equipment and supplies

* 1970, 1971 and 1972 cargo tonnages estimated by Ministry of Transport, Operations Branch.

** 1973 cargo tonnages source: Oldford, H.R., After Action Report. Resolute Bay Sealift, 1973.

this role is one of information exchange, as planning and operational responsibility rests with the Government of the Northwest Territories. GNWT are managing the project through the Resolute Bay Advisory Committee in Yellowknife, under the Chairmanship of Mr. R.A. Creery.

Approval to construct facilities is thus necessary from two Federal Government departments, MOT for the NWPA and DINA for leasing privileges. It was suggested two years ago that MOT take over leasing of the harbour bed at Resolute Bay, due to the magnitude of commercial activity in the harbour, as exemplified by requests by private enterprise to build wharf facilities. Leasing still rests with DINA, who discuss any contemplated leases with MOT before making any commitments.

A close degree of co-operation will be necessary between DINA, MOT and GNWT to ensure that the best wharf sites are not taken up by private industry, inhibiting public cargo transport to Resolute Bay.

c. James Bay

There are potential marine terminal developments at two locations in James Bay: at Fort George, to serve inward movement of supplies for the James Bay Hydro Project; and at Moosonee, in support of outward barge shipments of supplies to be transferred across James Bay to Fort George for the Hydro Project. In addition, Moosonee is a potential transfer point for pipe for a proposed Polar Gas pipeline from the Arctic Islands, which may run southward along the west coast of Hudson Bay to the Canada/U.S. border. (See Map IV-10.)

The only wharf facility at Fort George at present is a small wharf with seven feet of water alongside, about six miles up the Fort George River. Shipments into Fort George (principally from Montreal) by Agence Maritime Inc. amounted to 4,000 tons in 1971, and 3,000 tons in 1972. Cargo tonnage was composed of oil, pre-fab houses and building products.

The James Bay Development Corporation has requested the Ministry of Transport to provide a 650' wharf with 30' of water alongside to handle 30,000 ton tankers and other vessels at a cost of about $7 million. Commodities to be shipped include fuel oil, cement clinker, and general cargo, for a total of some 1,500,000 tons between 1975 and 1984. The company suggests that the wharf would also serve the general cargo needs of several new towns to be built as a result of the hydro-electric development, as well as Fort George.

The wharf facility at Moosonee, Ontario, a floating wharf, 114' long by 16' wide, with 7' of water alongside (constructed in 1968) was updated in 1973 by an extension to deeper water and dredging in the wharf area. A Bailey Bridge type of floating dock was added to extend the wharf out into deeper waters at a cost of $41,000. Dredging was undertaken in the immediate wharf area to increase the available draft an additional two feet. Improvements were carried out during the summer of 1973, and cargo over the floating facility destined for Fort George was estimated to be about 10,000 tons for 1973.*

The Department of Public Works has received joint representation from Agence Maritime Inc., and the Ontario Northland Railway (ONR) for improvement of marine terminal facilities at Moosonee. The proposals involve cargo traffic related to the James Bay Hydro Development over the ONR to Moosonee, thence across James Bay by barge to Fort George.

Cargo transport by barge from Moosonee would provide an alternative means of transport for the James Bay Hydro Project, compared to a route via rail to Mattagami, Quebec, and by truck to the site, and to an all-water route from eastern Canada via the Hudson Strait and Hudson Bay.

ONR discussions with MOT with respect to Federal Government financial participation in upgrading the wharf were based on the multi-user nature of the facility. Other shippers such as Hudson Bay Transport and Two Bay Enterprises would be using the wharf and ONR would be serving many shippers by transporting cargo destined for Fort George.

The distance by sea from Moosonee to Fort George is about 160 miles. Vessels used by Agence Maritime for this journey are of 500 dwt, capable of carrying about 350 tons of cargo, and requiring about 8 feet of water.

In 1960, DPW conducted a major survey at Moosonee, and identified a suitable location for a permanent wharf structure at Ships Sand Island where depths of 15 feet exist close inshore. ONR have stated their willingness to extend their rail lines approximately six miles to this proposed wharf location. A more permanent facility may be considered at this location once the James Bay Development is well underway. Potential cargo tonnages are estimated to ONR to be 2.6 million tons over 10 years, of which 1.5 will be shipped in the first five years.

Pacific Consulting Services Limited (CP Rail) have been retained by TransCanada Pipelines Limited (managers of the project) to investigate and report on the logistics requirements necessary for a feasibility study of the possible Polar Gas pipeline from the Arctic Islands to the Canada/U.S. border.

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* Source: Department of Public Works and the Ontario Northland Railway.

A transshipment port would be required to support 700,000 tons of pipe in one shipping season. A transfer point on Hudson Bay will be required and Moosonee is being considered as a transfer point for pipe in support of a pipeline system. It has not yet been announced whether the pipeline would go down the east or west coast of Hudson Bay. Polar Gas does not expect to make its construction application before 1976 or 1977. On the basis of technical research that will be completed by the end of 1974, Polar Gas hopes to be able to decide on which side of Hudson Bay the pipeline will be built, as continuing studies of both routes will be too expensive. Polar Gas has spent about $10 million in studies to date.* A transshipment port on the Hudson Bay in support of the pipeline system will be required. Facilities at the transfer point would be required to handle an estimated 700,000 tons of pipe in one shipping season. Moosonee and Churchill have both been considered. A freight rate differential of $30/ton on pipe shipped via CNR to Churchill, versus shipment by ONR to Moosonee has been quoted in favour of Moosonee.

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* Pritchard, Timothy, "Polar Gas Wants to Avoid Controversy, Just Develop Pipeline", interview with John Houlding, Head of Polar Gas, The Citizen, April 4, 1974.

TABLE III-25

NORTHERN TRANSPORTATION COMPANY LIMITED

CARGO MOVEMENT 1973 NORTH AND SOUTHBOUND

	General Cargo	Bulk
Yellowknife	522.6	43,613.2
Snowdrift	211.5	453.1
Fort Reliance	47.8	-
Jean Marie River	66.9	102.4
Fort Simpson	1,010.8	2,013.8
Wrigley	1,210.4	117.1
Fort Norman	2,539.1	1,077.3
Fort Franklin	787.2	983.2
Norman Wells	11,741.9	81,222.3
Fort Good Hope	1,299.6	1,046.5
Arctic Red River	5,320.1	2,580.3
Fort McPherson	1,835.0	1,835.3
Aklavik	1,626.0	3,192.8
Inuvik	26,225.9	53,153.3
Cape Parry	211.9	-
Sachs Harbour	349.0	813.8
Holman Island	303.7	704.6
Coppermine	1,003.5	1,904.6
Cambridge Bay	999.0	4,667.0
Gjoa Haven	569.7	771.3
Paulatuk	334.1	283.8
Spence Bay	1,490.5	1,373.3
Lady Franklin Point	39.4	-
Bay Chimo	102.1	
Cargo Handled Ex Tuk:		
Tuktoyaktuk	13,201.3	19,332.6
N.B. to Arctic via Tuk	4,875.9	10,625.3
Western Arctic S.B. via Tuk	373.6	-
Inuvik to Liverpool	271.6	163.1
Liverpool to Delta and S.B.	1,115.1	-
Hay River to Jesse Bay	1,025.0	1,629.5
Inuvik to Jesse Bay	709.4	-

Note: These figures do not include Dew Line Figures.

Source: Northern Transportation Company Limited.

SECTION IV BULK COMMODITY TRANSPORT OUT OF THE NORTH

SECTION IV BULK COMMODITY TRANSPORT OUT OF THE NORTH

Introduction

It is often repeated that the cost of transporting resources out of the Arctic is the factor determining future resource exploitation. There are two principal reasons given. Firstly, in the case of metallic minerals, the resource will be transported in bulk form and so cost of transport is relatively large in relation to commodity value. Secondly, northern climate and topographic factors cause technological, operational and maintenance problems resulting in large capital costs for transport facilities, as exemplified by the need for special Arctic pipeline technology, the requirement for ice-strengthened and icebreaking vessels and wharf structures capable of resisting ice forces.

These problems are magnified the farther north the resource body is located. Several mines have been in production for some time around Great Slave and Great Bear Lakes and in the central and southern Yukon; however, these are on the mainland and are, with the exception of production near Coppermine, south of the Arctic Circle. Commercial resource exploitation north of the Arctic Circle on the mainland and in the Arctic Islands has not yet occurred. The first development will provide substance to speculations on the range of resource exploitation possibilities in the Arctic and will inevitably set a precedent for following developments.

Oil, gas and mineral exploration and development have substantial implications for marine transport development north of 60°. The present northward movement of exploration supply cargo, both bulk fuel and general cargo, could increase enormously during the exploitation phase if a gas pipeline is constructed. Mineral exploitation near coastal areas above the Arctic Circle will have an impact in terms of the need for wharf facilities in high Arctic waters and for ice-strengthened or icebreaking cargo vessels.

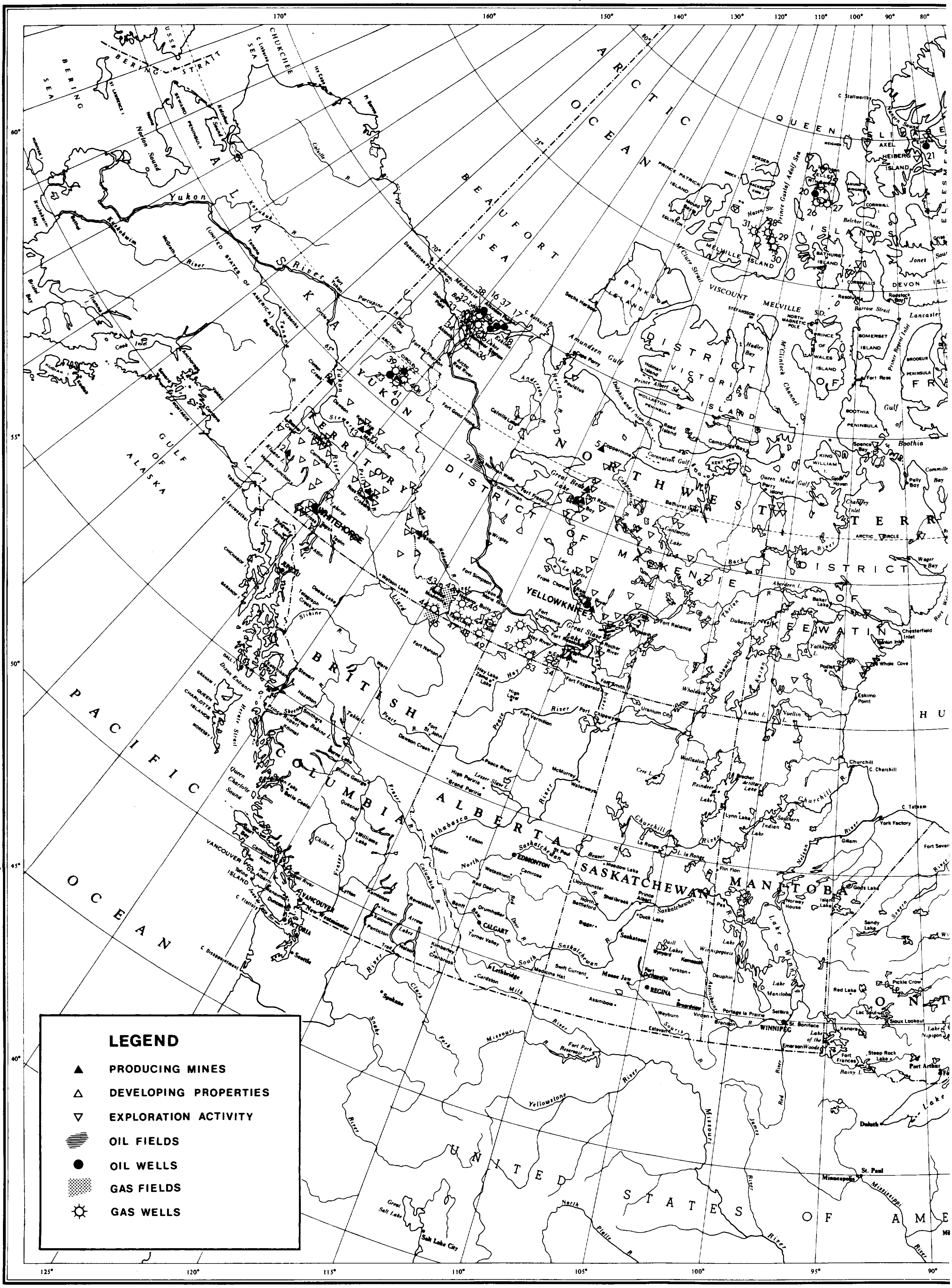
A. LOCATION OF MAJOR KNOWN ARCTIC RESOURCES

1. Oil, Gas and Metallic Minerals -- Relative Location

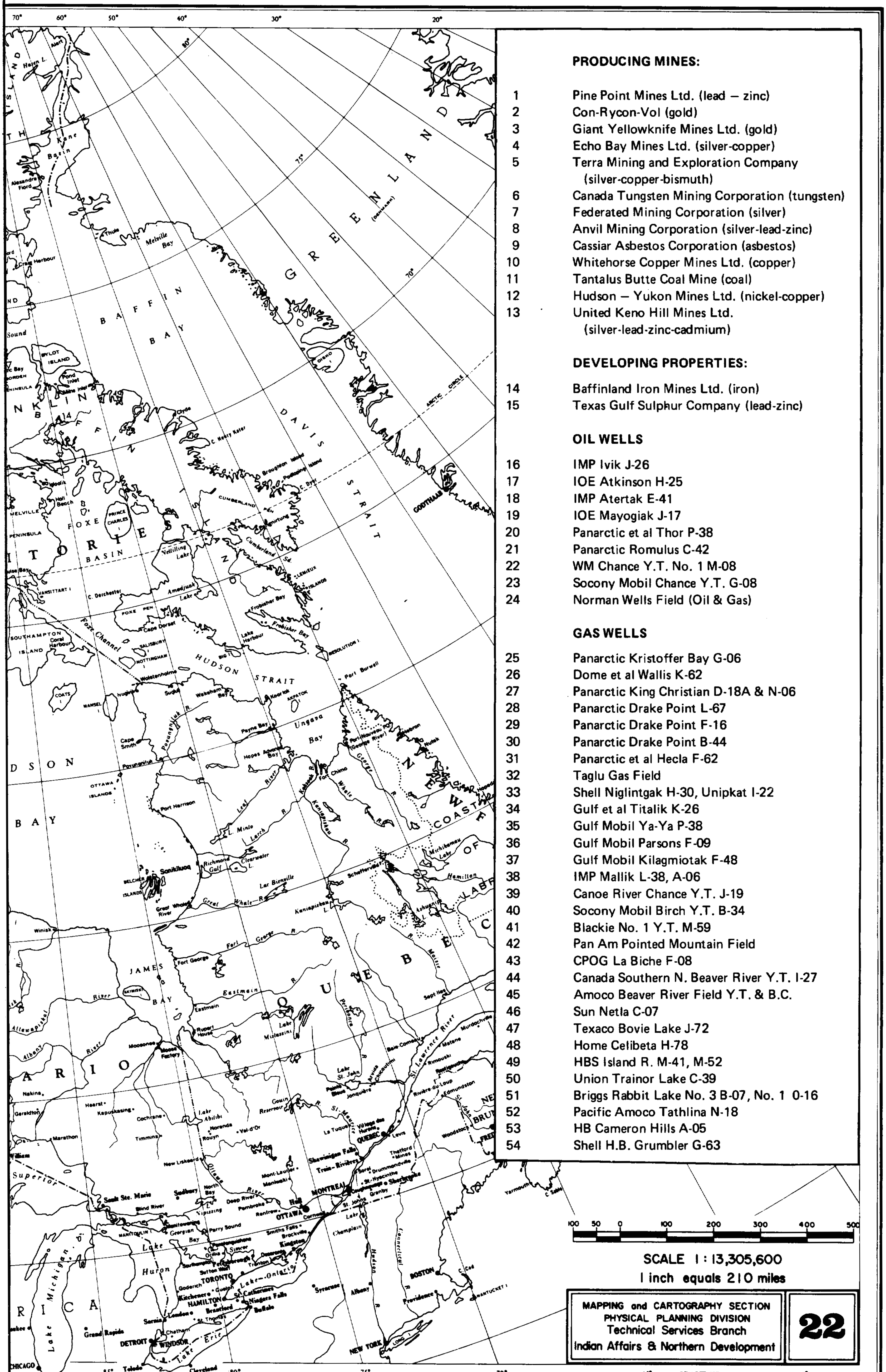
An overall picture of mining exploration and production, and oil and gas discoveries north of 60° is given by Map IV-1. Map IV-2 is less detailed and illustrates the location of major known Arctic mineral ore deposits. Table IV-1 following Map IV-2 details tonnages and grade of each deposit.

The maps illustrate the differing locations of oil and gas discoveries versus mineral discoveries. The former are in the

MINERAL, OIL AND GAS EXPLORATION ANI



) DEVELOPMENT - Northern Canada



western Arctic, concentrated on the Mackenzie Delta, Melville Island and Ellef Ringnes Island. Oil discovered on the Fosheim Peninsula of Ellesmere Island has been the most easterly hydrocarbon discovery to date.

In contrast, the major known metallic mineral discoveries have been in the eastern Arctic, principally on northwestern Baffin Island and in the Hudson Strait and Ungava Bay area of northern Quebec. A deposit on Little Cornwallis Island is the most northwesterly of the group.

Although the Ungava Bay deposits are located slightly south of 60° latitude, the entrance to Ungava Bay is north of 60°. The waters are thus subject to the Arctic Waters Pollution Prevention Act with the attendant stipulations on length of shipping season and type of vessel used, and in a functional sense can be included in a discussion of Arctic resource development.

2. Oil and Gas

Areas of Canada where the composition and structure of the sediment indicate potential for oil and/or gas are illustrated on Map IV-3, "Canada's Petroleum Basins".

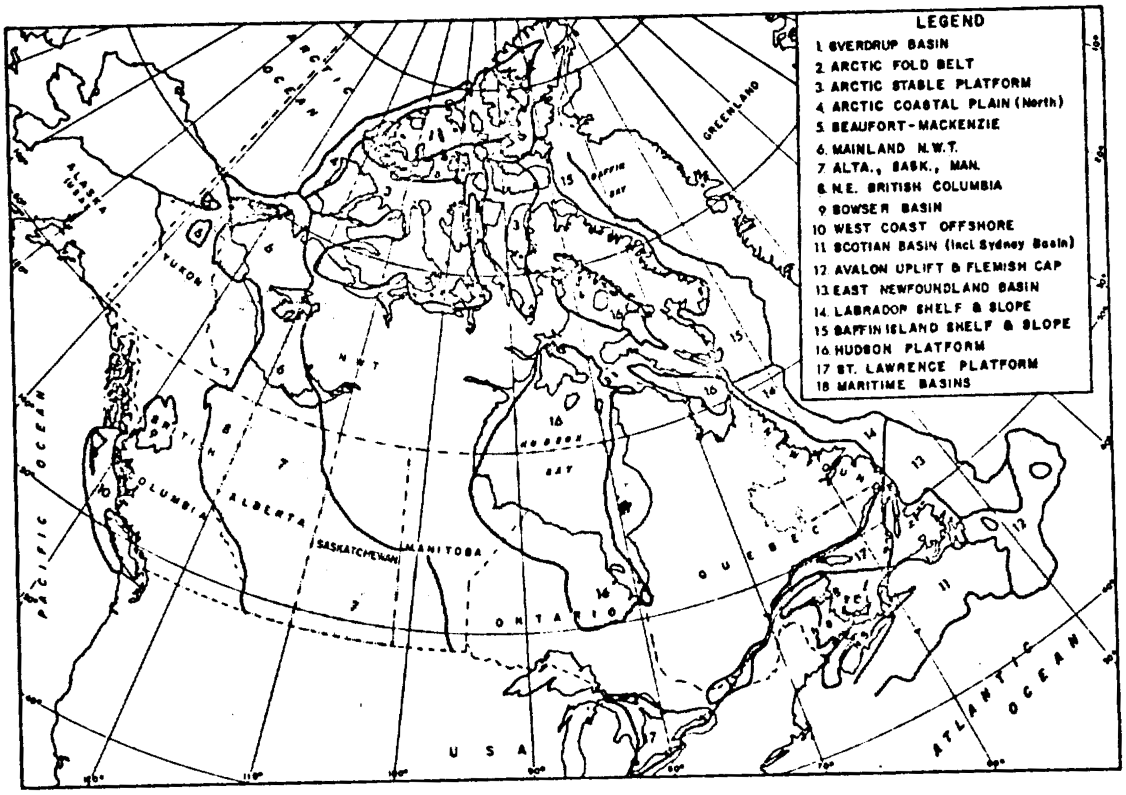
North of 60°, petroleum basins occur in most of the Arctic Islands and offshore areas, the Mackenzie Basin and the southwestern shores and waters of Hudson Bay. Table IV-2 details the ultimate recoverable oil and gas potential of the petroleum basins outlined in Map IV-3. Less than one-third of oil potential for all Canada is estimated to be found north of 60°, and somewhat more than one-third of the gas potential.

Table IV-4 compares the magnitude of potential versus proven oil and gas resources by region. The proportion of proven oil and gas reserves north of 60° is less than three percent, illustrating the great expectations for Arctic oil and gas potential which have not yet become a reality in terms of proven reserves. Appendix 4 contains several newspaper clippings which illustrate the controversial nature of estimates of northern oil and gas potential. Geological Survey of Canada estimates of oil and gas potential were adjusted downward between 1972 and 1973 for all the petroleum basins in Canada with the exception of the offshore East Coast, where estimates increased, and the Hudson Platform, where the estimate stayed the same. Estimates of potential in the Arctic Islands, Coastal Plain and Beaufort - Mackenzie Basins (Basins 1-5 on Map IV-3) were revised downward by about fifty percent for oil and by about twenty percent for gas.

Canada's relative international position for oil and gas reserves is shown in Figure IV-1. On an international scale Canadian resources are of small magnitude. However, when considered in

MAP IV-2

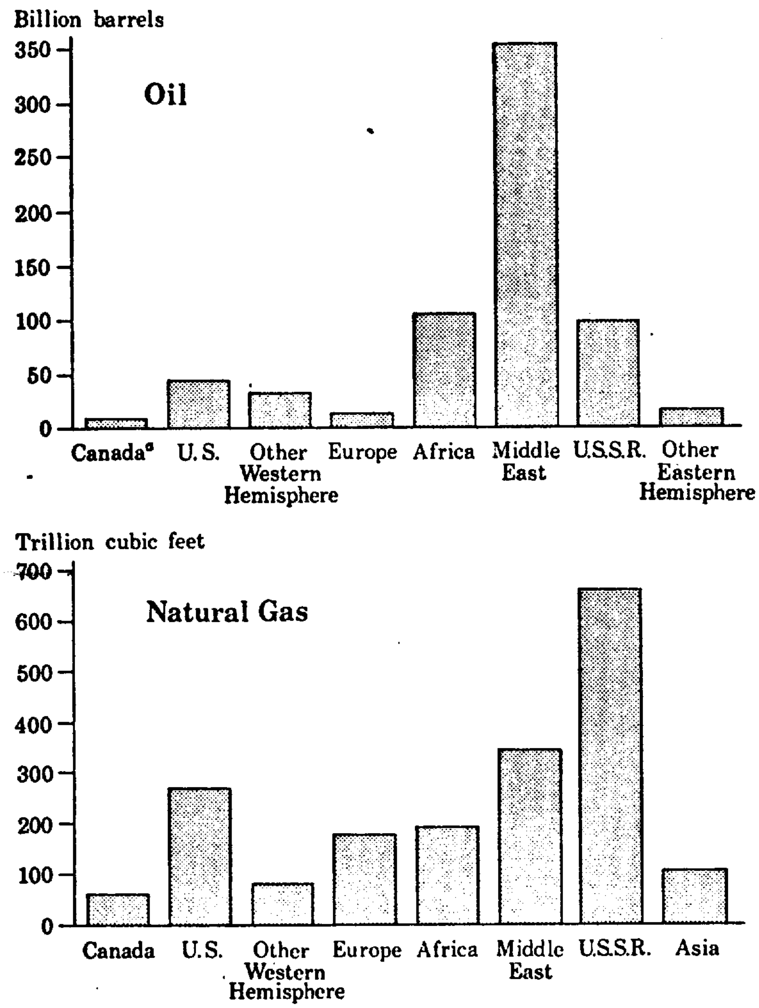
CANADA'S PETROLEUM BASINS



Source: Department of Energy, Mines and Resources, <u>An Energy Policy for Canada, Phase I, Vol.I Appendices</u> (Ottawa: Information Canada, 1973) p.35.

FIGURE IV-1

The World's Reserves of Oil and Gas, 1972



* Excludes tar sands, which could eventually produce 300 billion barrels of oil.

Source: Canadian Petroleum Association, "Worldwide Petroleum at a Glance", Oil & Gas Journal, December, 1972, p.82-83.

TABLE IV-1

ULTIMATE RECOVERABLE OIL AND GAS POTENTIAL*
GEOLOGICAL SURVEY OF CANADA ESTIMATES
1973 AND 1972

Area	Oil (Billion Barrels)	Gas (Trillion Cu. Ft.)
Arctic Islands and Coastal Plain (Basins 1-4)		
1973 Estimate	20.3	242.0
1972	49.3	327.4
Beaufort-Mackenzie (Basin 5)		
1973 Estimate	6.2	93.5
1972	14.7	117.2
Western Canada (Basins 6-10)		
1973 Estimate	22.2	120.3
1972	28.6	207.4
Offshore East Coast (Basins 11-15)		
1973 Estimate	47.5	307.1
1972	38.5	229.6
Hudson Platform (Basin 16)		
1973 Estimate	1.5	7.3
1972	1.5	8.7
Eastern Canada Onshore (Basins 17-18)		
1973 Estimate	1.5	12.7
1972	1.8	15.8
Totals 1973	99.2	782.9
1972	134.4	906.2

* See Table IV-3, Glossary of Oil and Gas Terms, for a definition of "Ultimate Recoverable Oil and Gas Potential".

Source: Department of Energy, Mines and Resources, An Energy Policy for Canada, Phase I, Vol. II, Appendices, (Ottawa: Information Canada, 1973), p. 53.

TABLE IV-2

GLOSSARY OF OIL AND GAS TERMS

Conventional Oil:	That which is recoverable from a well bore by conventional technologies.
Non-conventional Oil:	A viscous oil incapable of being produced by conventional technologies from a well bore. It includes, particularly, oil from the various oil sands which is or may be recoverable by mining or thermal techniques.
Proved Reserves of Oil and Gas:	That which can be demonstrated with geological and engineering data to be recoverable with reasonable certainty under existing economic and operating conditions.
Original in Place Reserves:	The oil or gas initially in place within a pool, part of which is recoverable, and another part non-recoverable.
Recoverable Potential:	The quantities of oil and gas postulated to be present in sedimentary rocks and that are potentially available through extensive exploration.
Ultimate Recoverable Potential:	The proved reserves (both produced and remaining) added to the recoverable potential.
BOE (Barrels of Oil Equivalent):	Oil in barrels plus oil equivalent of gas converted on a thermal basis (6,000 cubic feet equivalent to one barrel) together expressed in barrels.

Source: Department of Energy, Mines and Resources, An Energy Policy for Canada, Phase I, Vol II, Appendices, (Ottawa: Information Canada, 1973), p. 31 and 33.

TABLE IV-3

CANADA'S OIL AND GAS RESOURCES

	In Place	Recoverable	Cumulative Production	Remaining
1. Proved Oil Reserves (Conventional)[1,2] Billion Bbls.				
NWT	0.5	0.1	<0.1	<0.1
W. Canada	43.8	15.9	6.2	9.7
E. Canada	0.2	0.1	<0.1	<0.1
Subtotal	44.5	16.0	6.3	9.7
2. Proved Natural Gas Reserves[2,3] Trillion Cu. Ft.				
NWT	2.0	1.3	—	1.3
W. Canada	116.5	69.1	17.8	51.4
E. Canada	1.1	1.0	0.7	0.3
Subtotal	119.6	71.5	18.5	52.9
3. Potential Oil (Conventional) Billion Bbls.		[4] [5]		[4] [5]
Arctic Islands & NWT		70.1—28.1	—	70.1—28.1
W. Canada (Provinces)		6.5— 4.6	—	6.5— 4.6
East coast		41.7—50.4	—	41.7—50.4
Subtotal		118.3—83.1		118.3—83.1
4. Potential Natural Gas, Trillion Cu. Feet		[4] [5]		[4] [5]
Arctic Islands & NWT		481.1—341.7	—	481.1—341.7
W. Canada (Provinces)		100.5— 43.7	—	100.5— 43.7
East coast		253.1—326.1	—	253.1—326.1
Subtotal		834.7—711.5	—	834.7—711.5
5 Alberta Oil Sands[6] Billion Bbls				
Open-Pit Mineable		65.0	0.1	64.9
"In-Situ" Recovery		235.9		235.9
Subtotal	710.8	300.9	0.1	300.8
6. Alberta Heavy Oil[7] Billion Bbls	75.0	30.0	—	30.0
7. Total Resource (BOE) Billion Bbls	—	616.2—560.5	9.5	606.7—551.0

NOTE: Totals may not add due to rounding.

Footnotes

[1]Includes natural gas liquids.

[2]Source: Canadian Petroleum Association (December 1972).

[3]Figures quoted for "In Place" gas are on a raw gas basis, all others are pipeline gas.

[4]Geological Survey of Canada (February 1972) estimates of ultimate recoverable potential less proved reserves.

[5]Geological Survey of Canada (March 1973) estimates of ultimate recoverable potential less proved reserves.

[6]Source: Oil and Gas Conservation Board, "A Description and Reserve Estimate of The Oil Sands of Alberta", October 1963.

[7]Source: "The Oil Sands of Alberta"—H. J. Webber, The Journal of Canadian Petroleum Technology, October-December 1967.

Source: Department of Energy, Mines and Resources, An Energy Policy for Canada, Phase I, Vol. II Appendices (Ottawa: Information Canada, 1973) p.32-33.

relation to the small Canadian population and the desire of the United States to obtain oil and gas supplies from a politically stable source, Canadian resources assume importance.

Exploration drilling has been carried on with increasing intensity in the Arctic since 1960, when the Federal Government first allowed commercial resource exploration in the Arctic Islands. The 1960 Land Regulations stated the terms under which exploration would take place. Instead of paying rent for exploration permits, the oil companies were required to do a stipulated amount of exploration work to retain their holdings. A deposit per acre of land under permit was returned to the company if exploration work was done. For example, a company with permits for a million acres of land in an area where the deposit was 5 cents per acre for a stated length of time, could do $50,000 worth of seismic surveys to retain rights to the land. After a stated portion of the total permit time, work requirements increase in stages until the total permit time is completed. Work requirements lessen and permit terms lengthen the farther north the location. When oil or gas is discovered, the company has the right to take a twenty-one year lease on half the acreage under permit and then pay a royalty on oil or gas removed from the ground. The 1960 Land Regulations are presently being revised by DINA.

Exploration efforts in the Arctic Islands from 1960 to 1967 were not particularly successful. Initial results were disappointing; the first well drilled at Winter Harbour on Melville Island in 1967 at a cost of $1.8 million (about three times the cost of a well in Alberta) by Dome Petroleum was dry. Two other unsuccessful wells were drilled in 1963 and 1964. By 1967 many of the companies who had taken permits were falling behind in their work requirements. Dr. J.C. Sproule, a Calgary geologist who believed in the oil and gas potential in the Arctic Islands, organized a group of companies involved in exploration who pledged their land. However, sufficient financing was not available. In 1967, the Panarctic venture was created when the Federal Government agreed to a government/industry partnership by agreeing to contribute 45% of the required financing of a $20 million program. Panarctic now has capitalization of $10 million and has made five major gas discoveries.

In 1968 Atlantic Richfied Company found a huge oilfield at Prudhoe Bay, a few hundred miles west of the Canadian border which led in a year to almost a doubling of the land held under permit on the islands and mainland. Imperial Oil Limited discovered oil at Atkinson Point on the Mackenzie Delta in 1970 and by 1973 the company had announced three major gas finds and two oil discoveries.

Two transactions to sell the gas on the Mackenzie Delta have already been effected, on the condition that the Canadian Government would issue permits to build a pipeline to the United States and to export gas. Imperial has contracted to sell 10 trillion cubic feet of natural gas over twenty-two years at a minimum wellhead price of 32 cents per thousand cubic feet (mcf); Gulf has apparently committed 4 trillion feet and Shell has committed 9 trillion cubic feet, all to companies in the US.

Oil has not yet been found in the amounts hoped for. Current industry thinking is that oil may have accumulated in the shallow waters of the Beaufort Sea, offshore from the Mackenzie Delta. In 1972 Imperial Oil Limited constructed an artificial island called Immerk about 12 miles offshore at a cost of $3 million. The island consists of bottom sediments dredged from the Beaufort Sea and is essentially an experimental drilling platform for offshore exploration drilling which would have been ready for drilling during 1974. The water is shallow (about 10 feet in places) but it is frozen for nine months of the year and during the short open water season the area is subject to heavy winds and waves which could easily knock over a drilling rig.* However, on March 6, 1974, Northern Affairs Minister Chretien announced that no offshore drilling for oil and gas in the Beaufort Sea would be allowed before the summer of 1976. This period of time allows for two years of environmental studies to develop drilling policies designed to protect the marine mammals and acquatic ecology of the area. Oil companies have agreed to spend $3 million for studies on the marine environment in the Beaufort Sea.** When and if drilling is approved, the offshore wells could cost as much as $10 million each, compared to about $3 million for a well in the Arctic Islands and about $2 million for a well on the Mackenzie Delta.***

Expenditure on oil and gas exploration was estimated at $238 million in 1972, an increase of $58 million over 1971.**** Expenditures for exploration drilling and seismic exploration exceeded similar work in every province and the combined Atlantic and Pacific offshore. Seventy-one exploratory wells were drilled in 1972, with discoveries of gas or oil at eleven wells.*****

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* Judith Maxwell, Energy From the Arctic: Facts and Issues, (Montreal: C.D. Howe Research Institute, 1973), p. 19-24.

** Studies are part of a $5.5 million environmental assessment program conducted jointly by the Federal Government and the Arctic Petroleum Operators Association. "Beaufort Sea - No Drilling Before 1975", The Citizen, March 7, 1974, and "Offshore Drilling Programs Drawing Strong Protests", The Citizen, April 17, 1974.

*** Judith Maxwell, op. cit., p. 24.

**** Exploratory drilling is projected to double from $250 million in 1973 to $500 million in 1980, when commercial threshold volumes of gas & possible oil are expected to be indicated. Exploration expenditures should decline in the 1980's & will be increasingly concentrated in the offshore.(Source: From a talk given by A.Digby Hunt, ADM, Northern Affairs, DINA, at a Canadian National Energy Forum, Winnipeg in Oilweek, February 1974, p. 12.

***** DINA, North of 60° Oil and Gas Activities, 1972, (Ottawa: Information Canada, 1973), p. 20 and 24.

The only producing oil field north of 60° is located at Norman Wells where commercial development began after World War II. During 1972, oil was produced at an average rate of 2,620 barrels per day and refined at the only operating refinery north of 60°. The refinery is operated by Imperial Oil Limited and has a daily capacity of 1,500 barrels.*

3. Metallic Minerals

Stages in mineral resource development can be divided into showings or occurrences of minerals at a location, proven deposits and production.

Mineral exploration activity as shown on Map IV-1 corresponds to locations where showings of minerals have occurred, or where structures indicate potential mineralization. Areas of mining exploration in the western portion of the mainland Northwest Territories are concentrated on Great Bear Lake (copper and silver), Great Slave Lake (copper, silver and uranium) and the northwest shore of Hudson Bay (copper). In the Yukon, activity is concentrated in the southern portion of the Territory for copper, molybdenum, silver, lead, zinc and tungsten.**

Mineral occurrences for which the company concerned has published reserve figures are detailed in Table IV-5, with the exact location of the deposits. These are provisional figures only, since there is no legislation compelling mining companies to publish definite figures on the extent of mineral discoveries. Table IV-1 accompanying Map IV-2 is less detailed and presents major known Arctic mineral ore deposits. Of these, three deposits north of the Arctic Circle have been subject to development feasibility studies. Two of these deposits, a lead-zinc deposit at Strathcona Sound and an iron deposit at Mary River, are located on northwestern Baffin Island. The third is a lead-zinc deposit located on Little Cornwallis Island. Of the three, the Strathcona Sound deposit is at the most advanced stage of development. A formal proposal to the Federal Government for financial aid for resource development has been presented by Mineral Resources International, managers of the project.

There are seven producing mines in the Northwest Territories (Map IV-1), two open pit and five underground operations. Lead-zinc accounted for 85% of the total production value of $124,149,000

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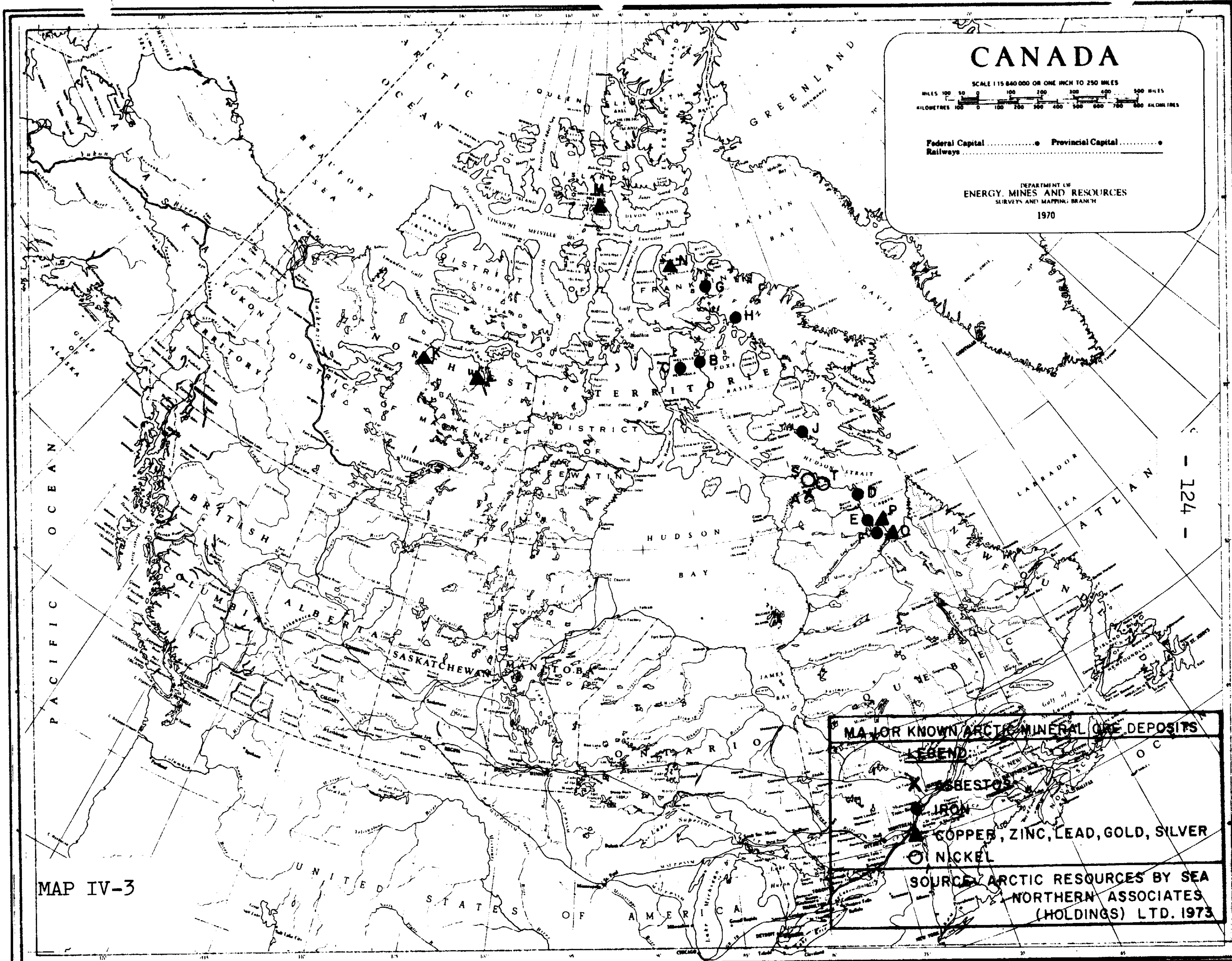
* DINA, North of 60° Oil and Gas Activities, 1972, op. cit., p. 9 and 31.

** DINA, North of 60° Mines and Minerals Activities, 1972 (Ottawa: Information Canada, 1973) p. 8-26.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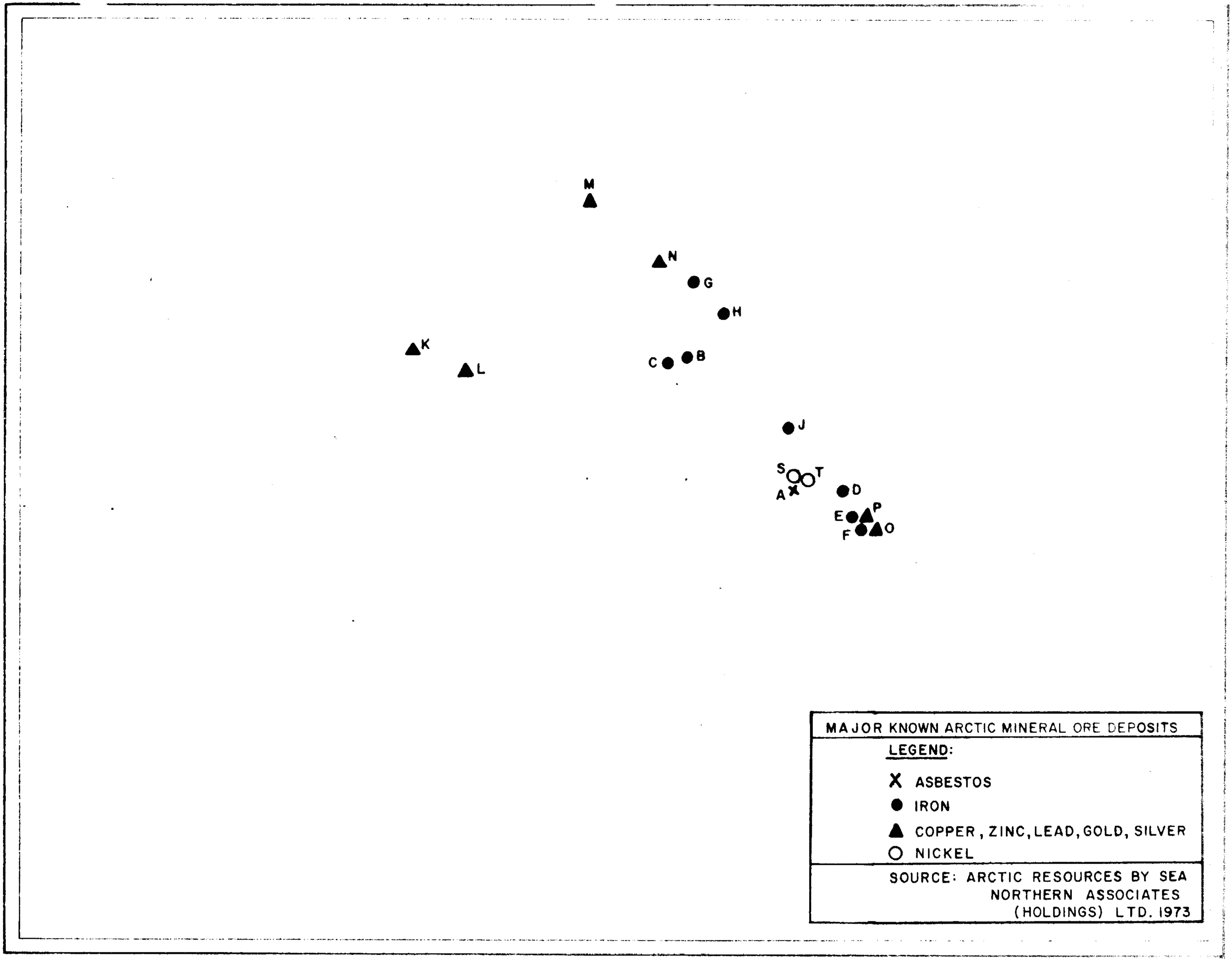
SCALE 1:15 840 000 OR ONE INCH TO 250 MILES
Federal Capital
Provincial Capital
Railways
DEPARTMENT OF
ENERGY, MINES AND RESOURCES
SURVEYS AND MAPPING BRANCH
1970
MAJOR KNOWN ARCTIC MINERAL ORE DEPOSITS
LEGEND
X ASBESTOS
● IRON
▲ COPPER, ZINC, LEAD, GOLD, SILVER
O NICKEL
SOURCE: ARCTIC RESOURCES BY SEA
NORTHERN ASSOCIATES
(HOLDINGS) LTD. 1973
MAP IV-3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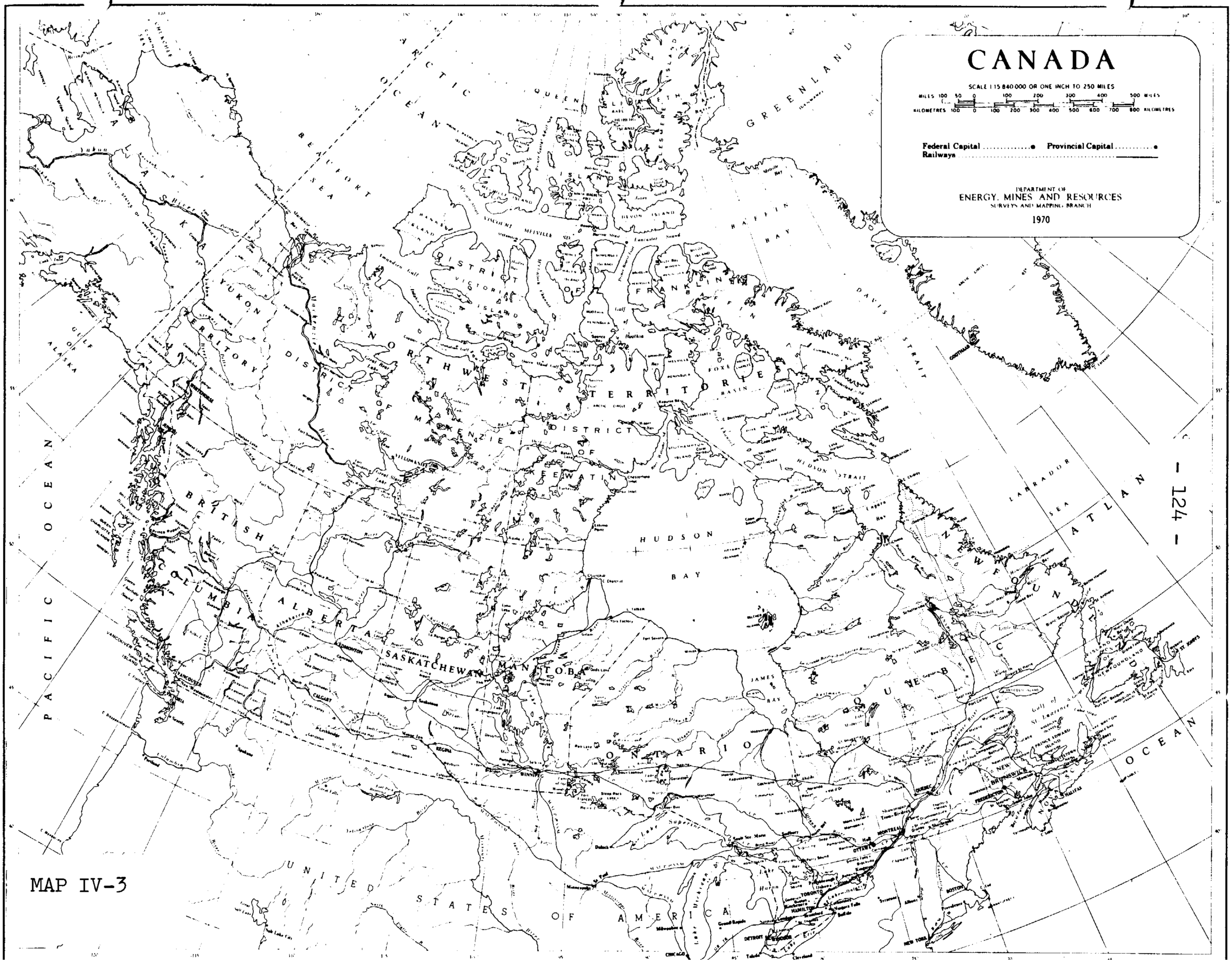
LEGEND:
ASBESTOS
IRON
COPPER, ZINC, LEAD, GOLD, SILVER
NICKEL
SOURCE: ARCTIC RESOURCES BY SEA
NORTHERN ASSOCIATES
(HOLDINGS) LTD. 1973


CANADA
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Federal Capital
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DEPARTMENT OF
ENERGY, MINES AND RESOURCES
SURVEYS AND MAPPING BRANCH
1970
ARCTIC OCEAN
BEAUFORT SEA
GREENLAND
BAFFIN BAY
DAVIS STRAIT
HUDSON BAY
JAMES BAY
HUDSON STRAIT
LABRADOR SEA
ATLANTIC OCEAN
PACIFIC OCEAN
GULF OF ALASKA
ALASKA
YUKON TERRITORY
NORTHWEST TERRITORIES
DISTRICT OF MACKENZIE
DISTRICT OF FRANKLIN
DISTRICT OF KEEWATIN
BRITISH COLUMBIA
ALBERTA
SASKATCHEWAN
MANITOBA
ONTARIO
QUEBEC
NEWFOUNDLAND
NEW BRUNSWICK
NOVA SCOTIA
PRINCE EDWARD ISLAND
UNITED STATES OF AMERICA
VICTORIA ISLAND
FOXE BASIN
EDMONTON
CALGARY
REGINA
WINNIPEG
TORONTO
HAMILTON
OTTAWA
MONTREAL
QUEBEC
FREDERICTON
HALIFAX
VANCOUVER
VICTORIA

MAP IV-3

TABLE 14

MAJOR KNOWN ARCTIC MINERAL ORE DEPOSITS

Chart Letter	Region	Reported Reserves of Ore (Million Tons)	Grade of Ore
	ASBESTOS		
A	Ungava, Que. - in production.	18.7	High Grade
	IRON		
B	E. Melville, N.W.T.	1,139	25-35% Fe
C	W. Melville, N.W.T.	3,352	35-40% Fe
D	Ungava, Que.	695	35% Fe
E	Ungava, Que.	581	35.7% Fe
F	Ungava, Que.	266	21-31% Fe
G	Baffin Island, Mary River	135	69% Fe
H	Baffin Island, Ege Bay	500	35% Fe
J	Baffin Island, Hobart Island	10	30-70% Fe
	COPPER, ZINC, LEAD, GOLD, SILVER		
K	Coppermine River, N.W.T.	5	2.5% Cu
L	High Lake, N.W.T.	5	3.5% Cu, 2.46% Zn, 0.23 oz./ton Au
M	Little Cornwallis Island	24	20% combined Pb + Zn
N	Strathcona Sound, Baffin Island	12	8.8% Zn, 1% Pb, 1.3 oz./ton Ag
P	Ungava, Que.	4	1.34% Cu, 1.8% Zn, 0.047% oz./ton Au & 0.54 oz./ton Ag
Q	Ungava, Que.	4.7	Cu, Zn, Au & Ag valued at $16.30 per ton
	NICKEL		
R	Ungava, Payne Bay, Que.	not known	1% combined Cu-Ni
S	Ungava, Deception River region (sum of 5 individual discoveries)	19	1.53% - 3.06% Ni, 0.70% - 0.78% Cu
T	Ungava, Wakeham Bay	(4 (16	0.96% Ni, 1.04% Cu 2.58% Ni, 0.71% Cu
	GRAND TOTAL -	6,790.4	

Source: Northern Associates (Holdings) Ltd., Arctic Resources By Sea, 1973.

TABLE IV-5

MINERAL OCCURRENCES NORTHERN COAST AND ARCTIC ISLANDS OF CANADA

p ber	Company Mineral Deposit	Commodity	Location	Reported Reserves and grade (as of August 1972)
	Crest Exploration Limited Subsidiary of California Standard Company	Iron	Snake River latitude 65° 15' longitude 133° 00'	20 billion tons 43% Fe
	Coppermine River Ltd No. 47 zone	Copper	Coppermine River latitude 67° 24' longitude 116° 23'	4,162,433 tons 2.96% Cu
	Bernack Coppermine Exploration Ltd June #1	Copper	Coppermine River latitude 67°34.4' longitude 115° 03.7'	1,000,000 tons 2.5% Cu
	Kennarctic Explorations Limited owned by Kennco Explorations (Canada) Ltd., a wholly-owned subsidiary of Kennecott Copper Corp.	Copper Zinc Gold	High Lake latitude 67° 25' longitude 110° 45'	5,206,856 tons 3.5% Cu, 2.46% Zn, 0.23 oz/to[illegible] Au, minor Ag and Pb.
	Bathurst Norsemines Ltd (Cominco Ltd. option) B B property	Zinc Silver Lead Copper Gold	Hackett River latitude 65° 55' longitude 108° 22'	Substantial tonnage in several zones. (A zone grad[illegible] 8.5% Zn, 1.4% Pb, 7 oz/ton A[illegible] 0.25% Cu, 0.05 oz/ton Au).
	Arvik M.L. (Cominco Ltd (75%), Bankeno Mines Limited (25%)			
	Polaris (Main showing)	Lead Zinc	Little Cornwallis Island latitude 75° 27.7' longitude 96° 57.0'	20 millions + tons, grading better than 20% combined Pb - Zn.
	Eclipse (East showing)	Lead Zinc	Little Cornwallis Island latitude 75° 32.5' longitude 96° 09'	1,535,000 tons (approx) 10% Zn, 2% Pb.
	Texas Gold Sulphur Company Inc.	Lead Zinc Silver	Strathcona Sound Baffin Island latitude 73° 02' longitude 84° 23'	12,000,000 tons 8.8% Zn, 1% Pb, 1.3 oz/ton A[illegible]

Company Mineral Deposit	Commodity	Location	Reported Reserves and grade
Baffinland Iron Mines Limited (Hudson Bay Mining and Smelting Co. Limited and 9 other participants)	Iron	Baffin Island latitude 71° 19' longitude 79° 21'	135,000,000 + tons 69% Fe
Patino Mining Corporation and Terra Nova Exploration Ltd	Iron	Eqe (Grant-Suttie) Bay, Baffin Island latitude 69° 41' longitude 76° 46'	500,000,000 + tons 35% Fe
Borealis Exploration Limited East Melville	Iron	Melville Peninsula latitude 68° 20' longitude 82° 35'	1,139,600,000 long tons 25 - 35% Fe
Borealis Exploration Limited West Melville	Iron	Melville Peninsula latitude 68° 14' longitude 85° 20'	3,352,500,000 long tons 35 - 40% Fe
East Korok Group	Iron	Hobart Island (North of), Baffin Island latitude 64° 20' longitude 73° 25'	10,000,000 tons 30 - 70% magnetic iron.
Asbestos Corporation Limited	Asbestos	Asbestos Hill, 40 miles south of Deception Bay, Ungava latitude 61° 45' longitude 73° 55'	18,738,000 tons ore containing asbestos Production started July 1972.
New Quebec Raglan Mines Limited (Controlled by Falconbridge Nickel Mines Limited)	Nickel Copper	Wakeham Bay Area, Ungava	16,050,000 tons @ 2.58% Ni, 0.71% Cu
Cross Lake	Nickel Copper	Cross Lake latitude 61° 35.6' to 61° 35.8' longitude 74° 13.1' to 74° 17.5'	10,050,000 tons 1.53% Ni, 0.78% Cu.
Donaldson	Nickel Copper	Raglan Lake latitude 61° 40.5' longitude 73° 17.5'	3,021,000 tons 3.06% Ni, 0.73% Cu
Katiniq	Nickel Copper	Deception River Area latitude 61° 41' longitude 73° 40'	5,276,000 tons 2.42% Ni, 0.70% Cu (assumed extension could double this reserve)
Raglan 2-area	Nickel Copper	Deception River Area latitude 61° 40.0' longitude 73° 44.7'	660,000 tons 2.43% Ni, 0.72% Cu (assumed extension could almost double this reserve

er	Company Mineral Deposit	Commodity	Location	Reported Reserves and grade
(cont'd)	Raglan 3-area	Nickel Copper	Deception River Area latitude 61° 39.8' longitude 73° 46.2'	1,093,000 tons @ 2.81 Ni, 0.69% Cu. (assumed extension 500,000 tons with same grade)
	Expo Ungava Mines Limited	Nickel Copper	Povungnituk River Area, Wakeham Bay region latitude 61° 33.1' longitude 73° 28.2'	4,065,895 tons @ 0.96% Ni, 1.04% Cu. (or 18,000,000 tons @ 0.47% Ni, 0.52% Cu)
	International Iron Ore Limited (Premium Iron Ore L, Steep Rock Iron ML, The Cleveland-Cliffs Iron Co. and others)	Iron	Roberts Lake-Payne Bay area, Ungava Latitude / Longitude	
	Kayak Bay Zone	Iron	60° 04' / 69° 45'	100,000,000 tons @ 35.3% Fe
	Hump zone	Iron	60° 29' / 70° 16'	200,000,000 long tons
	Yvon Lake	Iron	60° 27' / 70° 37'	100,000,000 long tons
	Synclinal zone	Iron	60° 20' / 70° 30'	200,000,000 long tons
	Igloo Lake zone	Iron	60° 25' / 70° 10'	100,000,000 long tons
	Atlantic Iron Ores Limited subsidiary of International Iron Ores L	Iron	Ford Lake Iron Range, Ungava latitude 59° 12' to 59° 20' longitude 69° 53' to 70° 15'	581,700,000 long tons of proven ore grading 35.7% soluble iron in 8 zone and 225 million tons of possible ore
	Consolidated Fenimore Iron Mines Limited	Iron Manganese	Leaf Lake Iron Range, Ungava latitude 58° to 59° longitude 70° to 70° 15'	266,604,920 tons of potential ore consisting of: 45,967,320 tons of carbonate ore @ 20.9% Fe, 2.06% Mn, 35.23% insolubles. 220,637,600 tons magnetite-hematite IF @ 31.12% Fe, 1.62% Mn, 43.73% insolubles.
	New Ungava Copper Corporation Limited (optioned to Imperial Oil L) Soucy No. 1	Copper Zinc Gold Silver	Leaf Bay area, Ungava latitude 59° 20' longitude 69° 55'	4,000,000 tons 1.34% Cu, 1.87% Zn, 0.047 oz/ton Au, and 0.54 oz/ton A

er	Company Mineral Deposit	Commodity	Location		Reported Reserves and Grade
(Cont'd)	Hollinger North Shore Exploration Company Limited Prud'homme No. 1	Copper Zinc Gold Silver	Gerido Lake, Ungava latitude 58° 15.6' longitude 69° 54.3'		4,745,000 tons having a gross metal content valued at $16.30/ton
	Hopewell Islands	Iron	Hopewell Islands latitude 58° 08' to 58° 34' longitude 77° 30' to 77° 46'		Substantial tonnage
	Nastapoka Islands	Iron Manganese	Nastapoka Islands latitude 56° 25' longitude 76° 40'		300 - 400 million tons @ 30 - 40% Fe plus Mn.
	Little Long Lac Mines Limited (acquired property from Belcher Mining Corporation Limited by Merger)	Iron	Belcher Islands		About 2 billion tons of appro[illegible] 30% Fe estimated in this 2,800-acre property which includes the measured reserves on Innetalling Isl[illegible]
	Innetalling Island	Iron Copper	Innetalling Island, Belcher Islands latitude 55° 53' longitude 79° 02'		400,000,000 + tons of open pi[illegible] reserves averaging about 2[illegible] indicated by diamond drilli[illegible] Copper mineralization has b[illegible] found in diabase overlying the iron formation.
	Hudson Bay Syndicate Inc. and Southern Exploration & Development Corporation		Richmond Gulf-Little Whale River Area		
			Latitude	Longitude	
	Ruby Lake	Zinc Lead	55° 56.7'	76° 44.0'	578,690 tons @ 1.26% Zn, 1.02[illegible]
	Nancy Island	Zinc Lead	55° 57.5'	76° 48'	294,463 tons @ 2.15% Zn, 0.72[illegible]
	Lake Montre	Lead	56° 01'	76° 40'	132,560 tons @ 1.75% Pb

(Cont'd) ....

Map Number	Company Mineral Deposit	Commodity	Location	Reported Reserves and Grade
22	Great Whale Iron Mines Ltd, Little Long Lac ML, Wright Hargreaves ML, and Malartic Gold Fields (Quebec) L.	Iron	Great Whale River latitude 55° 05' longitude 76° 55'	About 1 billion tons grading approx 37% Fe in 3 deposits.
23	Duncan Range Iron Mines Ltd.	Iron	Duncan Lake latitude 53° 32' longitude 77° 41'	An estimated 2 billion tons averaging 32% Fe could be extracted by open pit mining (surface exploration indicat 300,000,000 tons of bene-ficiating type taconite ore)

Note: Although sedimentary rocks in Northern Canada contain sulphur associated with gypsum piercement domes in the Arctic Islands, Coal, and soapstone, these mineral products have not been plotted on the map because they appear to have no immediate economic potential as a source of raw material for shipping from the North.

Source: Mineral Resources Branch, Department of Energy, Mines and Resources, Ottawa.

Prepared by:
Mineral Resources Branch
Department of Energy, Mines & Resources.
Ottawa, Canada
January, 1973

REPRESENTATIVE PHYSICAL SHIPPING CHARACTERISTICS

OF VARIOUS MINERAL COMMODITIES*

Commodity	Approximate Weight[1] (lb/cu. ft.)	Common Shipping Modes[3]
Copper ores	120-150	Bulk Shiploads: ≤ 12,000 tons Parcels: 1,000-4,000 tons Drums/Bags: 50-1,000 tons
Copper concentrates	100-110	
Iron ore	120-180	Shiploads to > 100,000 tons
Iron ore, crushed	135-150	
Lead ores	200-270	Bulk parcels: 1,000-4,000 tons Bagged and drum parcels
Lead concentrates	180-190	
Nickel ores	150	Bulk parcels Drum and bagged parcels (drum approx. 900 lbs.)
Nickel concentrates	110-130	
Zinc ore, crushed	160	Bulk shiploads: 7-14,000 tons Bulk parcels: 1,000-5,000 tons Drums (approx. 600 lbs), bags
Zinc concentrates[2]	75-80	
Asbestos ore/rock	81	Bulk shiploads Parcels Palletised bags Containerised bags
Asbestos fibre	50	

(1) Weights can vary considerably depending on composition, moisture content, size distribution, grade, etc. The above figures are an indication only, and commodities shipped from actual mining operations may fall outside the ranges indicated.

(2) Zinc is often concentrated with lead to produce a lead/zinc concentrate.

(3) Drums - usually old oil drums
Bags - plastic, multiwall paper, innerlined cloth
Sacks - burlap, cloth with no inner lining
Crates -) wood, steel, aluminium alloy,
Containers -) fibreglass reinforced plywood.

* Source: AMDEC Corporation publication, 1971.

in 1972. Six mines produced in the Yukon, two open pit and four underground. Lead-zinc accounted for 76% of the total production value of $102,418,000 in 1972.* In addition, production commenced at a mine located at Asbestos Hill, 40 miles south of Deception Bay, on Ungava Bay where Asbestos Corporation Limited shipped out 60,000 tons of asbestos in 1972.

Map IV-4,"Mineral Potential Map, Yukon and Northwest Territories" outlines areas in which continued exploration is likely to produce more showings of the indicated minerals. Areas marked "1" are those most favourable and those marked "4" are least favourable. Priorities indicated on the Map are based on a combination of factors, primarily current mineral showings and geological structure.** From a marine transport point of view, the "1" rating for Cornwallis, Little Cornwallis, northwestern Baffin Island and the northwestern Hudson Bay are most interesting. Also the "2" for most of Ellesmere Island and the western portion of Devon Island. These locations of potential mineral deposits are all in the eastern Arctic where surface vessel transport of the bulk commodity to market may be feasible. As well, areas of high potential located near a large known deposit add to the feasibility developing the latter, since increased reserves will add to the life of a mining project.

4. Programs Affecting the Rate and Pattern of Resource Exploration and Development North of 60°

There are many research projects and programs (both government and industry) which affect the rate and pattern of non-renewable resource exploration and development. These projects and programs are of interest since they are an influence on potential demand for marine transport infrastructure.

a. Oil and Gas Industry Research Activities

Approximately fifty-three research-type projects connected with oil and gas resources were initiated or continued during 1972. Several major programs consist of marine seismic programs, such as "Polarquest", a three-year program of reconnaissance surveys in the Arctic and surrounding waters.

In addition to the projects referred to above are the programs of the Arctic Petroleum Operators Association, (APOA), an

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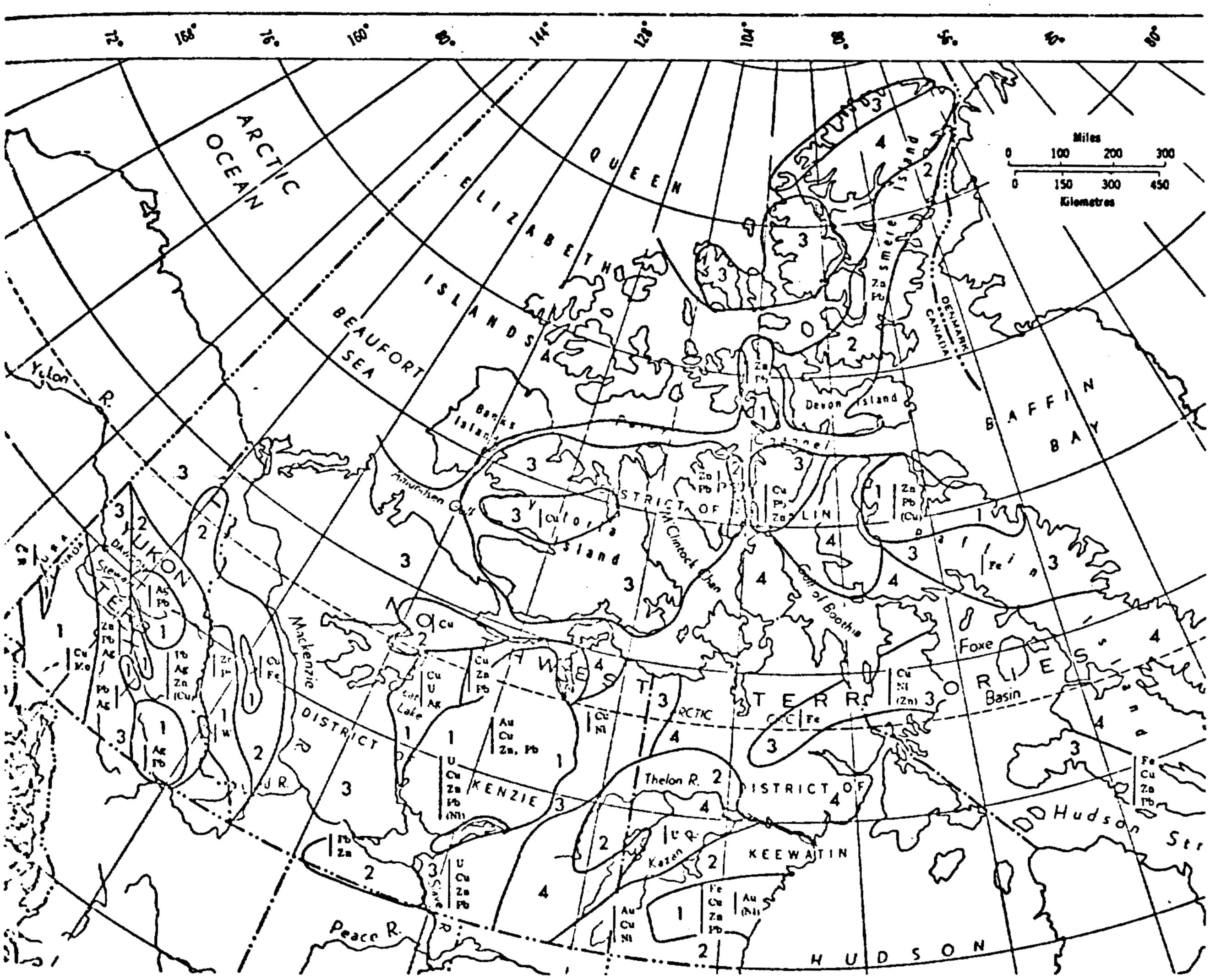
* DINA, North of 60° Mines and Minerals Activities, 1972, op. cit., p. 3, 7, 17.

** McGlynn, J.C.,"Non Energy Minerals", Appendix to: McLaren, D.J., "Non-Renewable Resources", in Science and the North - A Seminar on Guidelines for Scientific Activities in Northern Canada, 1972. Sponsored by: The Advisory Committee on Northern Development, The Sub-Committee on Science and Technology, October 15-18, 1972, Mont Gabriel, Quebec. (Ottawa: Information Canada, 1973), p. 163.

MAP IV-4

MINERAL POTENTIAL MAP
YUKON AND NORTHWEST TERRITORIES



Key: Areas marked "1" indicate areas most likely to show more showings of the indicated minerals, ranging to "4" which are least likely produce more showings.

Source: J.C.McGlynn, "Non Energy Minerals", Appendix to D.J.McLaren, Discussion Paper, "Non-Renewable Resources" in <u>Science and the North</u>, 1972., p.135.

association formed in 1970 and composed of twenty-four oil companies who hold permits in the Beaufort Sea area. During the period 1970 to 1972, fifty-seven APOA projects have been completed or are currently underway at a total estimated cost of $3.2 million. These projects concern ice thickness and movements of near shore ice in the Mackenzie Delta area, as well as wind, temperature and tidal data.*

b. DINA Programs

The Development and Incentive Program Section, Northern Natural Resources and Environment Branch, DINA,

> "initiates, implements and maintains policies, development programs and projects designed to stimulate the exploration for non-renewable resources in the Yukon and Northwest Territories."**

The incentive programs consist primarily of the provision of infrastructure and direct financial assistance.

i. Infrastructure

The Northern Roads Program, approved in 1965, involved an annual expenditure of $10 million for the period 1965 to 1975 in the Northwest and Yukon Territories, as the first phase in a twenty-year program to bring permanent roads to within 200 miles of all potential areas of resource development. A revision to this Program, "Northern Road Policy 1971" was approved in 1971, and incorporated changes in policy suggested by six years experience in administering the program. The revised policy provides for conservation measures to protect the northern land environment and cost-sharing formulas between federal/territorial/private interests and were defined according to the two categories of roads, Communication and Network Roads and Lateral Roads. The former provide a primary network of roads in the NWT connecting with the provinces and consist of trunk highways and secondary trunk roads and airport roads. Their initial cost is paid completely by the Federal Government who also supply 85% of the maintenance costs, and the Territorial Government 15%. During the period 1965 to 1972, 836 miles of new roads at a cost of $77.7 million have been constructed. Current projects

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* DINA, North of 60° Oil and Gas Activities, 1972, op. cit., p. 31.

** DINA, North of 60° Mines and Mineral Activities, 1972, op. cit., p. 31.

are the 365-mile Dempster Highway from near Dawson to Arctic Red River, and the Mackenzie Highway of which a 296-mile section from the NWT - Alberta border to Fort Simpson has been completed. The Mackenzie Highway will eventually run down the Mackenzie River Valley to Inuvik (964 miles) and will terminate at Tuktoyaktuk for a total mileage of 1,049 miles.

Lateral Roads are those leading from a Communication and Network Road to a resource exploration or development location, and the cost-sharing subdivision of this road type is as follows:

> Tote Trails are constructed by the resource developer to provide access to a resource property in the exploration or development stage. The grant may be up to 50% of the construction cost to a maximum contribution of $20,000.
>
> Initial Access Roads are more costly roads to provide access to resource properties in the exploration or development stage. The grant may be up to 50% of construction cost to a maximum contribution of $100,000 for projects in the exploration stage or $500,000 for projects in the development stage. Up to 1972, $428,427 had been spent on initial access roads in the Yukon Territory.
>
> Permanent Access Roads lead from the nearest permanent road to a resource development in the production stage. The grant may be up to 66% of the construction cost to a maximum contribution of $40,000.*

The Northern Resource Airports Program was approved in 1965 and

> "is a cost-sharing scheme for constructing small airports to provide access to non-renewable resources, exploration and development sites, tourist development sites and to improve transportation facilities."**

There are two categories of airports under this program. In the first category Government assistance is available for 50%

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* DINA, North of 60° Mines and Minerals Activities, 1972, op. cit., p. 31-32.

** Ibid., p. 32.

of the cost of an exploratory airport up to a maximum contribution of $20,000. In the second category the Federal Government may contribute 50% of the cost up to a maximum of $100,000 per airstrip or airport built in connection with the pre-production or early production stage of natural resource exploitation. By mid-1973 nineteen airstrips at a cost of $271,679 were built under this program.

The Remote Airports Program is also administered by this Section, but it is more population rather than resource orientated and is designed

> "to provide small isolated communities, not warranting normal airports for scheduled airline services, with gravel all-weather airstrips, 3,300 feet in length capable of meeting the essential educational, health and emergency requirements of the community."*

The program entails construction of eleven airports during the period 1969 to 1979 at an estimated cost of $6,167,000. DINA sets the priorities and the actual construction is supervised by the Ministry of Transport. Since 1969 airports have been constructed at Pangnirtung, Baffin Island and Old Crow, Yukon Territory and airports at Fort McPherson, Whale Cove and Cape Dorset are under construction. Construction is scheduled to begin before 1975 at the remaining communities of Eskimo Point, Aklavik, Chesterfield Inlet, Pond Inlet and Igloolik.

ii) Direct Financial Assistance

The Northern Mineral Exploration Assistance Program is designed to encourage mineral exploration activity in the Yukon and Northwest Territories. Maximum assistance to a single applicant for one or more exploratory programs is limited to $50,000, not to exceed 40% of the cost of the exploration program. During the period 1967 to 1972, 176 corporate applicants have applied for assistance and $3,613,773 has been paid in grants. In addition, payments of $9,022,500 have been made for oil and gas exploration in the Arctic Islands.**

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* DINA, North of 60° Mines and Minerals Activities, 1972, op. cit., p. 33.

** Ibid., p. 31-33.

B. PROPOSED SYSTEMS OF TRANSPORTING RESOURCES OUT OF THE NORTH

Introduction

In late 1973 and early 1974, the Federal Government received the first formal proposals for resource production and transport to market for locations north of the Arctic Circle.

In late 1973, Mineral Resources International submitted a proposal for financial aid to exploit a lead-zinc deposit at Strathcona Sound on northwestern Baffin Island, and in March 1974 Canadian Arctic Gas Pipeline Limited submitted an application to build the Mackenzie Valley gas pipeline from the Mackenzie Delta to southern Alberta. The capital cost and the environmental impact differ enormously between the two projects. The factor they have in common is that they are the first. The Strathcona Sound project, if carried through, will create a precedent in terms of the extent of government financial involvement and the conditions attached to this involvement. Government financial participation will imply some policy decision as to the manner that non-renewable resources in the Arctic Islands are to be exploited.

The principal implications of the Strathcona Sound project are related to the contribution of the project to the regional economy, specifically duration of the project and employment of native peoples, as well as benefits gained on a national scale due to use of domestic vessels, possible refining of the minerals and use of Canadian supplies for townsite construction. MOT financial assistance for a single user wharf facility for concentrate loading would create a precedent. The Strathcona Sound project is important more due to its implications for northern marine transport development policy, rather than the cargoes involved or the cost of participation in the building of the wharf facility.

Implications of the Mackenzie gas pipeline are broader and include environmental impact, the whole enormously controversial energy supply question and the social and economic benefits of development on a regional and national scale. If the pipeline is approved, potential supply cargo transport by water over the estimated two-year construction period will be double present traffic on the Mackenzie.

1. Marine Transport Implications of the Location of Arctic Oil, Gas and Mineral Resources

Maps IV-5 and IV-6 illustrate the location of Arctic resources with respect to generalized ice conditions. Known large Arctic mineral ore deposits are located almost without exception in areas of first-year ice, whereas oil and gas wells in the Arctic Islands are located in areas of multi-year ice.* Generally

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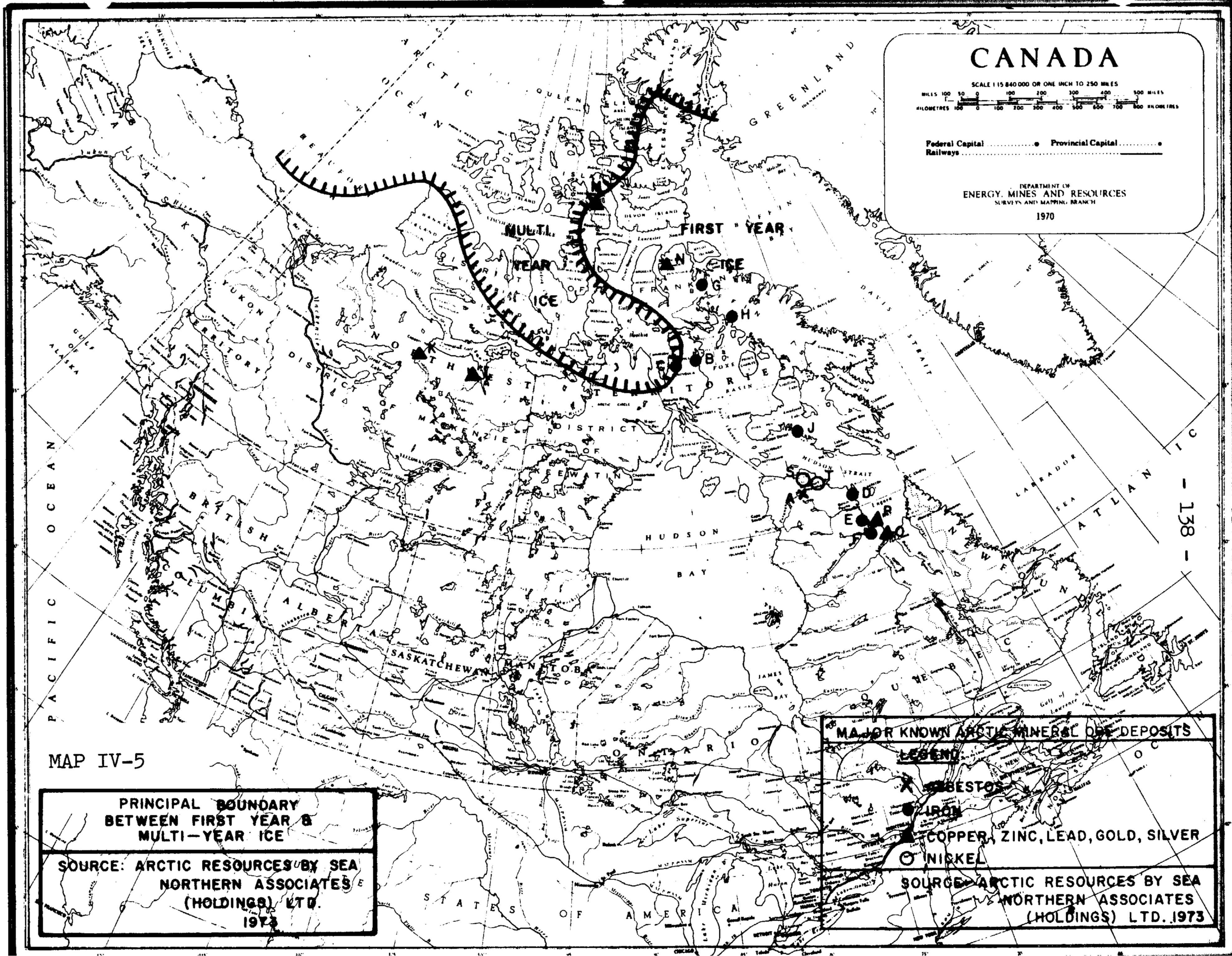
* See Appendix 6, "Ice Glossary" for definition of terms.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SCALE 1:15 840 000 OR ONE INCH TO 250 MILES
Federal Capital
Provincial Capital
Railways
DEPARTMENT OF
ENERGY, MINES AND RESOURCES
SURVEYS AND MAPPING BRANCH
1970
MULTI
YEAR
ICE
FIRST YEAR
ICE
MAP IV-5
PRINCIPAL BOUNDARY
BETWEEN FIRST YEAR &
MULTI-YEAR ICE
SOURCE: ARCTIC RESOURCES BY SEA
NORTHERN ASSOCIATES
(HOLDINGS) LTD.
1973
MAJOR KNOWN ARCTIC MINERAL ORE DEPOSITS
LEGEND
ASBESTOS
IRON
COPPER, ZINC, LEAD, GOLD, SILVER
NICKEL
SOURCE: ARCTIC RESOURCES BY SEA
NORTHERN ASSOCIATES
(HOLDINGS) LTD. 1973
ARCTIC OCEAN
PACIFIC OCEAN
ATLANTIC
GREENLAND
DAVIS STRAIT
LABRADOR SEA
HUDSON BAY
HUDSON STRAIT
JAMES BAY
FOXE BASIN
BAFFIN BAY
ALASKA
YUKON TERRITORY
NORTHWEST TERRITORIES
DISTRICT OF MACKENZIE
DISTRICT OF KEEWATIN
DISTRICT OF FRANKLIN
BRITISH COLUMBIA
ALBERTA
SASKATCHEWAN
MANITOBA
ONTARIO
QUEBEC
NEWFOUNDLAND
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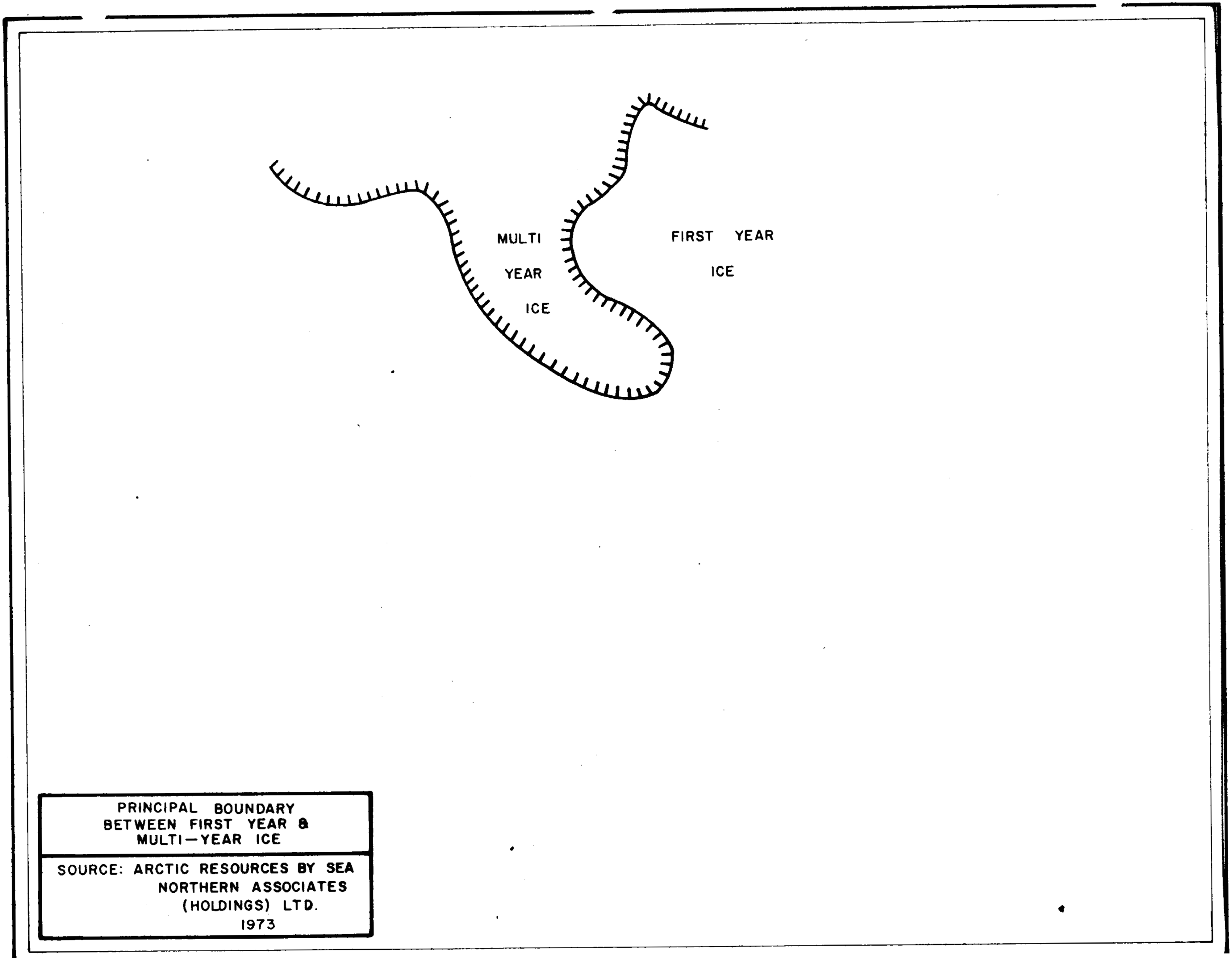
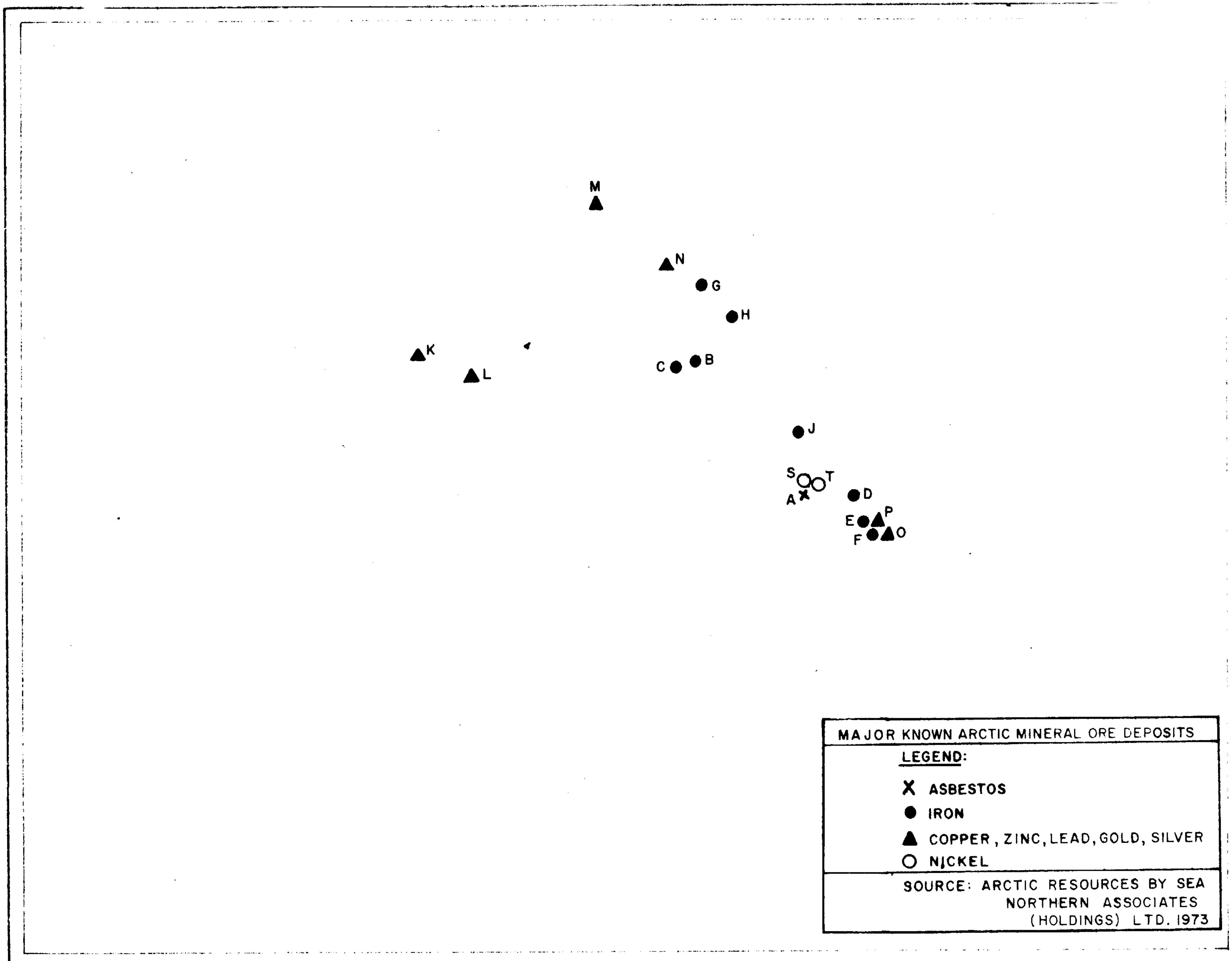

MULTI
YEAR
ICE
FIRST YEAR
ICE
PRINCIPAL BOUNDARY
BETWEEN FIRST YEAR &
MULTI—YEAR ICE
SOURCE: ARCTIC RESOURCES BY SEA
NORTHERN ASSOCIATES
(HOLDINGS) LTD.
1973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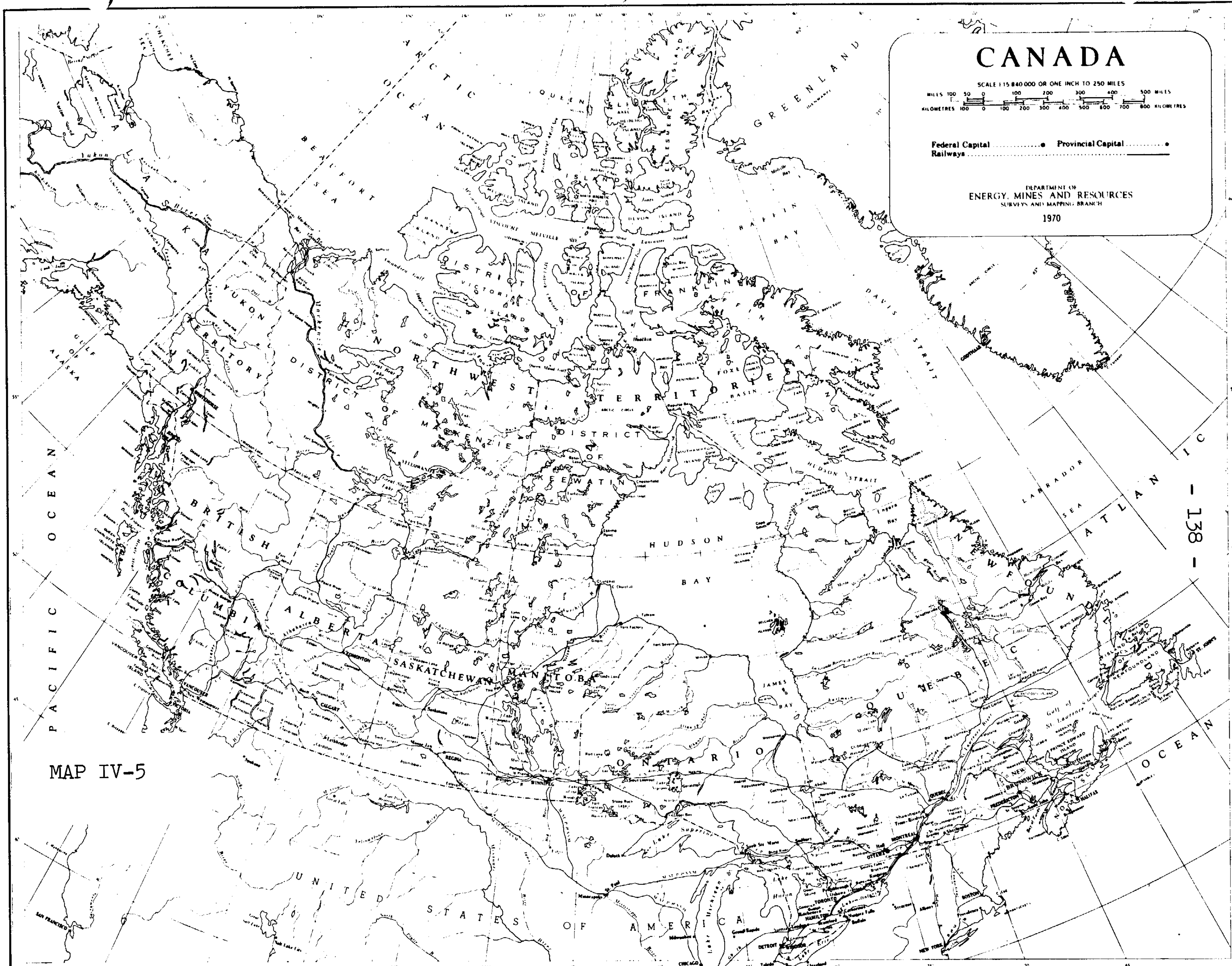
MAJOR KNOWN ARCTIC MINERAL ORE DEPOSITS
LEGEND:
ASBESTOS
IRON
COPPER, ZINC, LEAD, GOLD, SILVER
NICKEL
SOURCE: ARCTIC RESOURCES BY SEA
NORTHERN ASSOCIATES
(HOLDINGS) LTD. 1973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SCALE 1:15 840 000 OR ONE INCH TO 250 MILES
Federal Capital
Provincial Capital
Railways
DEPARTMENT OF
ENERGY, MINES AND RESOURCES
SURVEYS AND MAPPING BRANCH
1970
ARCTIC OCEAN
BEAUFORT SEA
GREENLAND
BAFFIN BAY
DAVIS STRAIT
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JAMES BAY
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PACIFIC OCEAN
YUKON TERRITORY
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DISTRICT OF MACKENZIE
DISTRICT OF KEEWATIN
DISTRICT OF FRANKLIN
BRITISH COLUMBIA
ALBERTA
SASKATCHEWAN
MANITOBA
ONTARIO
QUEBEC
NEWFOUNDLAND
NEW BRUNSWICK
UNITED STATES OF AMERICA
ALASKA

MAP IV-5

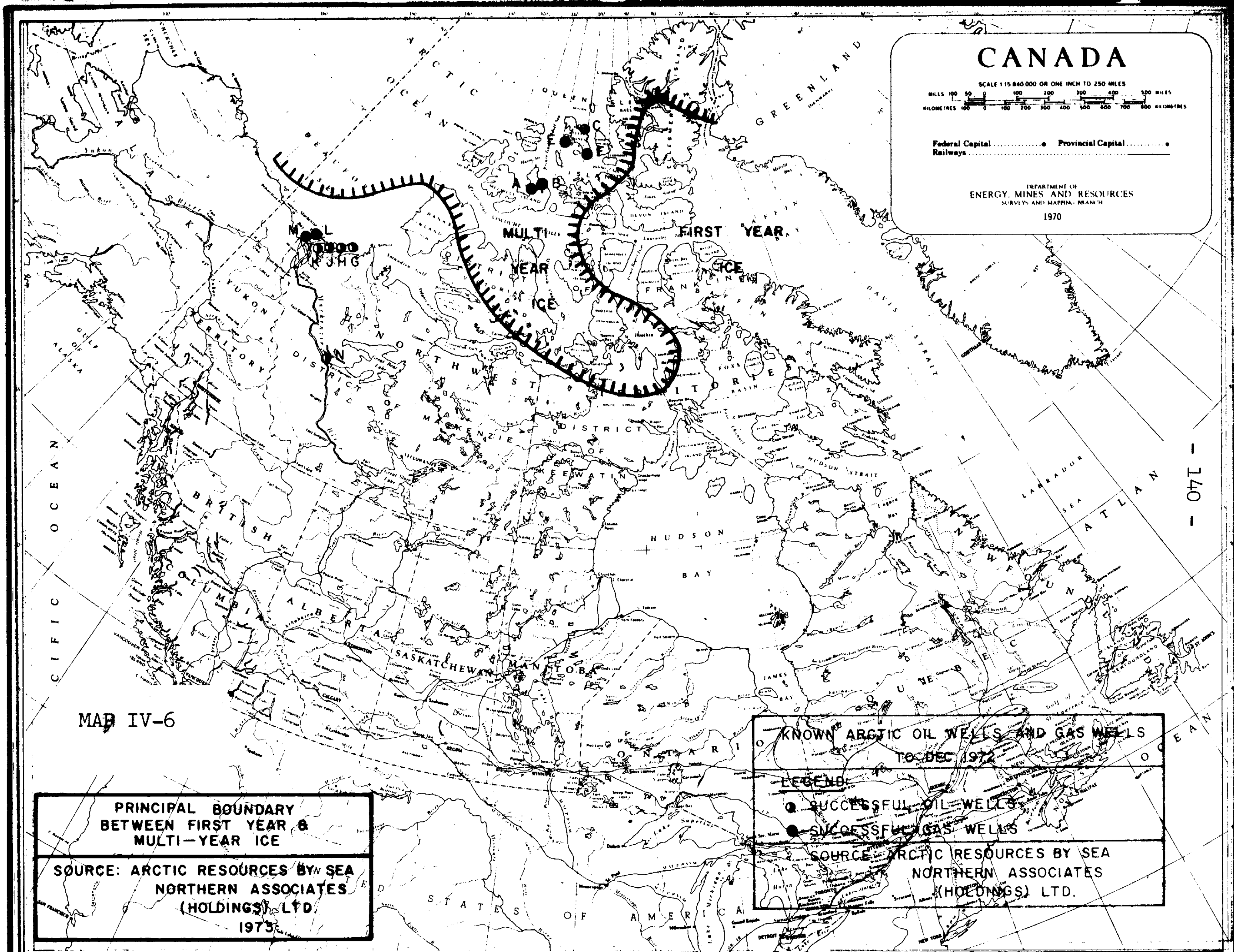
TABLE IV-4

MAJOR KNOWN ARCTIC MINERAL ORE DEPOSITS

Region	Reported Reserves of Ore (Million Tons)	Grade of Ore
ASBESTOS		
Ungava, Que. - in production.	18.7	High Grade
IRON		
E. Melville, N.W.T.	1,139	25-35% Fe
W. Melville, N.W.T.	3,352	35-40% Fe
Ungava, Que.	695	35% Fe
Ungava, Que.	581	35.7% Fe
Ungava, Que.	266	21-31% Fe
Baffin Island, Mary River	135	69% Fe
Baffin Island, Ege Bay	500	35% Fe
Baffin Island, Hobart Island	10	30-70% Fe

Chart Letter	Region	Reported Reserves of Ore (Million Tons)	Grade of Ore
	COPPER, ZINC, LEAD, GOLD, SILVER		
K	Coppermine River, N.W.T.	5	2.5% Cu
L	High Lake, N.W.T.	5	3.5% Cu, 2.46% Zn, 0.23 oz./ton Au
M	Little Cornwallis Island	24	20% combined Pb + Zn
N	Strathcona Sound, Baffin Island	12	8.8% Zn, 1% Pb, 1.3 oz./ton Ag
P	Ungava, Que.	4	1.34% Cu, 1.8% Zn, 0.047% oz./ton Au & 0.54 oz./ton Ag
Q	Ungava, Que.	4.7	Cu, Zn, Au & Ag valued at $16.30 per ton
	NICKEL		
R	Ungava, Payne Bay, Que.	not known	1% combined Cu-Ni
S	Ungava, Deception River region (sum of 5 individual discoveries)	19	1.53% - 3.06% Ni, 0.70% - 0.78% Cu
T	Ungava, Wakeham Bay	(4	0.96% Ni, 1.04% Cu
		(16	2.58% Ni, 0.71% Cu
	GRAND TOTAL -	6,790.4	

Source: Northern Associates (Holdings) Ltd., Arctic Resources By Sea, 1973.


CANADA
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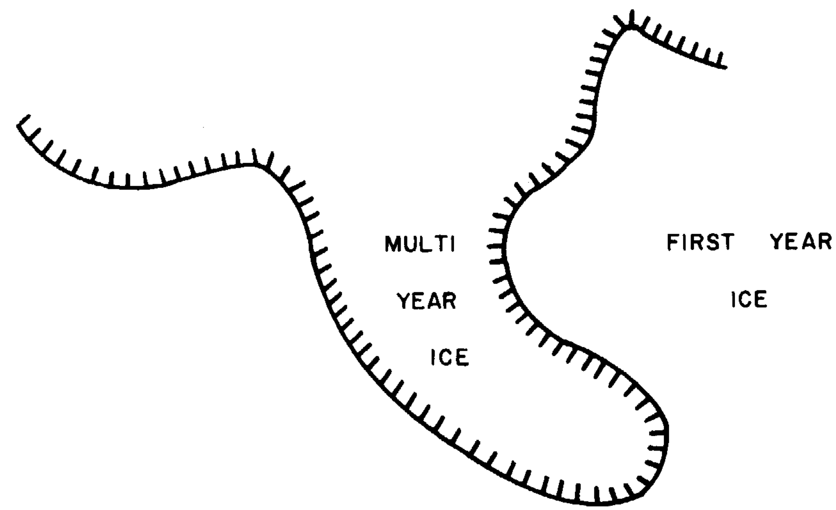
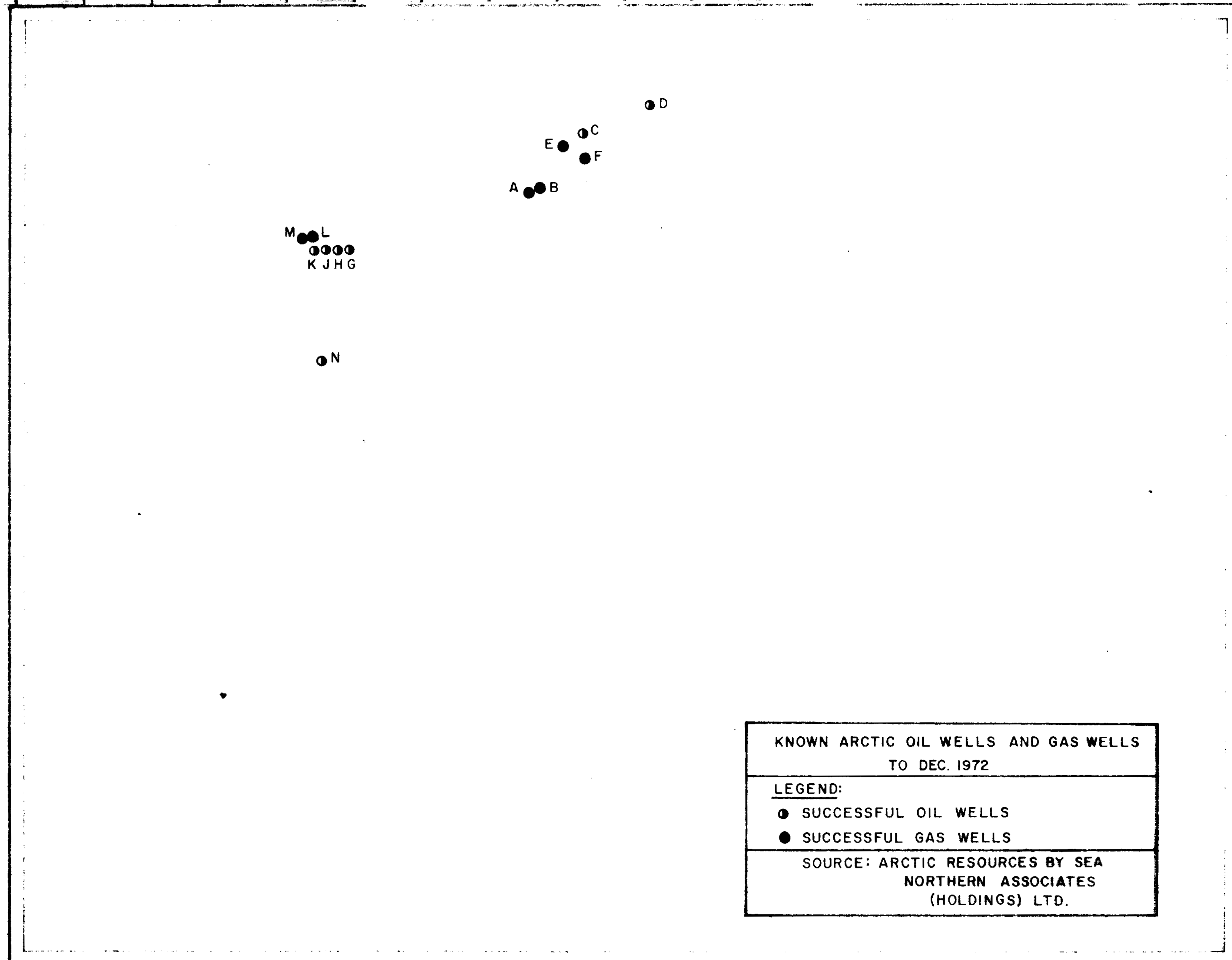
Federal Capital
Provincial Capital
Railways
DEPARTMENT OF
ENERGY, MINES AND RESOURCES
SURVEYS AND MAPPING BRANCH
1970
MULTI YEAR ICE
FIRST YEAR ICE
KNOWN ARCTIC OIL WELLS AND GAS WELLS
TO DEC 1972
LEGEND:
SUCCESSFUL OIL WELLS
SUCCESSFUL GAS WELLS
SOURCE: ARCTIC RESOURCES BY SEA
NORTHERN ASSOCIATES
(HOLDINGS) LTD.
PRINCIPAL BOUNDARY
BETWEEN FIRST YEAR &
MULTI-YEAR ICE
SOURCE: ARCTIC RESOURCES BY SEA
NORTHERN ASSOCIATES
(HOLDINGS) LTD.
1973
HUDSON BAY
ARCTIC OCEAN
PACIFIC OCEAN
GREENLAND
BRITISH COLUMBIA
ALBERTA
SASKATCHEWAN
MANITOBA
ONTARIO
QUEBEC
YUKON TERRITORY
NORTHWEST TERRITORIES
DISTRICT OF MACKENZIE
DISTRICT OF KEEWATIN
DISTRICT OF FRANKLIN
UNITED STATES OF AMERICA
MAP IV-6



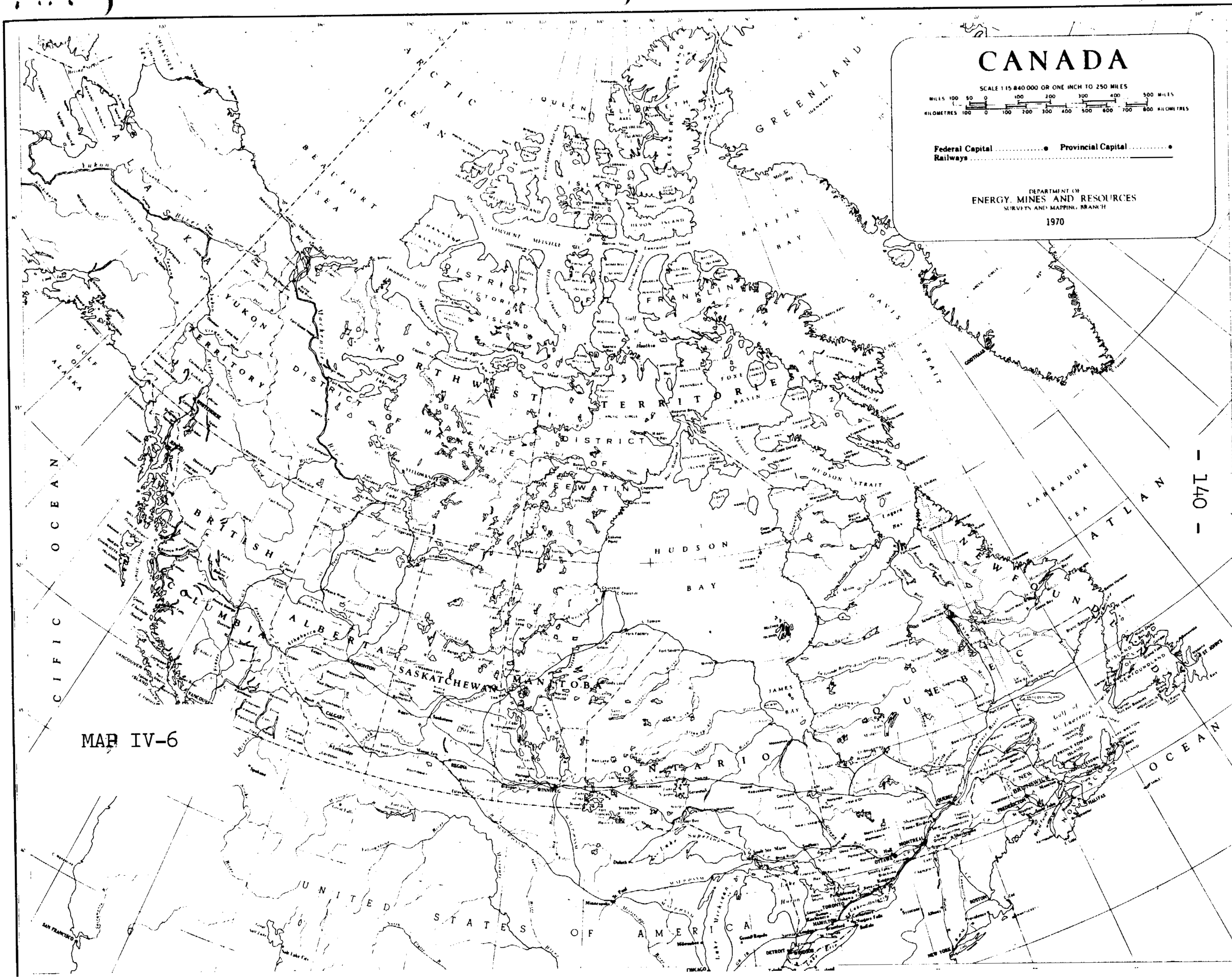
PRINCIPAL BOUNDARY
BETWEEN FIRST YEAR &
MULTI—YEAR ICE

SOURCE: ARCTIC RESOURCES BY SEA
NORTHERN ASSOCIATES
(HOLDINGS) LTD.
1973



KNOWN ARCTIC OIL WELLS AND GAS WELLS TO DEC. 1972

SOURCE: ARCTIC RESOURCES BY SEA
NORTHERN ASSOCIATES
(HOLDINGS) LTD.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Railways
DEPARTMENT OF
ENERGY, MINES AND RESOURCES
SURVEYS AND MAPPING BRANCH
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GREENLAND
BAFFIN BAY
DAVIS STRAIT
HUDSON STRAIT
LABRADOR SEA
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JAMES BAY
PACIFIC OCEAN
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GULF OF ALASKA
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YUKON TERRITORY
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PRINCE EDWARD ISLAND
UNITED STATES OF AMERICA
VICTORIA ISLAND
DEVON ISLAND
FOXE BASIN
EDMONTON
REGINA
WINNIPEG
TORONTO
OTTAWA
QUEBEC
HALIFAX
FREDERICTON
ST. JOHN'S
VANCOUVER
CALGARY
MONTREAL

MAP IV-6

TABLE IV - 6

KNOWN ARCTIC OIL WELLS AND GAS WELLS TO DECEMBER 1972

Map Reference		Location
		ARCTIC ISLANDS
		Melville Island
A	Gas	Por Hecla F-62
B	Gas	Drake Point
		Ellef Ringnes Island
C	Oil	Kristoffer Bay G-06
		Ellesmere Island
D	Oil	Romulus
E	Gas	Thor Island
		King Christian Island
F	Gas	King Christian D-18A "step-out" well N-06
		MACKENZIE DELTA AREA
G	Oil	Atkinson
H	Oil	Mayogiak
J	Oil	Atertak
K	Oil	Ivik
K	Gas	Ivik
L	Gas	Taglu
M	Gas	Mallik

Source: Northern Associates (Holdings) Limited, *Arctic Resources by Sea*, 1973.

speaking, surface commercial shipping is only feasible for a navigation season beyond a few weeks in areas of first-year ice. This factor has resulted in general recognition that outward mineral transport in the eastern Arctic will be by vessel and that oil and gas transport will be by other modes. Pipelines have had the most consideration, but semi and fully submersible vessels, large aircraft and railways have, or are, all being considered as means of transporting oil and gas to market.

Maps IV-8 and IV-9 illustrate the relationship between ice conditions and resource location in terms of specific navigation seasons. The geographical limits of the Safety Control Zones of the Arctic Waters Pollution Prevention Act are based upon ice and weather conditions. Generally the higher the number designating a zone, the less severe are the ice conditions. Comparison of oil and gas discoveries with the zonal division show all the Arctic Island discoveries to be located in Zones 1 or 3. The Mackenzie Delta oil and gas is located in Zone 12, but it was decided by Humble Oil after the voyage of the S.S. Manhattan through the Northwest Passage from the Prudhoe Bay area to Eastern Canada, that for the amounts of oil present, pipeline transport of the oil to market had an economic edge over vessel transport. The mineral deposits are located in Zones 5 to 15, indicating less severe ice conditions, a consequently longer navigation season and marine transport therefore potentially feasible.

2. Specific Development Proposals -- Oil and Gas

Map IV-7 and Table IV-6 summarize specific proposals for pipeline or vessel transport of oil and gas from the Mackenzie Delta and Arctic Islands to markets. Recent developments have erased the prospect of a Mackenzie Valley oil pipeline, since a proposal to transport Prudhoe Bay oil by a trans-Alaska pipeline (the Alyeska Pipeline Service Company line) to the ice-free port of Valdez to be shipped by tanker to the northwestern United States, has received approval from the U.S. Congress. Not enough Canadian oil has been discovered to justify a pipeline along the Mackenzie Valley to carry only Canadian oil.

The Canadian Arctic Gas Pipeline Company Limited* is a consortium

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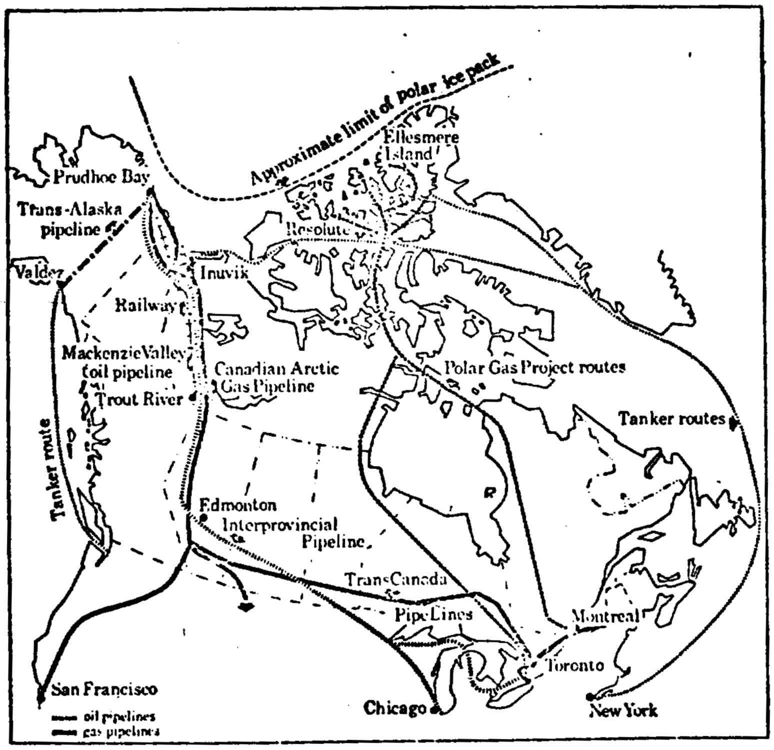
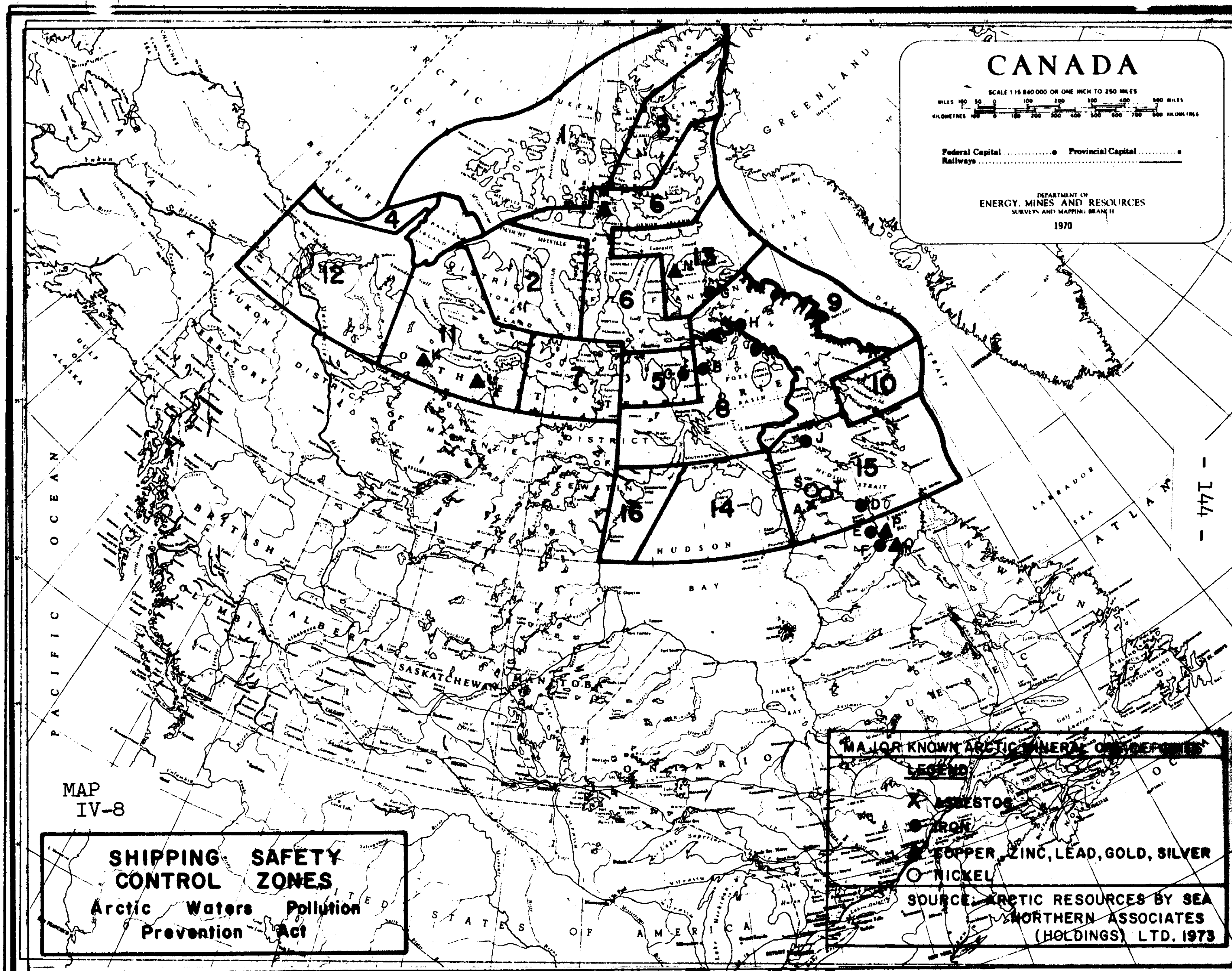
* The members are: Alberta Gas Trunk Line Co. Ltd., Alberta Natural Gas Co. Ltd., Atlantic Richfield Co., Canada Development Corp., Canadian National Railway Co., Canadian Pacific Investments Ltd., Canadian Superior Oil Ltd., Canadian Utilities Ltd., Colorado Interstate Corp., Columbia Gas Transmission Corp., Consumers' Gas Co., Gulf Oil Canada Ltd., Exxon Co. USA, Imperial Oil Ltd., Michigan Wisconsin Pipe Line Co., Natural Gas Co. of America, Northern and Central Gas Corp. Ltd., Northern Natural Gas Co., Pacific Lighting Gas Development Co., Panhandle Eastern Pipe Line Co. (Ohio), Texas Eastern Transmission Corp., Trans-Canada PipeLines Ltd., Trans Continental Gas Pipeline Corp., Union Gas Ltd.

MAP IV-7

PROPOSED TRANSPORTATION SYSTEMS
FOR ARCTIC OIL AND GAS



Source: Judith Maxwell, Energy from the Arctic: Facts and Issues, (Montreal: The C.D. Howe Research Institute, 1973), p. 33.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Federal Capital
Provincial Capital
Railways
DEPARTMENT OF
ENERGY, MINES AND RESOURCES
SURVEYS AND MAPPING BRANCH
1970
MAP
IV-8
SHIPPING SAFETY
CONTROL ZONES
Arctic Waters Pollution
Prevention Act
MAJOR KNOWN ARCTIC MINERAL ORE DEPOSITS
LEGEND
ASBESTOS
IRON
COPPER, ZINC, LEAD, GOLD, SILVER
NICKEL
SOURCE: ARCTIC RESOURCES BY SEA
NORTHERN ASSOCIATES
(HOLDINGS) LTD. 1973
ARCTIC OCEAN
BEAUFORT
GREENLAND
BAFFIN BAY
DAVIS STRAIT
HUDSON STRAIT
HUDSON BAY
JAMES BAY
LABRADOR SEA
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YUKON TERRITORY
DISTRICT OF MACKENZIE
DISTRICT OF KEEWATIN
BRITISH COLUMBIA
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SASKATCHEWAN
MANITOBA
ONTARIO
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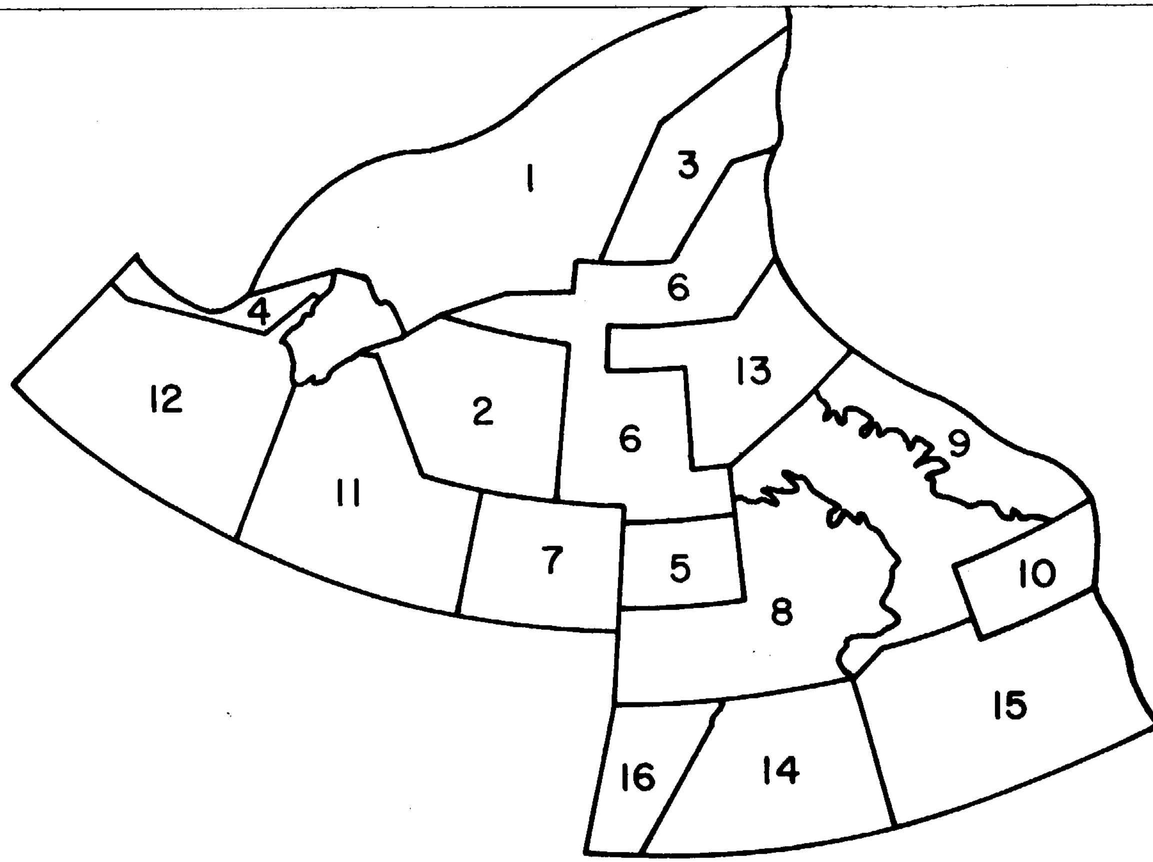
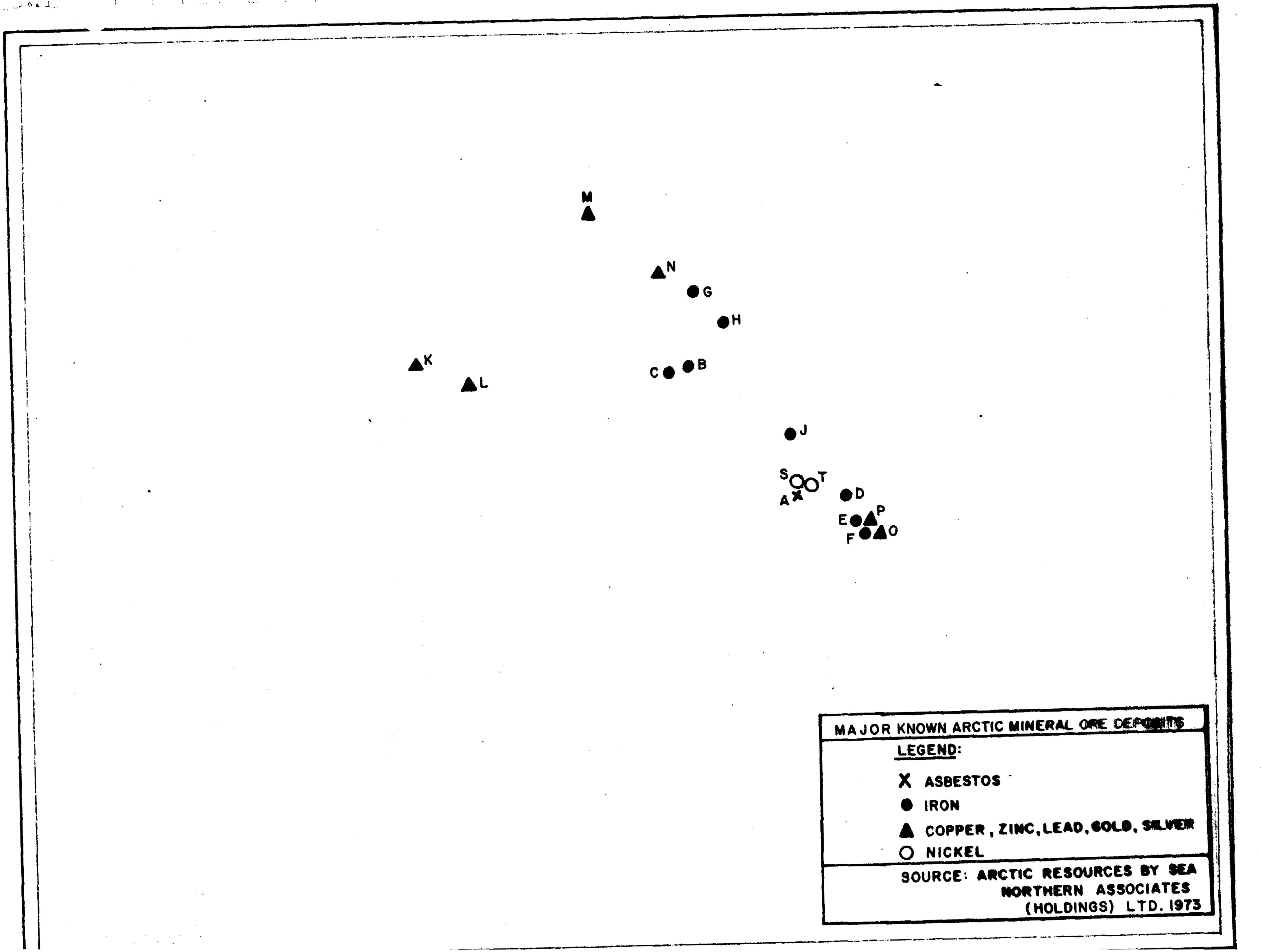


SHIPPING SAFETY CONTROL ZONES

Arctic Waters Pollution Prevention Act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MAJOR KNOWN ARCTIC MINERAL ORE DEPOSITS
LEGEND:
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IRON
COPPER, ZINC, LEAD, GOLD, SILVER
NICKEL
SOURCE: ARCTIC RESOURCES BY SEA
NORTHERN ASSOCIATES
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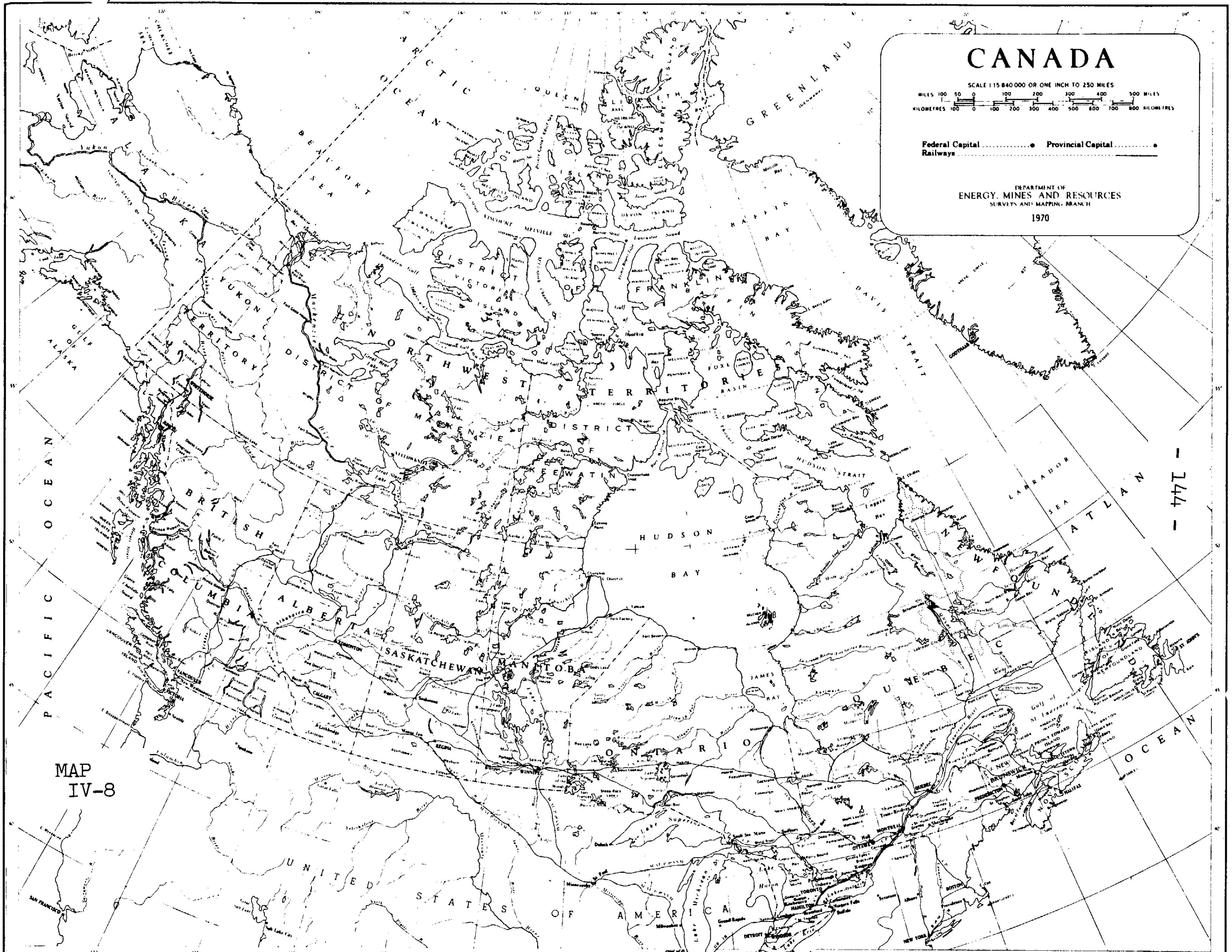
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VICTORIA ISLAND
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ALBERTA
SASKATCHEWAN
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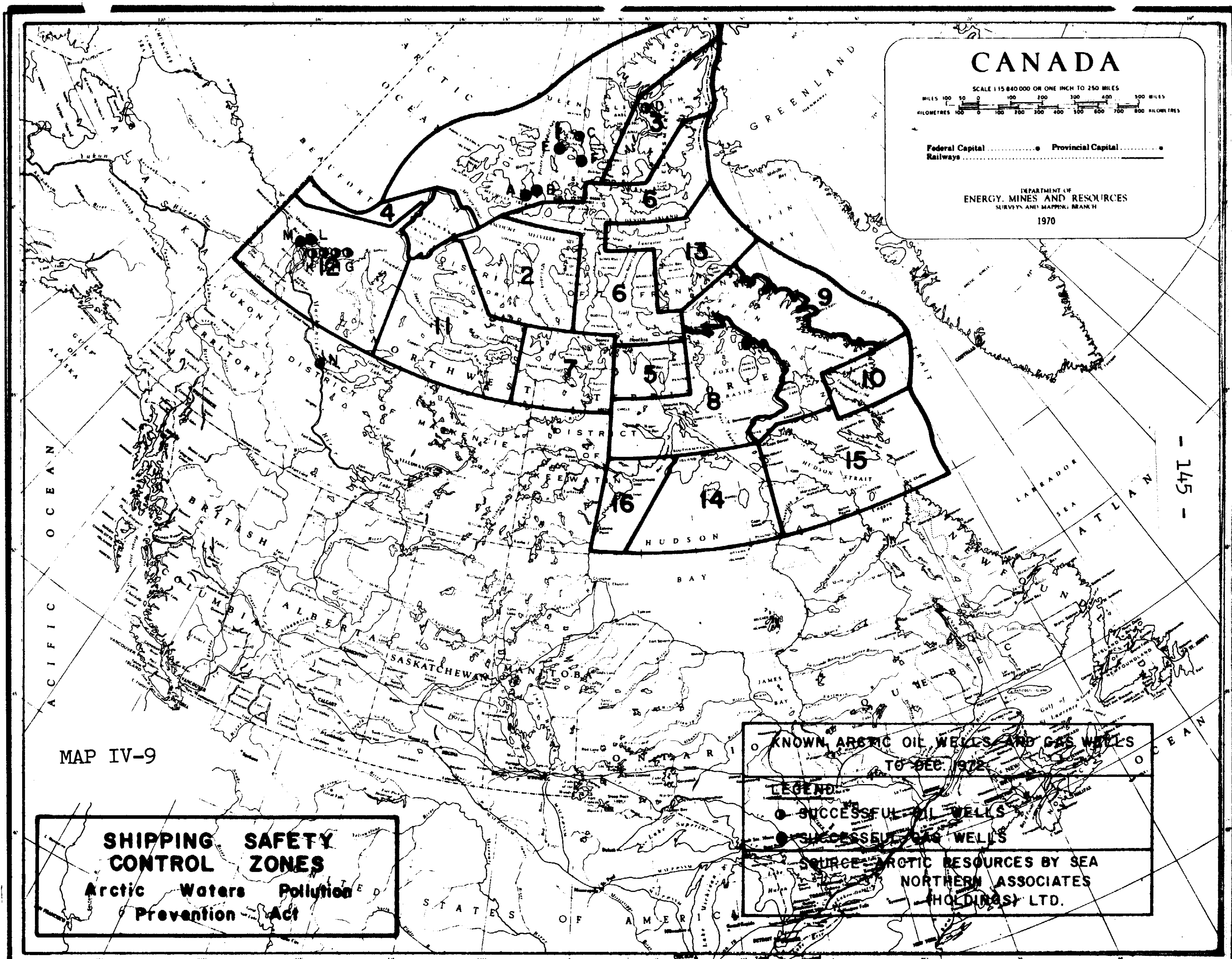
NEWFOUNDLAND
NEW BRUNSWICK
NOVA SCOTIA
PRINCE EDWARD ISLAND
UNITED STATES OF AMERICA

MAP IV-8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ENERGY, MINES AND RESOURCES
SURVEYS AND MAPPING BRANCH
1970
KNOWN ARCTIC OIL WELLS AND GAS WELLS
TO DEC. 1972
LEGEND:
SUCCESSFUL OIL WELLS
SUCCESSFUL GAS WELLS
SOURCE: ARCTIC RESOURCES BY SEA
NORTHERN ASSOCIATES
(HOLDINGS) LTD.
SHIPPING SAFETY
CONTROL ZONES
Arctic Waters Pollution
Prevention Act
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MANITOBA
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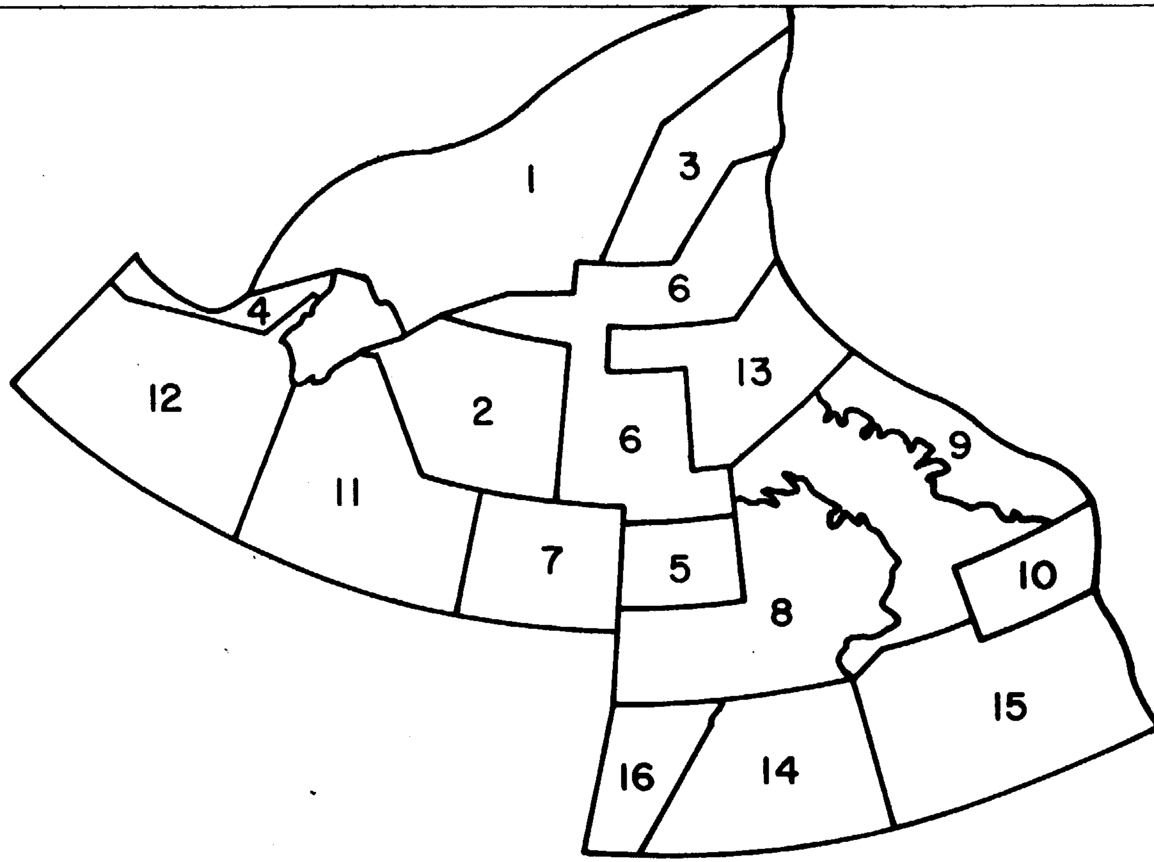
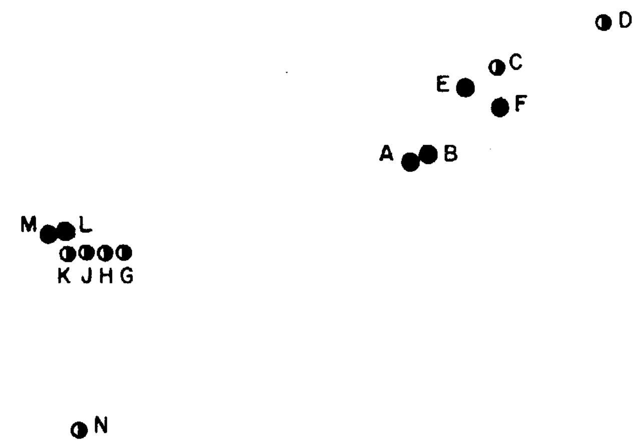
YUKON TERRITORY
PACIFIC OCEAN
ARCTIC OCEAN
LABRADOR SEA
HUDSON STRAIT
FOXE BASIN

MAP IV-9



SHIPPING SAFETY
CONTROL ZONES

Arctic Waters Pollution
Prevention Act

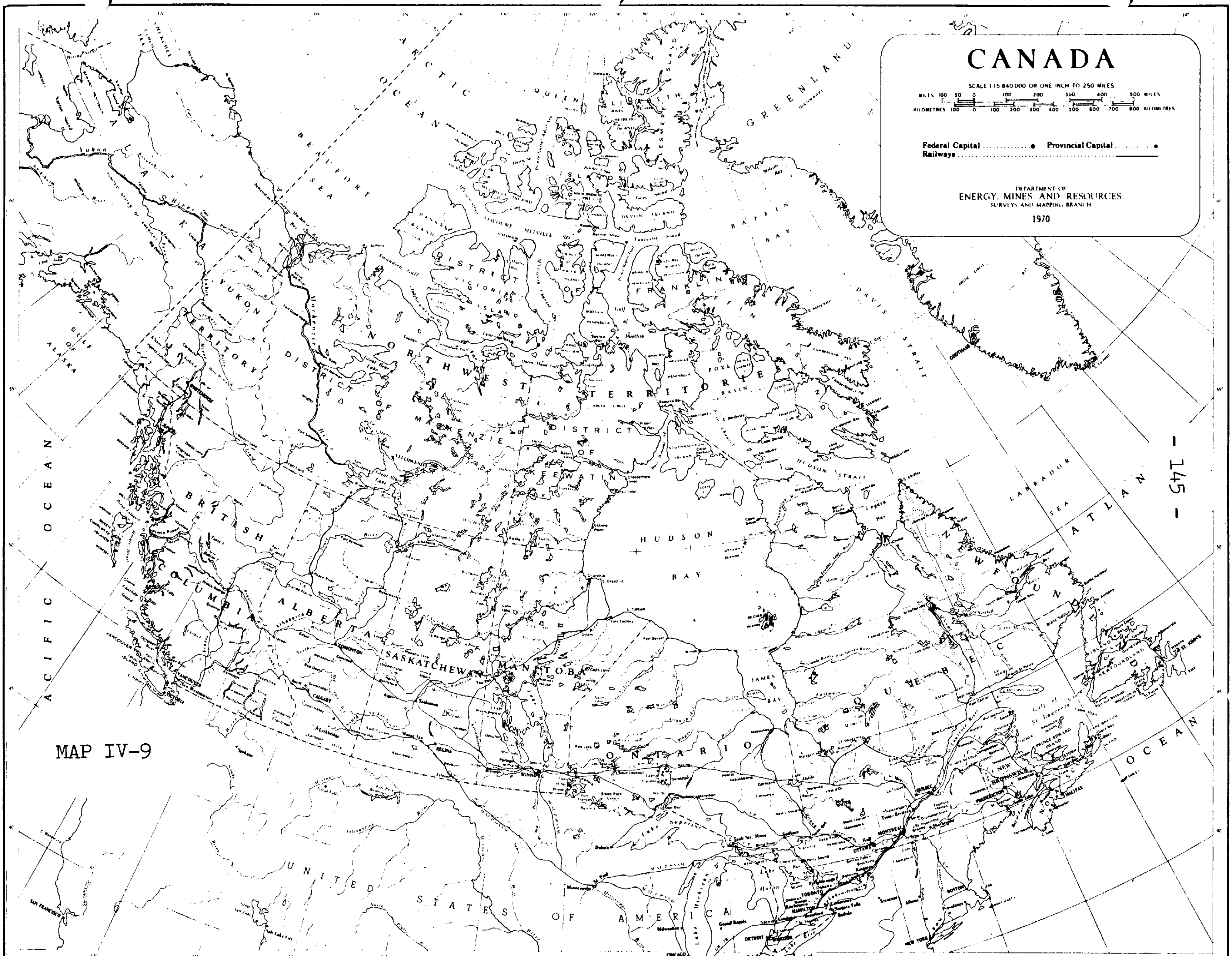


KNOWN ARCTIC OIL WELLS AND GAS WELLS
TO DEC. 1972

LEGEND:

- SUCCESSFUL OIL WELLS
- SUCCESSFUL GAS WELLS

SOURCE: ARCTIC RESOURCES BY SEA
NORTHERN ASSOCIATES
(HOLDINGS) LTD.


CANADA
SCALE 1:15 840 000 OR ONE INCH TO 250 MILES
MILES 100 50 0 100 200 300 400 500 MILES
KILOMETRES 100 0 100 200 300 400 500 600 700 800 KILOMETRES
Federal Capital
Provincial Capital
Railways
DEPARTMENT OF
ENERGY, MINES AND RESOURCES
SURVEYS AND MAPPING BRANCH
1970
ARCTIC OCEAN
BEAUFORT SEA
GREENLAND
BAFFIN BAY
DAVIS STRAIT
QUEEN ELIZABETH ISLANDS
DEVON ISLAND
VICTORIA ISLAND
DISTRICT OF FRANKLIN
BAFFIN
FOXE BASIN
HUDSON STRAIT
LABRADOR SEA
ALASKA
GULF OF ALASKA
YUKON TERRITORY
NORTHWEST TERRITORIES
DISTRICT OF MACKENZIE
DISTRICT OF KEEWATIN
HUDSON BAY
JAMES BAY
BRITISH COLUMBIA
ALBERTA
SASKATCHEWAN
MANITOBA
ONTARIO
QUEBEC
NEWFOUNDLAND
NEW BRUNSWICK
PACIFIC OCEAN
ATLANTIC OCEAN
UNITED STATES OF AMERICA
VANCOUVER
VICTORIA
EDMONTON
CALGARY
REGINA
WINNIPEG
OTTAWA
MONTREAL
QUEBEC
TORONTO
HAMILTON
DETROIT
CHICAGO
BOSTON
NEW YORK
HALIFAX
FREDERICTON
ST. JOHN'S
SAN FRANCISCO

MAP IV-9

TABLE IV-7

SUMMARY OF ALTERNATIVE SYSTEMS OF TRANSPORTING OIL AND GAS FROM THE ARCTIC MAINLAND AND ISLANDS TO MARKET

Potential Transportation Systems

	Arctic Gas Pipeline	Mackenzie Valley Oil Pipeline
Possible timing	Perhaps begin by late 1976, when government approvals are given	Not until more oil is found in Delta or Alyeska line is blocked in courts
Research effort	$60-70 million in testing, research, and preparation of application	$7 million in testing and research. Report issued December, 1972
State of technology	Pipelines are proven, but new techniques needed for permafrost	Pipelines are proven, but new techniques needed for permafrost
Route	Mackenzie Delta to U.S. border with branch to Prudhoe Bay	Prudhoe Bay to Edmonton, connecting with existing lines to Chicago area
Distance	2,500-3,000 miles	2,500-3,000 miles, including connection
Capacity	4 billion cubic feet per day	1.8 million barrels per day
Capital cost	$5.4 billion (current dollars)	$3.38 billion (1972 dollars) to Edmonton only
Construction	Five years: two for main line plus three more for branch and extra compression. Maximum employment, 8,000; average, 5,000 to 6,000	2½ years; 17,500 man-years
Gravel needed	n.a.	41.6 million cubic yards
Permanent jobs	600 in Canada, 100 in Alaska	600
Ecological considerations	Cold buried line should not melt permafrost if properly constructed and maintained. Revegetation should cover trench. Careful techniques for stream crossings needed	Insulated hot line on gravel pad. 360 miles to be elevated where permafrost is ice-rich. Risks of heat loss and consequent erosion. Careful techniques for stream crossings needed

Source: Judith Maxwell, Energy From the Arctic: Facts and Issues, (Montreal: The C.D. Howe Research Institute, 1973), p.43-45.

	Tankers	Submarines
Possible timing	Not until more oil is found. Then more design work is needed – possibly taking two years	Not until more oil is found. Then extensive feasibility studies to create design for prototype – possibly fiv years
Research effort	$40 million on S.S. Manhattan's experimental voyages	Not known
State of technology	Further design work required	No prototype has been produced
Route	From oil fields to United States, Canada, or Europe	From oil fields to United States, Canada, or Europe. Possible staging depot at Greenland for transfer to conventional tankers
Distance	Variable	Variable
Capacity	250,000-deadweight-ton ship could carry 16 million barrels per year to U.S. east coast	250,000-deadweight-ton ship could carry 28.5 million barrels per year
Capital cost	Ships – up to $80 million each. Terminals could be very expensive	Ships – $800 to $1,200 per DWT. Terminals could be very expensive
Construction	Depends on shipyard capacity. Probably 3-4 years. Terminals – not known	Depends on shipyard capacity. Probably 4-5 years
Gravel needs	Limited amounts for terminal tank farm	Limited amounts for terminal
Permanent jobs	Not known	Not known
Ecological considerations	Risk of damage to ship or terminal, leading to spills	Risk of damage to nuclear ship or terminal, leading to spills

	RC-1 Aircraft (for LNG)	Arctic Oil Railway
Possible timing	Lengthy feasibility studies needed before construction of prototype aircraft – could take more than five years	More feasibility studies under way
Research effort	$2 million spent to date. $10 million needed for next round	$1 million spent. Another $1.5 million study under way
State of technology	Planes would use existing engines and electronics, but no plane this large has ever been built	Railways over similar terrain are operating, but no experience with ice-rich permafrost
Route	King Christian Island to Moosonee, Ontario, or Winnipeg. Transfer to pipeline to Toronto or Chicago	Prudhoe Bay to Trout River, NWT. Transfer to oil pipeline to Edmonton and United States
Distance	1,700 miles plus at least 1,000-mile pipeline	1,240 miles plus at least 1,500 miles of pipeline
Capacity	Each aircraft: 46 million cubic feet. 34 planes: 3 billion cubic feet per day	2 million barrels per day, with possible expansion to 6 million barrels per day
Capital cost	First aircraft – $1 billion (1971 dollars) Others – $80 million each Terminals – $1 billion or so Pipeline connection – not known	$2.4 billion (1972 dollars) plus cost of oil pipeline from Trout River south
Construction	Not known	Five years; employment of up to 2,000 men. 10,000 men at peak of construction
Gravel needs	Not known – but substantial amounts needed for runway	395-505 million cubic yards
Permanent jobs	Not known	4,500
Ecological considerations	Risk of an air crash in a remote place. Avoids both ice and permafrost	Railway bed would avoid contact between oil and permafrost. Risk of derailment and of wildlife disruption by frequent trains. Careful techniques for stream crossings needed

of twenty-seven companies, sixteen of which are major American producers and distributors of natural gas. Eleven of the companies are majority owned by Canadians, five have some Canadian interest and the remaining eleven are totally foreign controlled.*

On March 21, 1974, Arctic Gas filed initial applications with the National Energy Board and DINA to build a gas pipeline from Prudhoe Bay/Mackenzie Delta south to the Canada - U.S. border. Cost of construction is estimated at $5.7 billion for the 2,435 mile line. If approved, construction would begin during the winter of 1976-1977 with a projected completion date of mid-1979. About 8,000 men would be employed during the construction stage, and about 700 men would be employed permanently after completion.** Mackenzie Delta gas would begin to flow in mid-1978, Alaska gas the following year.

A similar problem exists for the Arctic Gas pipeline as for the Mackenzie Valley oil pipeline,in that Arctic Gas needs the Prudhoe Bay gas in order to obtain sufficient quantities of gas to make the pipeline economically feasible. Arctic Gas cannot remove any gas from the Prudhoe Bay field until oil production begins. Only one-third of the estimated 26 trillion cubic feet of the gas at Prudhoe Bay can be removed during the early years of production, estimated to commence in 1978. The permitted extraction rate of the remaining gas will be decided in 1978 by the Alaskan Conservation Board after oil production commences.***

Arctic Gas plans to build a forty-eight-inch natural gas pipeline to transport 4.5 billion cubic feet per day; so the fields in the Mackenzie Delta would have to produce 1.64 trillion cubic feet per year (4.5 billion x 365) to keep the pipeline working to capacity. If the line were to operate for twenty-two years, then 36 trillion cubic feet (22 x 1.64 trillion) would be the threshold volume of gas, ie. the amount of gas to fill a pipeline for its operating life. About one-half of the 36 trillion cubic feet is expected to come from Prudhoe Bay, so Arctic Gas would require about 18 trillion cubic feet of gas in order to proceed with the pipeline. The president of Gulf Oil announced that Mackenzie Delta gas discoveries are "believed to be approaching the 15 - 20 trillion cubic foot" level in a speech to the annual meeting of shareholders on April 26, 1973.****

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* <u>The Citizen</u>, March 21, 1974.

** Judith Maxwell, op. cit., p. 43.

*** Ibid., p. 34.

**** Ibid., p. 23 and 28.

Federal Government approval for the proposed pipeline is a two part process. Arctic Gas submission of supporting documents dealing with environmental impact, regional, social and economic impact, engineering studies and assessment of alternative routes will initiate the first stage of governmental consideration of the project. DINA hearings conducted by Tom Berger, a Supreme Court judge, will consider public opinion on granting of the right-of-way to the pipeline company.

The right-of-way must be granted by DINA before the second step in governmental procedure can be undertaken. If right-of-way is granted, the application goes to the National Energy Board (NEB) for a certificate of public convenience and necessity. At this point, Arctic Gas is required to file the remaining support documents on national economic impact, supply and demand projections, financing procedures, tariff structures which are affacted and costs of servicing. (For the US portion of the pipeline, similar procedures are required before the Department of the Interior and the Federal Power Commission.)

The National Energy Board's recommendation on the pipeline will be tabled in Parliament if the recommendation is positive, rather than going directly to the Cabinet for a final ruling. If the NEB turns down the application, the Cabinet has no authority to approve it. However, the pipeline application has been made with a specific construction schedule in mind so the time available for public debate on the subject will be limited.

Opposition to the pipeline project is centered around problems with Indian land claims and environmental concerns.

A formal intervention against the project is expected to be filed during the next three or four months by two native groups: the Indian Brotherhood of the Northwest Territories (consisting of 7,000 treaty Indians living along the Mackenzie River); and the Committee for Original Peoples Entitlements (COPE) who represent Indians, Eskimos and Métis on the Mackenzie River Delta. In a court battle in 1973, these two native groups gained the right to file a legal declaration of interest against 400,000 square miles of land in the NWT, including the entire right-of-way for the proposed pipeline route.

At the opening of the 51st session of the Council of the Northwest Territories, Jean Chrétien, Minister of DINA, emphasized that there would be a negotiated settlement of native land claims, and DINA was ready to negotiate immediately; however, the native peoples had asked for more time to prepare their claims. The Minister rejected the suggestion that development should be halted until the claims are settled, and emphasized that the need to create employment opportunities for northerners will continue to be the most pressing challenge for both Federal and territorial governments.*

Environmental opposition to the pipeline proposal has been expressed by the Canadian Arctic Resources Committee, a privately funded, academic-dominated organization with national membership, who are also preparing a formal intervention against the pipeline application. Pollution Probe, an environmental group based at the University of Toronto are preparing opposition to the application, to be presented at the NEB hearing stage.

Prime Minister Trudeau has given qualified support for the project, stipulating that ecological and social issues must be cleared up before the project is finally approved. The New Democratic Party have opposed pipeline construction before settlement of outstanding native land claims.**

Arctic Gas have carried out the most extensive environmental impact studies ever conducted by private industry. About $50 million has been spent by the consortium on studies since 1967, and a further $20 million will be spent before construction begins.

An application by a competing group, El Paso Natural Gas Company, is expected this summer for an Alaskan gas pipeline paralleling the trans-Alaska oil pipeline. The gas would be carried by pipeline, liquified at the terminal point and moved to west coast ports by tanker.***

In 1972, the Polar Gas Project was set up to study the possibility of pipeline transportation of gas in the Arctic Islands to market. TransCanada PipeLines Limited, Canadian Pacific Investments Limited and Tenneco Oil and Minerals Limited, a subsidiary of Tenneco Inc. of Houston, Texas. Panarctic has already surveyed most of the route from King Christian Island to the mainland. If a method could be found of pipelining the gas to the Boothia Peninsula, the line could then be laid down the coast of Hudson Bay which is rocky terrain with little permafrost problems. Exploitation of the gas finds in the Arctic Islands have a more distant time frame than the Delta gas, since insufficient gas has been found****and depths between the Arctic Islands are up to 1,000',beyond the capability of present pipeline technology. The deepest existing undersea pipeline is in 800' of water. A 10-year period has been estimated necessary to develop Arctic inter-island pipeline technology.*****Application is expected for the Polar Gas pipeline no earlier than 1976-77. By the end of 1974, the consortium hopes to have obtained sufficient information to decide on which side of Hudson Bay the pipeline will be built.******

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* Reporting on a speech given by Jean Chretien in Yellowknife at the opening of the 51st session of the Council of the NWT, in the article "El Paso Liquifaction Plan Threat to Mackenzie Line",Oilweek, January 28, 1974, p. 15.

** Steve Hume, "Pipeline Through Arctic Faces Formidable Hurdles", The Citizen, April 17, 1974.

*** "Gas Pipeline Application Expected in 2 Weeks", The Citizen,March 1/74.

**** Discoveries in Arctic Islands to end of 1973 are estimated at 1/3 the threshold reserves necessary for a pipeline. From a talk by A. Digby Hunt, ADM, Northern Affairs, DINA, at a Canadian National Energy Forum Winnipeg, Oilweek, February 25, 1974, p. 12.

***** Judith Maxwell, op. cit., p. 30 and 37.

****** Pritchard, T, "Polar Gas Wants to Avoid Controversy, Just Develop Pipeline", The Citizen, April 4, 1974.

Feasibility of surface tanker transport of oil and gas from the Arctic Islands depends on resource location. If sufficient quantities were found in the eastern areas of the Arctic, tanker transport would be a logical alternative,due to less severe ice conditions. Availability of deep water sites for tanker terminals (large tankers can require up to and exceeding 100 ft. of water) would be the next consideration. The usual solution for loading tankers at shallow harbour sites is running a pipeline out to deeper water where the tanker loads. This may be impractical due to possible ice action on the pipeline.

In the northwestern portion of the Arctic,surface tanker transport is not feasible due to the severity of the ice conditions. In this area transport by semi-submersible vessel and submarines has been considered as well as giant aircraft. Table IV-6 details estimates of cost comparisons of the different modes, their relative cargo capacities and research done on each mode. Tanker transport is the least expensive, but appears to be the least likely to be used,since all the oil and gas discoveries to date have been in the northwestern Arctic Islands, with the exception of one oil well on Ellesmere Island. In addition, Map IV-3 "Canada's Petroleum Basins" illustrates that the petroleum basins in the Arctic Islands are for the most part in the western and central islands,indicating a proportionately smaller chance of discovering oil and gas in eastern regions where the ice conditions are less severe.

3. Research on Arctic Tanker Transport and Marine Terminals

The voyages of the S.S. Manhattan in 1969 and 1970 were made with the objective of discovering whether transport of Prudhoe Bay oil by surface vessel through the Northwest Passage was technically and economically feasible,and whether vessel transport was cheaper than the proposed trans-Alaska pipeline from Prudhoe Bay to Valdez. Humble Oil and Refining Company (now Exxon) and partners financed the refitting of the tanker. Portions of the hull were strengthened and an icebreaking bow was added. After refitting,the "Manhattan" was about 120,000 dwt with a total shaft horsepower of 43,000. Total cost of the experiment was $40 million.

The "Manhattan" made two voyages. The first was from late August to the end of November 1969 (when ice conditions were least severe),on a route from the east coast of the U.S. through the Northwest Passage to Point Barrow in Alaska and back again. She was accompanied by the C.C.G.S. "John A. MacDonald" on the first voyage and by C.C.G.S. "Louis St. Laurant" on the second voyage in 1970. The second voyage was made in April and May when ice conditions were at their most severe and the "Manhattan" operated in the general area of Lancaster Sound and the north coast of Baffin Island.

In October 1970,Exxon stated in a press release that although shipment of oil by tankers was commercially feasible, the pipeline route appeared to have the economic edge. No further design research was done because the company was committed to using the trans-Alaska pipeline route.*

In 1971, the Department of Public Works completed a study on the feasibility of a marine tanker terminal in the Prudhoe Bay area entitled "Herschel Island Feasibility of a Marine Terminal". The study was conceived when the possibility of shipping Prudhoe Bay oil by tanker through the Northwest Passage was being considered. The study rejected a site on Herschel Island and considered three other nearby sites: Babbage Bight, Darnley Bay and Franklin Bay, concluding that Darnley Bay was the most suitable.

Eight alternative marine terminal designs were considered. The design chosen consisted of two breasting dolphins composed of caissons with concrete external walls and steel interior walls at a cost of $80,403,000. The structure would take five years to construct.**

However, by the time of the completion of this study, the voyage of the "Manhattan" and the decision of Humble Oil to transport the Prudhoe Bay oil by pipeline removed the need for a marine terminal in the Prudhoe Bay area. However, the information gained in this study will be useful to subsequent studies.

Development of an ice-strengthened or icebreaking tanker could take two years for design and possibly four years to construct. At present no design research is being carried out since the oil industry has not found sufficient oil to justify research.

A few tankers used to carry liquified natural gas (LNG) are currently in service on conventional routes and cost about $125 million for a 200,000 cubic meter capacity vessel. These vessels require liquifaction facilities at the supply end and a gasification plant at the market destination. No significant amounts of research have been done to the present time on the design of an icebreaking LNG tanker.***

In June 1971, the chairman of the Arctic Petroleum Operators Association wrote to the Minister of Public Works requesting that the Government give consideration to undertaking a Harbour and Marine Transportation Feasibility Study with respect to the

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* Judith Maxwell, op. cit., p. 38.

** Department of Public Works, <u>Herschel Island, Feasibility of a Marine Terminal</u> (1971) p. 122 and 140.

*** Judith Maxwell, op. cit., p. 39,40.

feasibility of liquid hydrocarbon movement from the Arctic Islands to markets in the eastern United States and Europe.

The chairman indicated that since tanker movement to the interior Queen Elizabeth Islands was unlikely, an inter-island pipeline would therefore be required that could terminate at one or more harbours open for year-round operations. It would be desirable to have the terminal as close as possible to the center of potential hydrocarbon production. If the Government were willing to undertake the proposed study, the APOA would form an advisory committee to define the scope of the study in co-operation with government representatives and provide available information needed to carry on the study.

In response to this request, work was commenced by a Ministry of Transport Working Group on a Feasibility Study of Arctic Marine Transport. The study examined factors to be taken into account in the choice of Arctic terminal sites. The candidate harbours were considered on the basis of deep water, surrounding ice regimes and the nature of the land in areas where year-round surface tanker transport was feasible. Candidate harbours mentioned from preliminary studies have been Radstock Bay, Maxwell Bay and Norfolk Inlet on Devon Island, and Goose Fiord and Makinson Inlet on Ellesmere Island. An Interdepartmental Steering Group on the Feasibility Study of Arctic Marine Transport of the Task Force on Northern Oil Development* have considered potential terminal sites and have advised that supplemental hydrographic surveys be done at locations on Ellesmere and Devon Islands during the period 1973 to 1975.

4. Specific Development Proposals -- Metallic Minerals

As was discussed earlier, three large mineral deposits north of the Arctic Circle are mentioned most often as those which will be developed earliest. These are: a lead-zinc deposit on Strathcona Sound on northwestern Baffin Island, a lead-zinc deposit on Little Cornwallis Island, and an iron deposit at Mary River, near Milne Inlet on northern Baffin Island. A proposal for financial support to develop the deposit at Strathcona Sound has already been received by the Government.

Table IV-7 following summarizes some relevant details of the three projects for comparative purposes.

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* Representation consists of DOE, DINA, DPW and MOT.

a. Strathcona Sound

The firm of Mineral Resources International Limited (MRI) propose to develop a lead-zinc mine on a site owned by Texas Gulf Limited. Texas Gulf would retain a 35% interest in the project once developed. Financial backing for the estimated total project cost of $45 million includes the Metallgesellschaft A.G. of West Germany and Billiton N.V. of the Netherlands.

The firm of Watts, Griffis and McQuat Limited were engaged by Mineral Resources International to co-ordinate an overall feasibility study of the project. The marine shipping terminal portion of the total feasibility study was done by the firm of Carr and Donald and Associates Limited. Terratech Limited were responsible for soil borings and analysis at potential wharf sites.

The project proposal included a new town which, in its final stage, would accommodate approximately 850 people, an Arctic Class "B" airport (estimated cost $3.5 million), an 18-mile road to the community of Arctic Bay (population about 260 in 1971) and a wharf for the shipment of zinc and lead concentrates (estimated cost $3.8 million).

Concentrates would be mined at Strathcona Sound and shipped in vessels of 20,000 to 50,000 dwt to a smelter in England. Outward shipments to the smelter would be about 150,000 tons per year. Inward supply shipments would be about 10,000 tons of general cargo and 10,000 tons of fuel oil to service the new community at Strathcona Sound and the existing community at Arctic Bay.

Concentrate production would take place on a year-round basis and be stored in a concentrate storage building capable of holding the year's production. Outward shipments would take place during the summer season. Navigation is possible for 36 days (see Table IV-7) for unstrengthened ships and 94 days for Lloyd's Class 1.

Four potential wharf sites and three types of wharf facilities were examined by Carr and Donald, the consultants for the marine terminal portion of the study. A site about two miles from the proposed mine was selected. The three types of wharf examined included a multiple-buoy mooring with a large shiploader, a De Long type pre-fabricated wharf, and a dock composed of three steel sheet pile cells. The sheet pile cell alternative was selected as being the most economic. The multiple-buoy mooring option, although obviously cheaper than a fixed structure attached to the land, became more expensive due to the much higher cost of the shiploader, the required horizontal extent of which was much longer. Shiploader cost for the multiple-buoy mooring alternative was about ten times more than the shiploader for the cell type and De Long type docks.

Cost of the wharf facility was originally estimated in October 1973 by Carr and Donald to be $2.3 million. Subsequently they have updated the figure to $3.8 million. Costs will be highly dependent on the availability and delivery of construction materials, particularly steel, as well as on co-ordination of wharf construction with that of onshore facilities. It is proposed that construction will begin on the wharf in 1975 to be ready for service in late 1976.

This project received approval of the Cabinet in mid-1974, following the signing of an agreement between the Company and the Minister of Indian Affairs. The Federal Government will participate to the amount of $16.7 million in this project in recoverable and non-recoverable loans, and in return will receive an 18% equity position in the project, as well as assurance that certain social and economic benefits would accrue to Canada and Inuits from the project.

b. Baffinland Iron Mines

The enormous iron deposit at Mary River, northern Baffin Island, has been subject to "a detailed and ongoing feasibility study... to determine whether or not production can be achieved".* Terratech Limited, the consultants who did the soil borings at potential wharf sites at Strathcona Sound as part of the overall Watts, Griffis, McQuat study, have also carried out borings at the Baffinland Iron Mines site.

The proposed loading port location at Milne Inlet is located in the same AWPPA Shipping Safety Control Zone (13) as the deposit at Strathcona Sound, and thus has an identical navigation season. However, the resource tonnages are so large at Mary River that outward shipments only during the summer season would probably not be economically feasible. For year-round cargo movement an icebreaking cargo vessel about five times the power and three times the cost of a conventional vessel of similar size would be required.

c. Little Cornwallis Island

The lead-zinc deposit at Little Cornwallis Island is estimated to be five times the size of the deposit at Strathcona Sound. Reserves have not yet been totally calculated. Development of this deposit is in a longer time frame than at Strathcona Sound due to its location in a more severe ice zone. Nevertheless, this is the only deposit of the three where any quantity of minerals have actually been shipped out. A first trial shipment of about 3,600 tons of ore was shipped during the 1973 navigation season to Ogdensburg, New York, for metallurgical tests.**

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* DINA, North of 60° Mines and Minerals Activities, 1972, op. cit., p. 8.

**The Toronto Globe and Mail, November 3, 1973.

Resolute Shipping Limited (a subsidiary of Federal Commerce and Navigation Company Limited) submitted a study to Cominco in 1972 on the feasibility of Canadian commercial water transport of bulk minerals out of the Arctic with special reference to the Little Cornwallis deposit. The study examined the problems of shipping lead-zinc concentrates from Little Cornwallis to Europe in regularly spaced shipments totalling 200,000 to 400,000 tons annually. The study concluded that a vessel could be built to-day that could survive, but it was impossible to say by what magnitude she would be delayed by natural conditions. To make voyages year-round to Little Cornwallis, a vessel would have to be at least Arctic Class 7 (see Table IV-7) which describes a vessel stronger and more powerful than any icebreaker in existence today.

The study examined two icebreaking ore carriers of different Arctic class and size and the consequent cost per ton of the ore in Europe. The implications of using an Arctic Class 7 vessel of 22,000 dwt size at a construction cost of $40 million (year-round service) were compared with that of using an Arctic Class 4 vessel of 52,000 dwt (construction cost $39 million) for service six months per year.

The study concluded that in comparing the use of an ice-strengthened ship versus an icebreaking ship, the former offers no real alternative since use of an icebreaking vessel offers a degree of security and regularity of loading that a merely ice-strengthened vessel could not achieve.*

5. Other Major Arctic Mineral Deposits

Although the three deposits discussed above are those mentioned most frequently with respect to development, other major deposits are known, some of greater magnitude. (See Map IV-2 and Tables IV-1 and IV-5.)

The two largest known iron deposits in the Arctic are located on the west and east sides of Melville Peninsula where Borealis Exploration has found an estimated 2.6 to 3.3 billion ton deposit that is about 40% iron on the west and a deposit of about 1.1 billion tons, grading at an average of 30%, on the east. Estimated gross value of the western find is $16.3 billion and that of the eastern is $5.2 billion.

On the western Arctic mainland there are substantial copper deposits near Coronation Gulf. West of the Coppermine River, Coppermine River Limited have found an estimated 4.2 million ton

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* Resolute Shipping Limited, <u>The Regular and Unrestricted Shipment of Lead-Zinc Concentrates from Little Cornwallis Island to Europe</u>, (1972), p. 31 and 52.

TABLE IV-8
STRATHCONA SOUND, LITTLE CORNWALLIS ISLAND AND MARY RIVER
MINERAL DEPOSIT LOCATION, SIZE AND LENGTH OF NAVIGATION SEASON

Name, Company and Exact Location	Deposit Size and Grade	AWPPA Shipping Safety Control Zone	Vessel/Navigation Season		
Strathcona Sound,	Lead-zinc	13	Arctic Class:		
Northwestern Baffin Island,	estimated at		10 All year		
Mineral Resources Intern.	8,000,000 tons		8 All year		
Lat. 73°02'	8.8% zn, 1% Pb.		7 All year		
Long. 84°23'			6 All year		
			4 Jun 01 - Feb 15	260	days - 8.50 months
			3 Jun 10 - Dec 31	204	days - 6.75 months
			2 Jun 25 - Nov 15	143	days - 4.75 months
			1A Jul 15 - Oct 31	108	days - 3.50 months
			1 Jul 15 - Oct 15	92	days - 3.00 months
			Type:		
			A(Ice 1*) Jun 25 - Oct 22	119	days - 4.00 months
			B(Ice 1) Jul 15 - Oct 15	92	days - 3.00 months
			C(Ice 2) Jul 15 - Oct 10	87	days - 2.75 months
			D(Ice 3) Jul 30 - Sep 30	62	days - 2.00 months
			E(No Ice) Aug 15 - Sep 20	36	days - 1.25 months
Baffin Island Irom Mines Ltd.,	Iron	13			
Hudson Bay Mining & Smelting	135,000,000 tons	(Milne Inlet)			
Co. and 9 other participants	69% Fe.		Navigation season as for		
Lat. 71°19'			Strathcona Sound		
Long. 79°21'					
Little Cornwallis Island	Lead-zinc	6	Arctic Class:		
Cominco Limited (75%),			10 All year		
Bankeno Mines (25%)			8 All year		
(Two Showings):			7 All year		
Polaris (Main Showing)			6 Jul 15 - Feb 28	228	days - 7.50 months
Lat. 75°27.7'			4 Jul 20 - Dec 31	164	days - 5.50 months
Long. 96°57.0'			3 Aug 01 - Nov 20	112	days - 3.75 months
Eclipse (East Showing)			2 Aug 15 - Nov 20	97	days - 3.25 months
Lat. 75°32.5'			1A Aug 25 - Oct 31	67	days - 2.25 months
Long. 96°09''			1 Aug 25 - Sep 30	36	days - 1.25 months
			Type:		
			A Aug 15 - Oct 15	61	days - 2.00 months
			B Aug 25 - Sep 30	36	days - 1.25 months
			C Aug 25 - Sep 25	31	days - 1.00 months
			D No Entry		
			E No Entry		

find, estimated value $123 million, while to the east of the River, Kennarctic Explorations Limited have found a copper-zinc deposit of an estimated 5.2 million tons at an estimated gross value of $222 million.

Near Bathurst Inlet on the Hackett River, Bathurst Norsemines Limited have discovered a lead-zinc-silver deposit estimated at 10 million tons with a gross value of $400 million.*

6. Major Studies Done on Feasibility and Modes of Transport of Arctic Bulk Cargoes

Two major studies have been done during the past three years on feasibility and modes of transporting resources from the Arctic to market. The first of the two was done in 1969 by the firm of Warnock Hersey International Limited for the Northern Economic Development Branch of DINA and was entitled "Arctic Transportation Study". The second report was done in 1973 by Northern Associates (Holdings) Limited for the Canadian Marine Transportation Administration of the Ministry of Transport.

a. The terms of reference for the Warnock Hersey report included: Determination of what transport modes will encourage the maximum development of Arctic resources; analysis of all available information respecting climatic and geographic restraints and other constraints affecting the adaption of high volume transport modes to conditions in the Arctic; and an estimation of total capital and operating costs of adapting the transport modes considered in the study to Arctic conditions as well as magnitude of costs for various modes on a ton/mile basis.

The study examined resource transport by surface ocean vessels, submarines, pipelines, railways, air-cushion vehicles, aircraft, off-highway vehicles, conveyor belts and monorails. The study concluded that surface ocean vessels of the dual purpose (bulk/oil) type are the most economic means of delivering oil and bulk commodities to market in the eastern United States and Europe. For short distance transport of metallic mineral production from, for instance, a mine to a marine terminal, the most economic alternative of off-highway vehicle, railway, conveyor belt, monorail or air-cushion vehicle was determined by a combination of modal capital and operating costs with rates at which the product is to be shipped and the topography.

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* The Edmonton Journal, June 5, 1973, and Table IV-5.

Various types of marine terminal facilities were considered at general resource locations such as the Mackenzie Bay, Coppermine, Little Cornwallis Island, Baffin Island, Melville Island and Axel Heiberg Island. Very rough estimates were given on construction costs of marine terminals (including storage building, conveyors, shiploaders and site preparation) varying from about $2 million to $16 million. Marine facilities consisted of single and multiple buoy systems. Since no specific sites were considered and therefore there was no data on soil conditions or ice movement, these estimates represent a very approximate order of magnitude.

This study was done at a time when considerably less was known about transport in the Arctic than at present. Since the writing of this report, the voyage of the "Manhattan" and the appearance of the Arctic Waters Pollution Prevention Act and accompanying Regulations have cleared up some questions on probable modes of hydrocarbon transport and created certain conditions of navigation.

b. The Northern Associates Report "Arctic Resources by Sea" is a more specialized study which deals specifically with the comparative feasibility and economics of transport by surface, sub-surface and submarine vessels of export cargoes of bulk oil, gas and minerals from the Arctic to market.

The main conclusions and recommendations made in this report with implications for Arctic harbour and port development are discussed below.

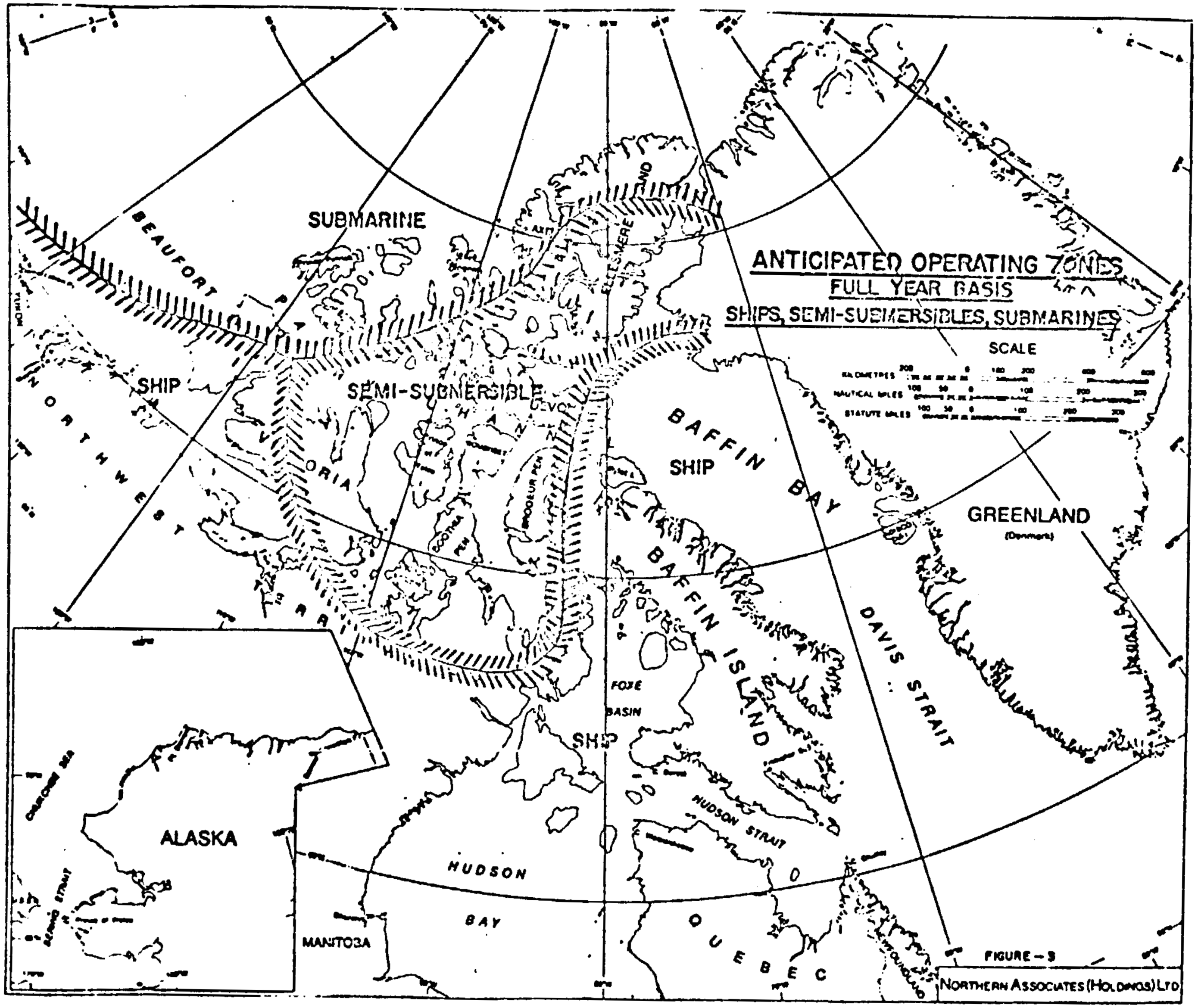
> <u>Arctic Resources</u>: The point is made that no serious consideration of Arctic transportation is possible unless cargoes are in competitive demand. As world demand for oil, natural gas and minerals is seen in the context of depletion of resources in more readily accessible areas, and increase in prices, exploitation of natural resources in remote locations such as the Arctic becomes more economically attractive. It is stated that this situation exists now and consequently a need for a commercial Arctic fleet of vessels is imminent.
>
> <u>Feasibility of surface, semi-submersible and submarine vessels in different areas of the Arctic</u>: The Arctic can be divided into two main ice regions, those where the waters are covered by predominantly first-year ice and those where the waters are predominantly covered by multi-year ice. (See Map IV-5). The Northwest Passage has two major ice barriers: the multi-year ice covering Viscount Melville Sound and the extremely variable and

unpredictable ice regime off the north coast of Alaska, where first-year ice interposes between shorefast ice and the adjacent Arctic pack. The pack is often driven inshore by the predominant northerly winter winds. This factor, combined with the shallow water conditions which exist to large distances from shore, combine to make dangerous and uncertain conditions for large vessels along the coast of Alaska.

The study delimits three operating zones in the Arctic based on ice conditions in which surface, semi-submersible and submarines are feasible in turn for traffic on a full year basis. (See Map IV-10.) Extension of all year-round shipping in areas of first-year ice is within the capability of surface ship technology at present. An enormous step would have to be taken in surface ship technology to achieve year-round operation in areas of multi-year ice. The areas on Map IV-10 were determined both in terms of technical feasibility and economics for eastbound routes. The transport cost for cargo carried in a surface vessel is lowest until ice conditions become difficult around the entrance to Lancaster Sound, at which point the semi-submersible begins to show an economic advantage which remains along the length of the Parry Channel to the Mackenzie Delta. In the Queen Elizabeth Islands no economic comparisons are possible since severe ice conditions make the area unsuitable to any vessel except submarines.

However, the study emphasizes that knowledge of ice conditions is still in relative infancy, submarines are not suitable to carry all types of cargo and shallow depths in areas of the western Arctic reduces the possibility of submarine use. It, therefore, appears that Arctic shipping routes for <u>surface</u> vessels may not extend much beyond the range of the present summer season activities and further, the main Arctic sea traffic lanes in the near future will be eastbound for both surface and submarine vessels. A shorter season surface vessel traffic in varying degrees will be possible in areas of multi-year ice depending upon the surface ship's ice capacity.

MAP IV-10



Source: Northern Associates (Holdings) Limited, <u>Arctic Resources By Sea</u>, 1973.

Construction costs for different types of vessels of 150,000 dwt are estimated as follows:

Vehicle Type and Power (of sufficient ice capability for traffic in areas shown in Map IV-10)	Oil Cost (Million $)	Ore Cost (Million $)	LNG Cost (Million $)
Surface 180,000 hp	49	56	279 (93 each)
Semi-Sub 160,000 hp	71	78	345 (115 each)
Submarine 75,000 hp	120	128	Not suitable

(Source: Northern Associates (Holdings) Limited, Arctic Resources by Sea, 1973.)

Note: An approximate factor of three is necessary to get equivalent capacity on an LNG vessel.

Note: 150,000 dwt ton vessel is specified since it is felt to be the minimum size required for year-round commercial operation in which the maintenance of a schedule is vital.

Transport Costs per Ton Mile for Surface, Semi-Sub and Submarine Vessels: Costs for year-round operation for the three vessel types (listed above) for oil carriage from the Arctic to the east coast are: surface ship 0.28 cents/ton mile, semi-sub 0.41 cents/ton mile, and submarine 0.35 cents/ ton mile.

The question of the feasibility and cost of LNG carriage from the Arctic Islands is investigated. The use of special LNG semi-submersibles capable of travelling to the source of the cargo and shipping direct is not considered a short-term possibility, due to the severe ice problems in the Queen Elizabeth Islands. The second alternative, that of collecting the gas by an inter-island pipeline terminating at a location on the southeast portion of Devon or Ellesmere Islands is considered more feasible in the near future, due to less severe ice conditions. It is estimated that LNG could be moved to the eastern Canadian seaboard over a twelve-month season for about 60 cents per Mcf. The problem of liquefaction of the gas is mentioned and comparisons made with liquifaction plants in other remote locations.

The Use of Tug and Barge Transport: Deepsea tug and barge operations are currently being carried out on the east and west coasts of North America. These are all "open-water" operations or operations are carried out during the summer months in the presence of light, scattered ice conditions.

Two alternate methods are used to connect the towing tug and barge: a towline from tug to barge "towing", or rigid or semi-rigid connections between bow of tug and stern of barge "pushing". The first method is considered to be unsuitable for use in ice conditions due to two factors: excessive towline load when the barge's progress is hampered by ice, and deflection of the barge from its path by ice impact or a sudden halt of the tug causing the barge to run up under or over the tug.

Both rigid and semi-rigid connections between the tug and barge exist in the push "towing" field; however, the rigid type connection where the tug and barge operate as a single unit appears to be more suitable for Arctic service,in view of the possibility of entrapment in a pressure field producing unequal forces along the length of the vessel. In certain conditions, tug/barge operations show advantages over using conventional vessels, expecially for short voyages on a fixed route,due to smaller crews and lower first cost (depending on the type of barge used). An example of the possible use of a barge/tug operation within the Arctic might be for shuttle service to raw materials from an area inaccessible to large vessels. The overall economics would depend principally on the cost/ton mile of the shuttle vessel compared with that of the main vessel and the length of the shuttle haul compared with the total haul.

Brief mention is made of the possible use of icebreaking tugs towing submerged barges for oil transport; however, no further consideration is given since the concept is at an early developmental stage with no operating experiences. Potential difficulties of snagging of the towline on ice ridges and the relatively small size of the tug, make it unlikely that she would be an efficient icebreaker where the ice is thickest or larger pressure ridges occur.

It is concluded that a wide range of vessel types, surface and sub-surface, have a role to play in future Arctic shipping trade and, therefore, must be included in the requirements for further research.

Variation in Marine Transportation Costs With Length of Season: In the case of vessels over 150,000 dwt, there is little change in costs between short season and full year trading assuming the vessel can be employed to cover her full cost during the remaining months. Also stockpiling costs during the closed season can be impractical in certain cases, such as for oil and LNG cargoes, thus requiring a full year shipping service, so that seasonal economic comparisons have no real meaning. For suitable cargoes in regions where full year surface operations are not possible, the vessel could be used for a part season in an area of greater ice severity and spend the rest of the year in another Arctic area of less ice severity. An example was given of a 150,000 dwt surface vessel operating in the Queen Elizabeth Islands for a three-month season and then withdrawing to Milne Inlet service for the remaining nine months.

The Question of Whether Arctic Cargoes Should Be Shipped Direct to Foreign Markets or Transshipped at a Canadian Port: The position at which a transshipment terminal can be located in order to show an economic advantage over direct shipment from the Arctic to Europe occurs when the transshipment terminal is located about 1,100 miles from the Eastern Arctic voyage extremity -- at the entrance to the Gulf of St. Lawrence. (Under assumptions of use of a 150,000 dwt tanker from the Barrow Strait, the limit of year-round surface ship capacity.)

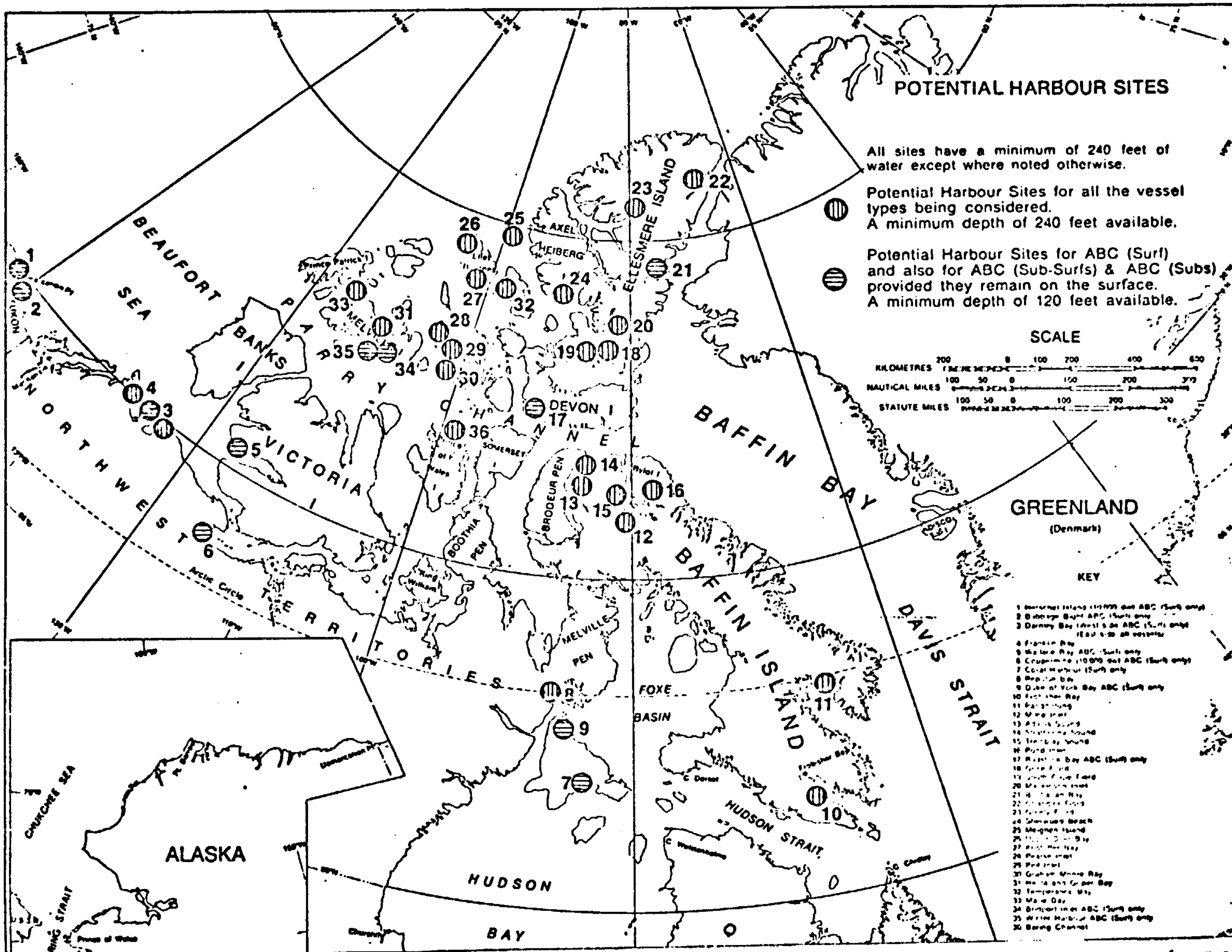
Potential Arctic Harbour Sites: Assuming use of 250,000 dwt surface ships, semi-subs, and submarines (which were assigned drafts of 90, 145 and 90 feet respectively) for transport of Arctic bulk cargoes, charts were examined to determine potential deep water harbour sites in the Arctic. These sites were derived from current Arctic charts and thus are only as good as the current state of bathymetric knowledge which is scanty. Depth of water was the only criteria and more detailed and specific site criteria such as accessibility, exposure, ice conditions and topography were not used. An estimated six years is required for construction of an Arctic terminal, one to two years for exploration, collection of data and site selection and three to four years for design and construction.

Emphasis was placed on the deep draft requirements of Arctic-capable surface ships and the deep water requirements of submarines. Accordingly, thirty-six locations were indicated where water depths ranged from 120 feet to 240 feet. (See Map IV-11). Two categories of harbours were chosen, the first with a minimum of 240 feet of which there were twenty-six sites and the second with a minimum of 120 feet of which there were ten sites.

The type of berthing facility utilized at an Arctic harbour will be dependent on many factors including:

- ice conditions and forces exerted by ice pressures;
- soil and permafrost conditions on shore and underwater;
- the depth of water required at the dock and approach channel for the size of vessel to be berthed;
- berthing forces, tug requirements and mooring forces;
- wind and wave, current and tide conditions;.
- earthquake forces when applicable;
- dead load of the structure and the live load due to machinery, etc.;
- topographic and hydrographic profile of the site; and,
- environmental aspects.

MAP IV-11



Source: Northern Associates (Holdings) Limited, Arctic Resources by Sea, 1973.

> Natural harbours should be used if depth of water and manoeuvering space can be obtained, as the land features may provide protection in some cases from swell, wind and ice. An offshore single-point mooring designed to resist ice pressure could be considered in a sheltered harbour where there is no movement of ice except during break-up. However, single-point moorings are vulnerable to severe wind and ice conditions, so if anything more than occasional traffic is envisaged, a conventional wharf would be required.

Final recommendations of the reports include more research on various aspects of vessel technology, ice science, oceanography, aids to navigation (perfection of hostile environment techniques), a reduction in the number of AWPPA Regulation Shipping Safety Control Zones from 16 to 4, and ways of combating Arctic pollution (specifically oil). The Government role is seen as easement of burden -- a recommendation for joint consultation between the Government and marine underwriters with the end of lower Arctic marine insurance premiums through specification of physical risks associated with Arctic shipping and follow through of measures to reduce these risks. As well, government investigation of the scope of available domestic sources of capital for long-term financing at better than usual rates is suggested to ease the burden of heavy initial capital outlays that will be associated with the construction of Arctic marine transport vessels and their supporting facilities.

7. Influence of Icebreaker Services on Resource Exploration and Marine Transport of Bulk Cargoes

The provision of Government icebreaker services supports the development of commercial ice navigation and provides encouragement for Canadian commercial enterprise to participate in these developments. Although there is no precise time frame predictable for large scale commercial exploitation of Arctic resources, it is necessary to be prepared for these movements. At present there is no policy which effectively controls the rate of development of Arctic resources,consistent with the present or future capacity of Canadian icebreakers to escort shipping or provide an emergency service. The United States and the Soviet Union are currently constructing icebreakers with capacity far greater than Canadian icebreakers. (See Appendix 5 for details of Canada's icebreaker fleet). There is at present no policy preventing foreign shipping from entering Canadian Arctic waters accompanied by foreign icebreakers. Only seven of the total fleet of Canada's twenty-four icebreakers are capable of summer operations in the Arctic.

Modernization of the existing fleet to upgrade its icebreaking capability is underway, as well as the addition of two new heavy icebreakers similar to existing vessels. Three larger icebreakers are under consideration: a vessel of about 17,000 tons displacement and 36-45,000 SHP capable of extending the season in the eastern Arctic west to Resolute and in the Baffin Bay to six months, to at least eight months in the Hudson Strait, Bay and Foxe Basin areas. The second vessel being considered is of 31,000 tons displacement and 80,000 SHP capable of year-round operation south of Parry Channel and for five or six months north and west of the Channel. For all year movements west of Resolute or north of Norwegian Bay, an icebreaker of up to 140,000 SHP and 46,000 tons displacement would be required.

The AWPPA Regulations, in providing for certain standards of vessel ice-strengthening and power, will gradually reduce requirements for icebreaker escort services; however, an ice-breaker management system should be somehow co-ordinated with the Regulations to facilitate icebreakers to function in the interests of commercial navigation. The role of the icebreaker has been the movement of supplies to isolated areas of the Arctic or escorting commercial supply ships. Icebreakers provide principally an emergency service, while by their presence, encourage resource developments requiring water transportation. However, growth in exploration activities and a general rise in Government cargo has led to increased demands on the icebreaker service, in terms of numbers of vessels, but also for additional power to extend the range of exploration and possible outward shipments of resources.

8. Icebreaking Cargo Vessels

The Regulations attached to the AWPPA clearly differentiate between ice-strengthened and icebreaking vessels. The broad categories of vessels with which the Regulations are concerned are: icebreaking vessels; ice-strengthened vessels; and conventional (open water) vessels, which are not strengthened in any way for ice.

Icebreaking vessels are specialized ships which are capable of operating without icebreaker support, which will cost proportionately more than their conventional size equivalent. Ice-strengthened vessels are conventional vessels which are designed with extra power and additional strengthening at particularly vulnerable areas, which can operate in ice-infested waters (provided the conditions are not too severe); however, such vessels cannot break even comparatively thin ice over any period of time without serious hull damage and must be dependent on icebreaker support except when working in open water. This distinction in function is designated in the Regulations by the use of the term "Class" for icebreaking vessels and "Type" for ice-strengthened vessels.

From Map III-3 and Table III-7 it can be seen that generally speaking, the higher the Arctic Class, the stronger the vessel and the higher the number assigned to a Shipping Safety Control Zone the longer the allowable navigation season. To date no commercial vessels have been built which could be classified as icebreakers, only Government vessels intended to assist commercial shipping. The C.C.G.S. "Louis St. Laurent" would probably be classed as Arctic Class 4. The strongest commercial ships to enter the Canadian Arctic to date are Type B or Lloyd's Ice Class 1 vessels.

The reference point for ice conditions to be used as a design basis for icebreaking vessels in the Regulations appears to be the thickness of first-year ice expected in a given area. For example, Class 4 vessels and above would be capable of continuous operation in neutral ice (ice not under pressure) having a first-year thickness of four feet or less. However, knowledge of Arctic winter ice conditions is very incomplete and any vessel, no matter how large or powerful, will encounter significant delays due to ice ridges and patches of old ice. (Old ice is ice which has survived one summer and is harder and tougher than first-year ice. As ice ages, its salt is drained away which renders it harder and tougher.)

Icebreaking vessels must be strong enough to withstand the ice pressures which may be placed on her shell and the vessels must be able to proceed forward through the conditions of the area she is designed to contend with. Vessel horsepower provides the thrust to move the vessel while the mass of the vessel is the major component of her ability to penetrate ridges.

Future icebreaking cargo vessels will differ from icebreakers now in existence. Government icebreakers are designed primarily to assist conventional shipping and are not usually called on to cover a given distance in a given time as a scheduled commercial vessel would be. Government vessels frequently resort to backing away from the ice and ramming it at full speed to break it. These vessels are designed for high manoeuverability and tend to be relatively small and light. An icebreaking cargo vessel (in order to save time and fuel) will have to rely on a different method of progress and therefore must have sufficient mass and driving power to proceed steadily through uniform ice cover and be able to pass through at least the smaller ridges without resorting to ramming.*

Research on surface vessel transport in the Arctic has focused on the crucial relationship between the design requirements of

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* Resolute Shipping Limited, The Regular and Unrestricted Shipment of Lead-Zinc Concentrates from Little Cornwallis Island to Europe, 1972, p. 4 and 5.

the vessel with respect to vessel operation in ice. Currently designs for Arctic bulk carriers of 250,000 dwt are under consideration which is an enormous jump from the current state of vessel technology of less than 15,000 dwt. Large contemplated vessel size is due to economics and factors of shipping cargo directly from Arctic to market. As well, interest has been shown by the Canadian shipbulding industry in "medium-sized" icebreaking cargo vessels of two size ranges: about 12,000 dwt suitable for part season operation in the Arctic and full season on the St. Lawrence; and a vessel of about 50,000 dwt built specifically for the Arctic. Present economics of Arctic movements and cost of the latter vessel constructed in accordance with the AWPPA Regulations make the latter vessel commercially unattractive.

The Weser Project

Since 1972 interest has been expressed by the Western German Government (through a Canada - West Germany Technological Exchange Agreement) in the development and construction of large icebreaking Arctic cargo vessels. The Germans have concluded that large ships are necessary for the transport of Arctic bulk cargoes and currently require ice condition information for the design of such a vessel. Concern is to obtain a maximum benefit for Canada from such an exchange since an exchange where Canada supplies information and to enable completion of vessel designs to be built in German shipyards has strong implications for the Canadian shipbuilding industry. The latter have expressed strong interest in potential opportunities for construction of Arctic-capable ships. Discussions between the two Governments are ongoing.

SECTION V THE INFLUENCE OF CLIMATOLOGICAL FACTORS ON NORTHERN HARBOUR AND PORT DEVELOPMENT

SECTION V THE INFLUENCE OF CLIMATOLOGICAL FACTORS ON NORTHERN HARBOUR AND PORT DEVELOPMENT

If resource exploitation is the impetus to future northern development, climatic factors are the main deterrent.

This deterrent to development arises firstly due to a lack of knowledge of Arctic climatic data, and secondly, due to the severity of the Arctic climate. The lack of data and severe climate inhibit both vessel passage, and construction and maintenance of marine terminal facilities.

In the early 1970's, there was a general realization on the part of the Federal Government that the pace of climatic data collection would not keep abreast of with the demand for information arising as a result of resource exploration. Accelerated programs of basic data collection on bathymetry, ice and climate were initiated. The sections following illustrate the extent of climatic data collection as of about 1972, and as such, do not reflect the most recent advances, many of which are not yet available in published form.

A. WEATHER STATIONS

Map V-1 illustrates the location of weather stations north of 60°. Many of the stations are associated with military installations. Data from these stations is summarized on a monthly basis in the publication "Monthly Record, Meteorological Observations in Canada", published by Atmospheric Environment of Environment Canada. The original data on which the Monthly Record summary is based is available on request from Atmospheric Environment. Data is available for many of the stations for a period of 15-20 years.*

B. TIDAL STATIONS

Arctic tidal data is available for a relatively limited number of ports, as illustrated by Map V-2, "Tidal Reference Ports", in the Arctic and Hudson Bay. These ports are concentrated in the eastern Arctic and the south central Arctic Islands.

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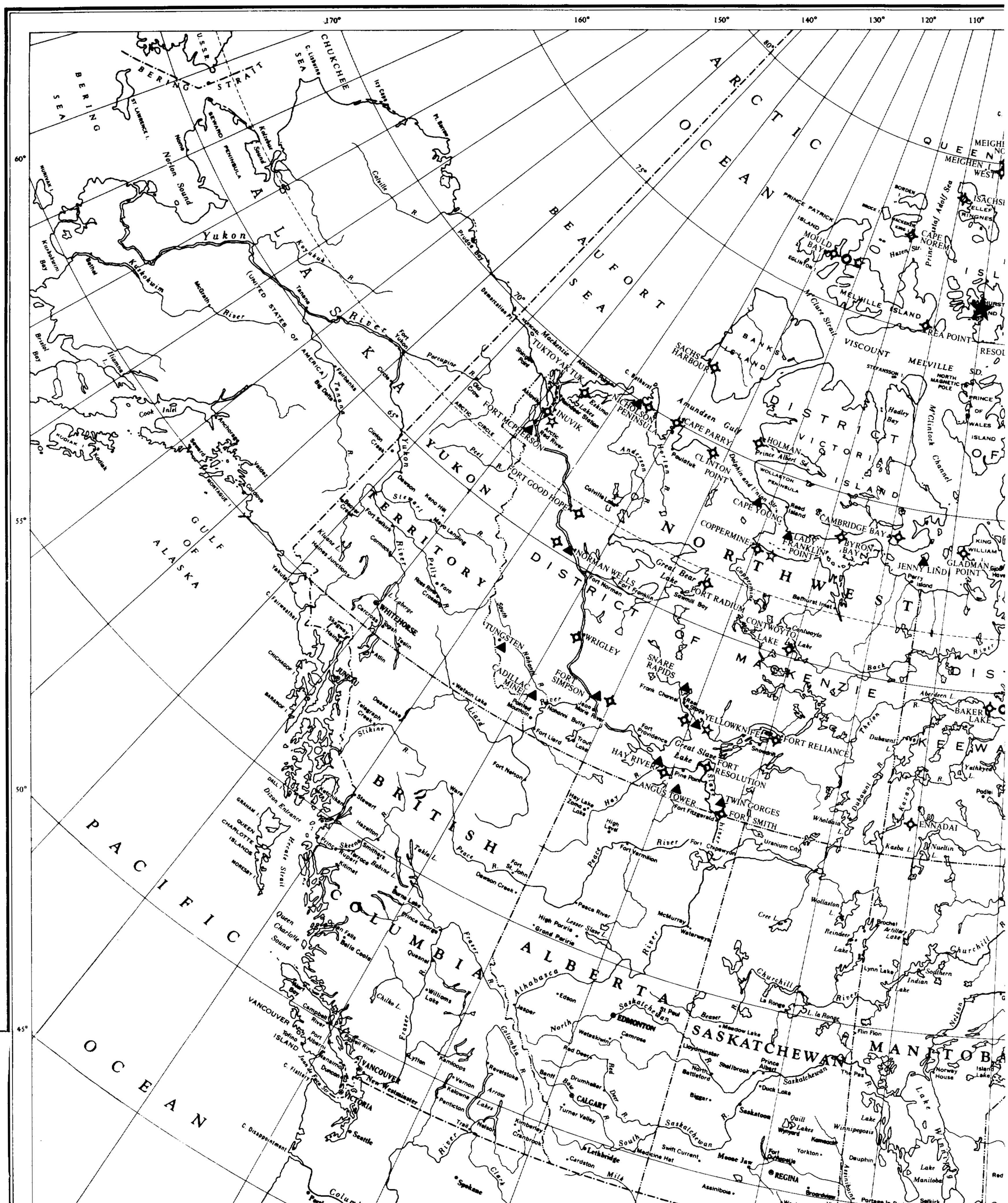
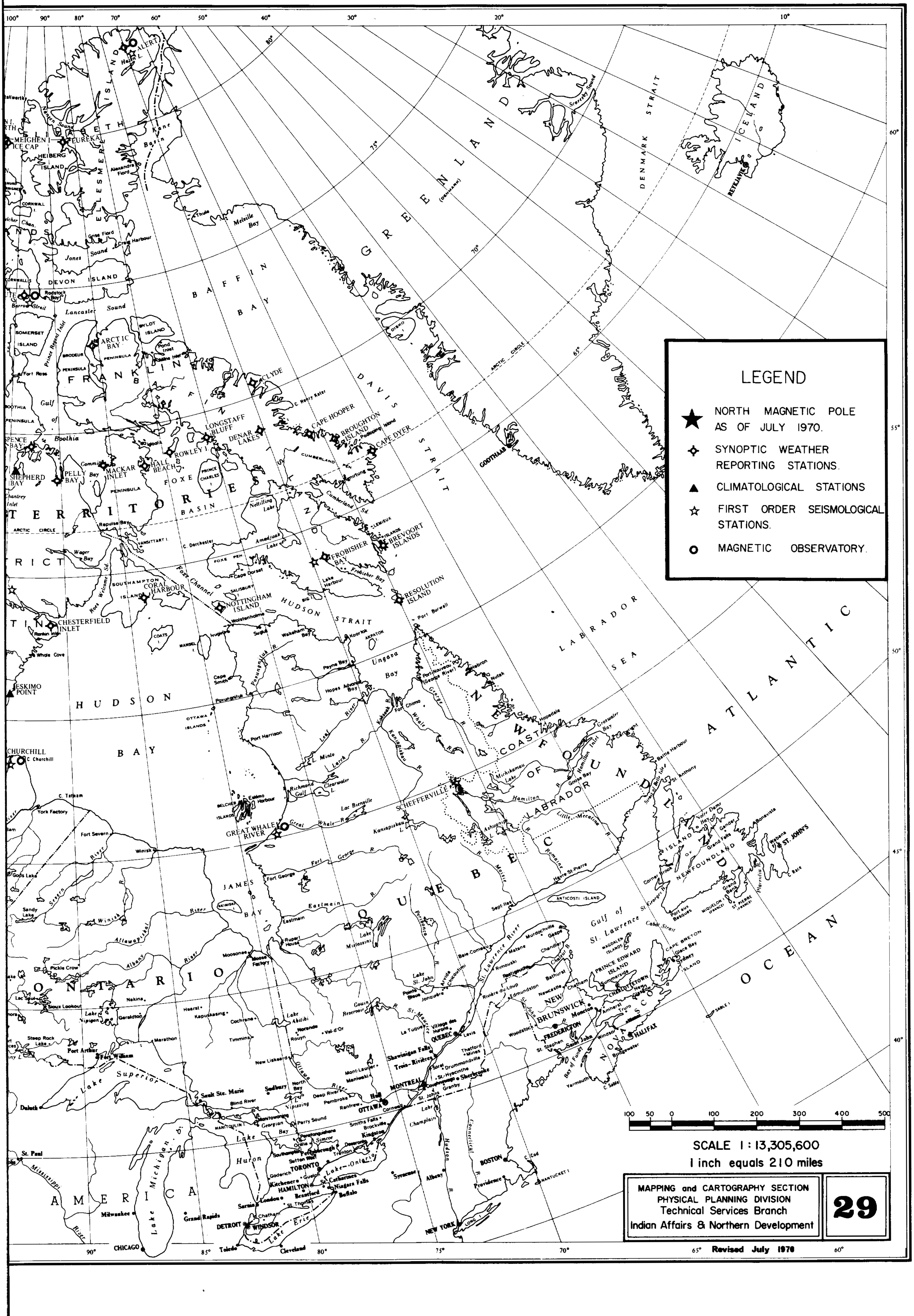
* William H. German, "Weather Engineering in the Arctic", Paper OTC 1807, Preprints of the Offshore Technology Conference, (American Institute of Mining, Metallurgical and Petroleum Engineers Inc., 1973), p. 695.

METEORLOGICAL STATION N

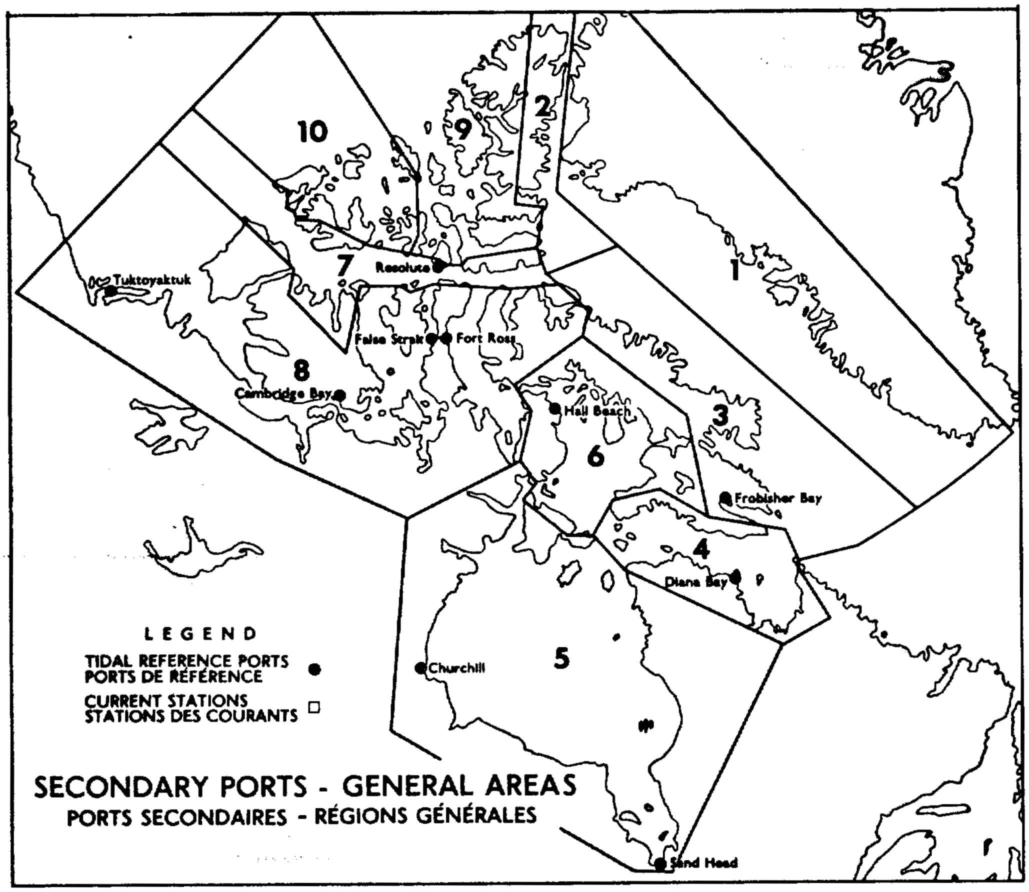


ETWORK & GEOPHYSICAL RESEARCH



MAP V-2

TIDAL REFERENCE PORTS AND SECONDARY AREAS
ARCTIC AND HUDSON BAY



Source: Atmospheric Environment, <u>Canadian Tide and Current Tables, Volume 4, Arctic and Hudson Bay 1973</u>, (Department of the Environment, 1973), inside cover.

Reference ports are those for which predictions are published in the form of daily tables for times and heights of high and low water. Secondary ports are those for which differences (adjustments) are published for times and heights of tide in order to obtain secondary port prediction. Tide tables giving tide predictions are found in the "Canadian Tide and Current Tables, Volume 4, Arctic and Hudson Bay", published by Atmospheric Environment of Environment Canada.

Tidal observations upon which predictions are made at a reference port encompass one year when possible. In most cases the observation period at a secondary port extends for approximately one month, and the quality of prediction for these secondary ports is therefore affected by the amount the tide levels fluctuated from normal during that period.

Map V-3, "Tidal Range in the Eastern Arctic", details the mean spring tidal range as far west as Resolute Bay. Tidal data for the Arctic Islands west of Resolute is extremely sparse. Tidal data for the Hudson Strait and Bay is detailed in Map IV-4, "Tidal Range, Hudson Strait and Hudson Bay".

Tidal range is greater in the eastern Arctic, especially in the Hudson Strait, Ungava Bay and Frobisher Bay areas, where the range is close to 35 feet in some locations. In the Hudson Bay, tides vary from two to six feet on the eastern shore, to about twelve feet on the western shore. Tide ranges in the western Arctic vary between negligible to about four feet. Maps V-3 and V-4 illustrate the general reduction of the tidal range in a westerly and northerly direction from Frobisher Bay and Ungava Bay.

C. BATHYMETRY

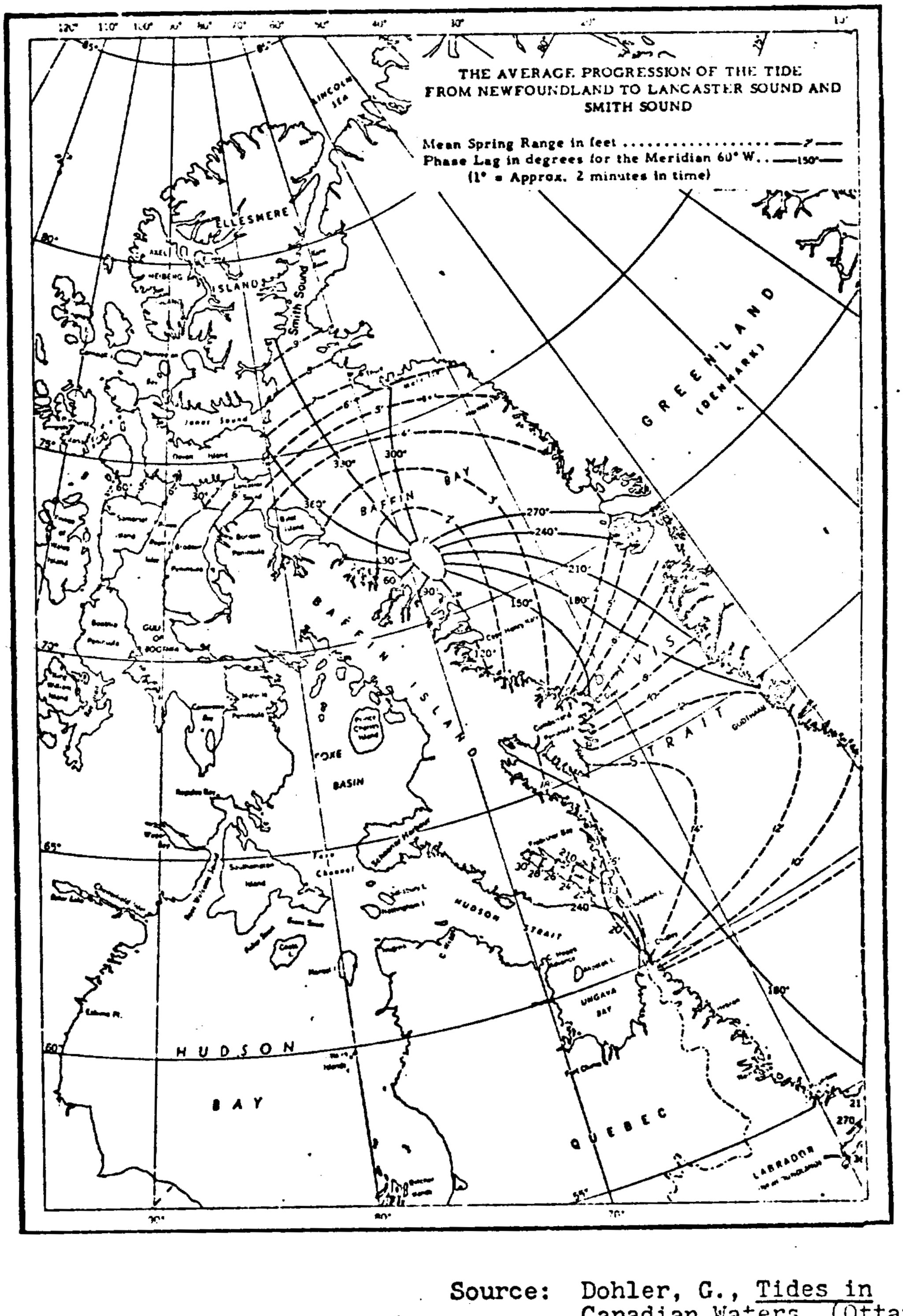
Current knowledge of water depths in the Arctic is very limited, and this lack is a major impediment to development of Arctic vessel traffic and port planning.

Map V-5 illustrates the status of hydrographic surveys in the Arctic as of 1972. As can be seen, standard surveys are relatively rare, and are concentrated in the Lancaster Sound, Barrow Sound and Mackenzie Bay areas, and at currently used harbour sites. Reconnaissance and track soundings have been done along shipping routes throughout the eastern, central and western Arctic, and Polar Continental Shelf have done spot soundings through the ice in the Beaufort Sea and Arctic Ocean. Canadian Coast Guard vessels carry out hydrographic surveying when other duties allow.

Accelerated hydrographic data acquisition programs have begun in the James Bay, and at locations on Devon and Ellesmere Islands.

MAP V-3

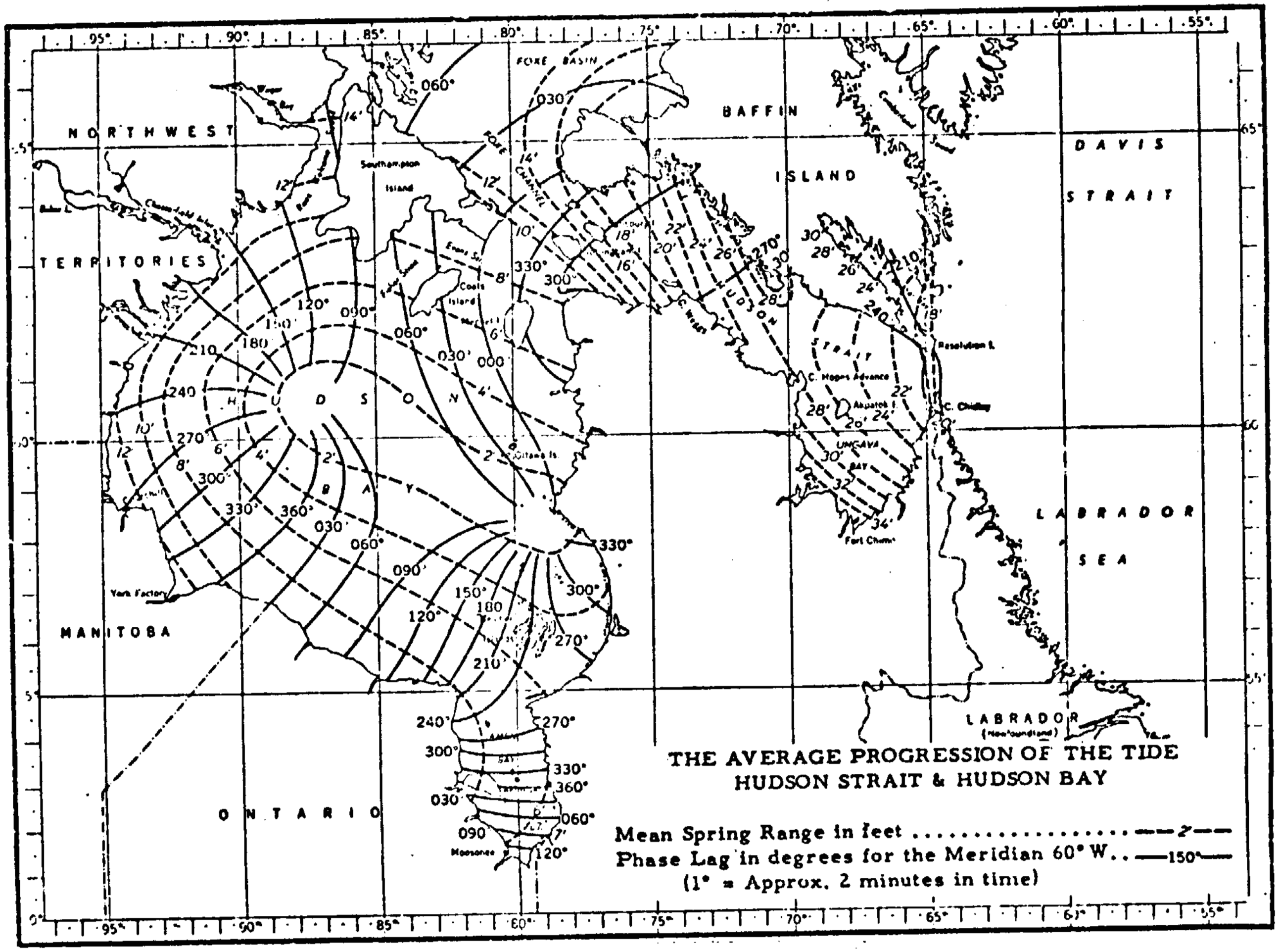
TIDAL RANGE IN THE EASTERN ARCTIC



Source: Dohler, G., Tides in Canadian Waters, (Ottawa: Canadian Hydrographic Service, Department of the Environment), p. 15.

MAP

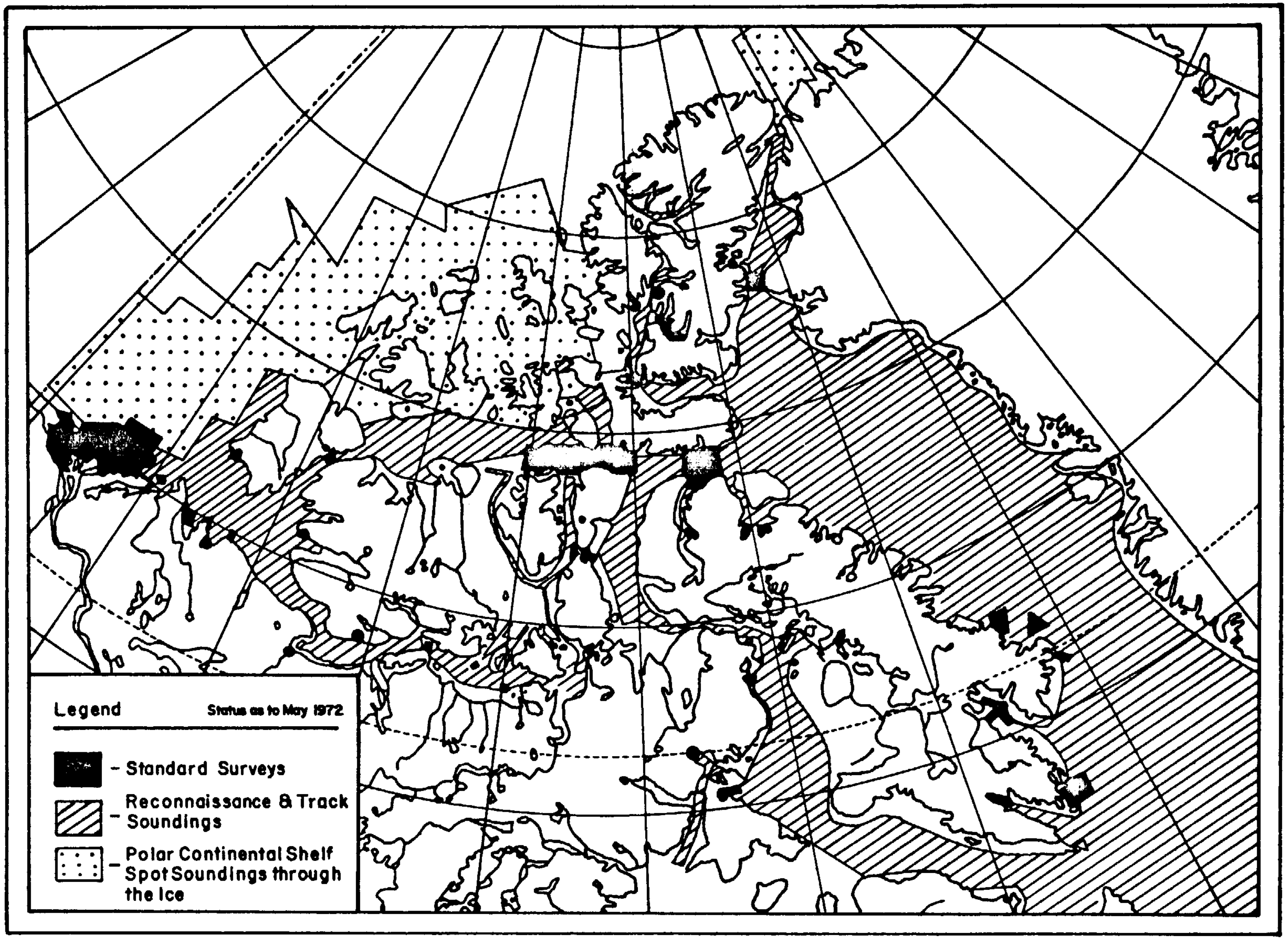
TIDAL RANGE
HUDSON STRAIT AND HUDSON BAY



Source: Dohler, G., Tides in Canadian Waters, (Ottawa: Canadian Hydrographic Service, Department of the Environment), p. 13.

MAP V-5

HYDROGRAPHIC SURVEY COVERAGE 1972



SOURCE: F. KENNETH HARE, "NATURAL ENVIRONMENT" IN SCIENCE AND THE NORTH. A SEMINAR ON GUIDELINES FOR SCIENTIFIC ACTIVITIES IN NORTHERN CANADA 1972 SPONSORED BY THE ADVISORY COMMITTEE ON NORTHERN DEVELOPMENT, THE SUB-COMMITTEE ON SCIENCE AND TECHNOLOGY. OTTAWA: INFORMATION CANADA, 1973 p. 82

Preliminary charts of the James Bay surveys are currently available and beginning in the summer season of 1973, supplementary hydrographic surveys were carried out as a start of accelerated data collection spanning the 1973-74 seasons at locations on Devon and Ellesmere Islands.

D. ICE

The severity of Arctic ice conditions is probably the single most active deterrent to northern resource development, as exemplified by the need for icebreaking bulk cargo vessels and the dangers of ice action on a contemplated inter-island gas pipeline gathering system between the Arctic Islands.

Information on ice conditions has been systematically collected for about 10-15 years in most areas.* Data is currently available in several forms. In its most summarized form, ice data is available on a yearly basis from the Atmospheric Environment publication, "Ice Summary and Analysis, Canadian Arctic". Information is summarized for both the eastern and western Arctic, and is presented in map form as illustrated on Maps V-6 and V-7, with the accompanying "Key to Ice Symbols", Figure V-1. Two or three maps such as these are produced during each month, during the period June to October inclusive.

Data on local and route ice conditions is available in the "Pilot of Arctic Canada", which is also the source of the Ice Glossary found in Appendix 6 of this report, containing definitions of descriptive terms used with respect to ice.

Ice reconnaissance is carried out both by air observers, and observers aboard vessels operating in Arctic waters. Ice data is gathered at Ice Central of the Department of the Environment in Ottawa, which is a combined data repository, ice forecasting center and ice advisory unit.

Thirty-six hour forecasts of ice conditions are broadcast daily for commercially active Arctic shipping routes. In conjunction with the daily forecasting, an ice chart is prepared and sent out three times per week. A longer range ice forecast is available in the form of 30-day ice predictions.

Ice Central also supplies an advisory service for expeditions, offshore developments, etc., in the form of a weekly map summarizing known ice conditions accompanied by meteorological

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* Atlantic Unit, Water Planning and Operations Branch, Coastal Zone Activities of the Department of the Environment, (Ottawa: Department of the Environment, 1972), p. 7.

MAP V-6

ICE CONDITIONS EASTERN ARCTIC
SEPTEMBER 10, 1969

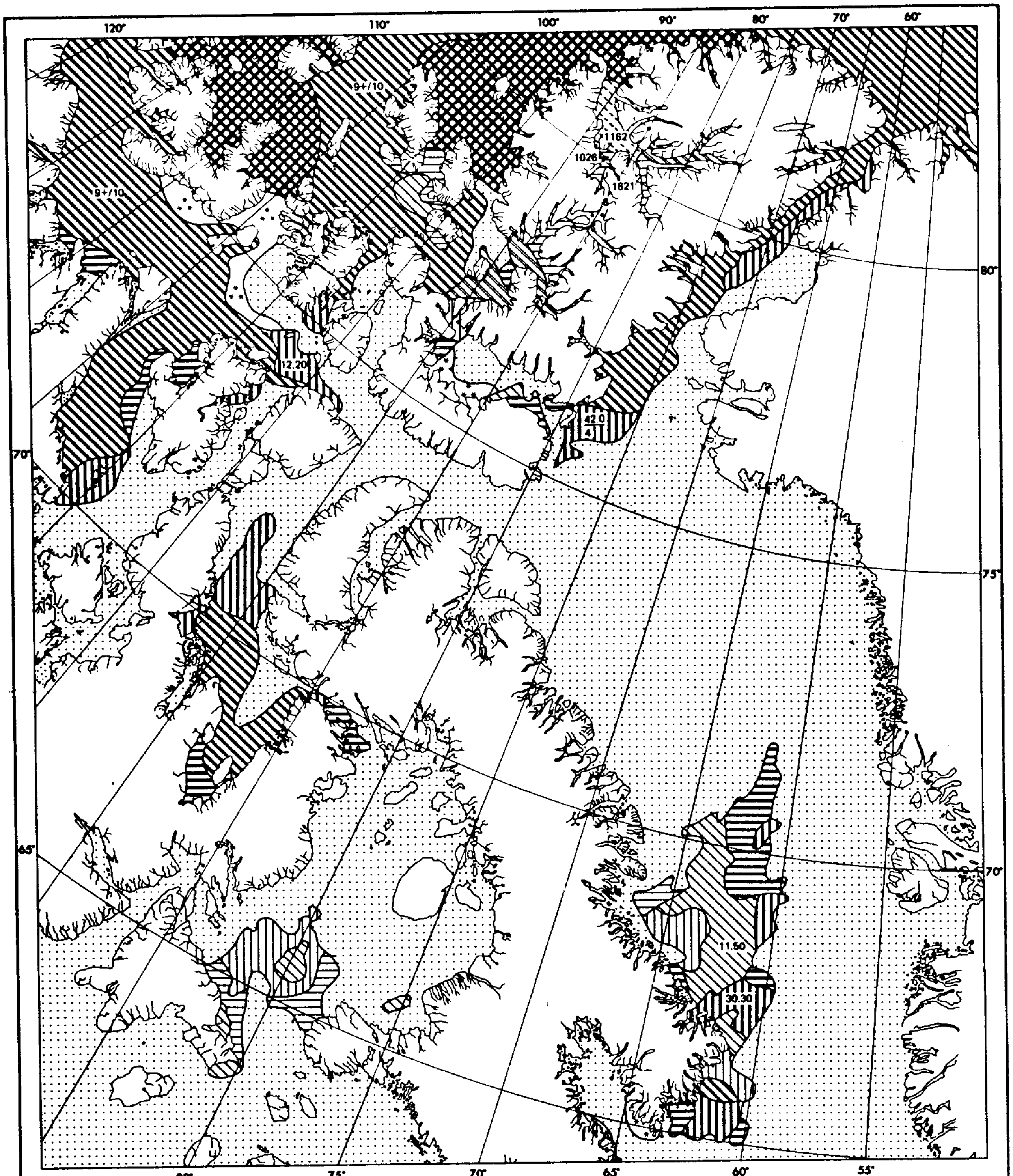


FIGURE 25. ICE CONDITIONS ON 10 SEPTEMBER 1969.

Although some new ice was forming, this was nearing the time of maximum open water. Prevailing winds had moved the disintegrating ice in Foxe Basin across Foxe Channel. The pack off the southeast Baffin Island coast continued to melt but remained much more extensive than usual for the time of year.

Source: Atmospheric Environment, Ice Summary and Analysis, Canadian Arctic 1969, (Ottawa: Information Canada, 1971), p. 29.

MAP

ICE CONDITIONS WESTERN ARCTIC
SEPTEMBER 10, 1969

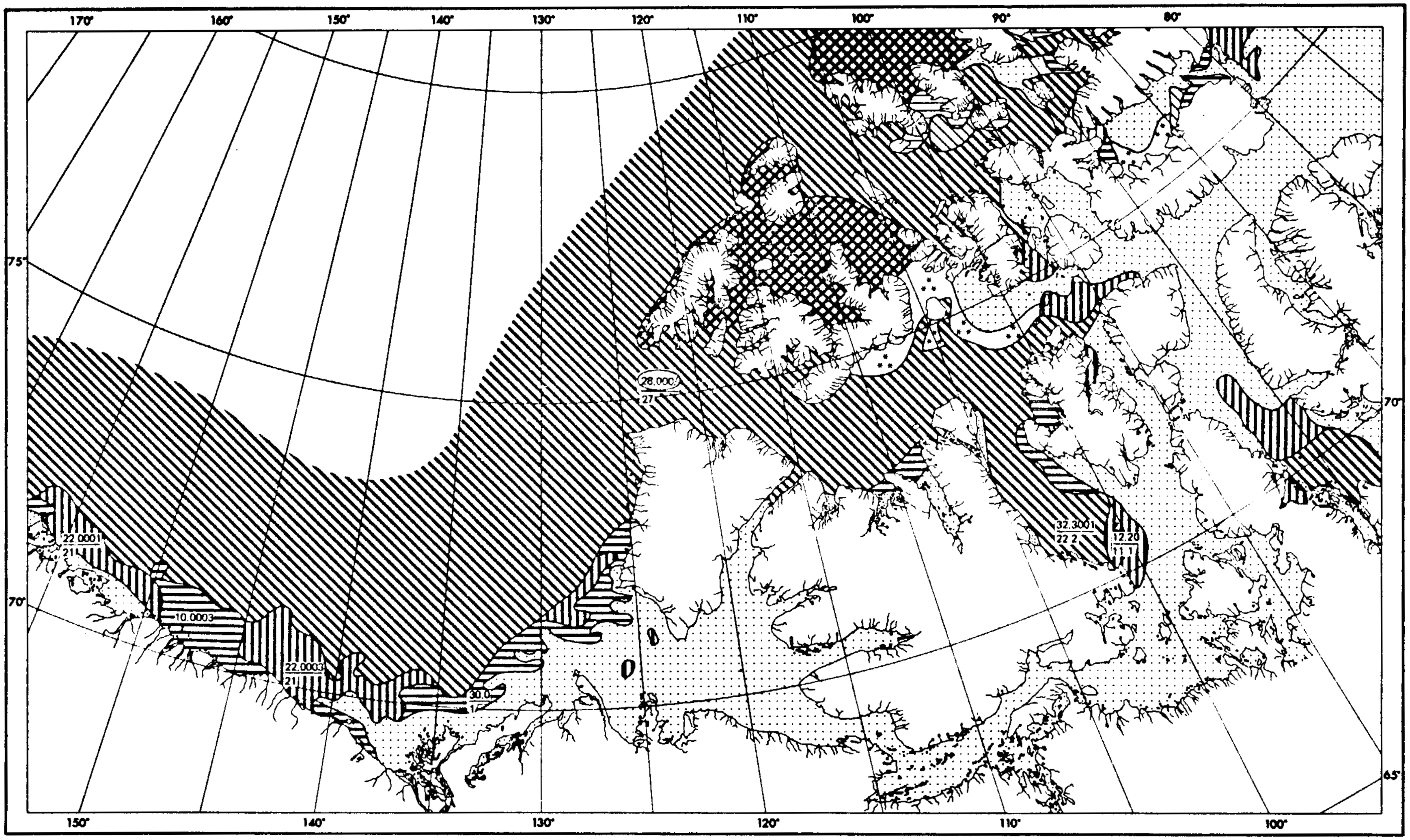


FIGURE 57. ICE CONDITIONS ON 10 SEPTEMBER 1969.

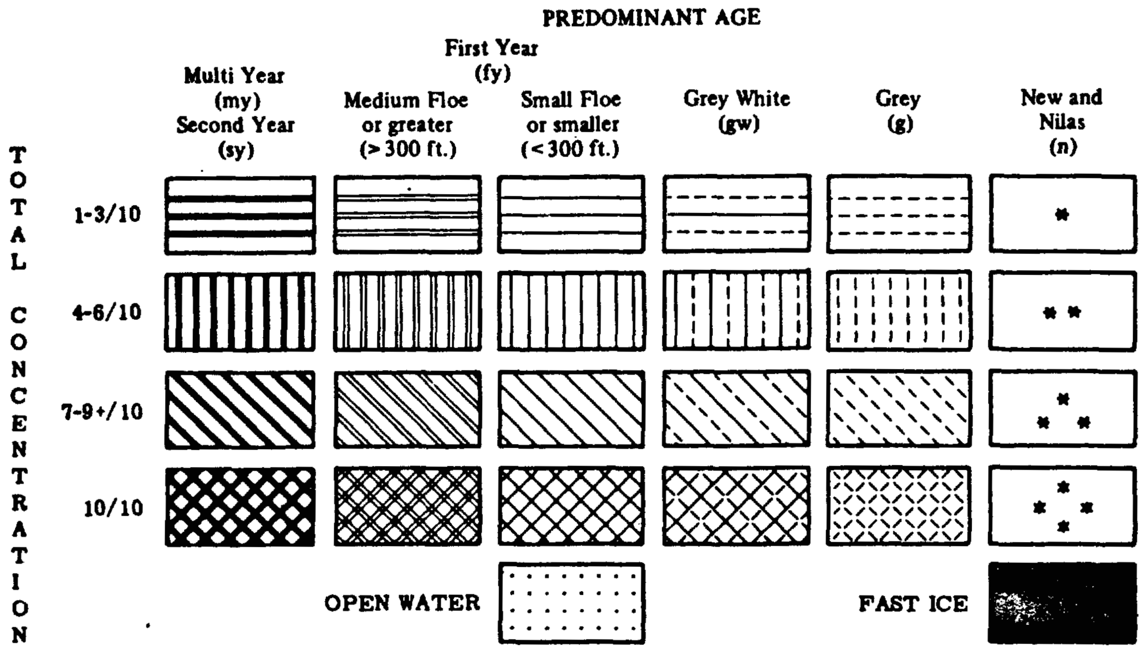
New ice was forming on the Alaskan coast but this was near the time of maximum open water. Victoria Strait and approaches were open water, as was most of Prince of Wales Strait. Through Byam Martin Channel into northern Viscount Melville Sound there were large areas of open water and New ice. From southern Ellef Ringnes Island eastward to Axel Heiberg Island lay very open pack ice and open water.

Source: Atmospheric Environment, <u>Ice Summary and Analysis, Canadian Arctic 1969</u>, (Ottawa: Information Canada, 1971), p. 67.

FIGURE V-1

CANADIAN METEOROLOGICAL SERVICE

KEY TO ICE SYMBOLS



CONCENTRATION AND SIZE BY AGE

$\dfrac{\text{Tenths of Each Age}}{\text{Tenths of Mdf. or Greater}}$ $\dfrac{(C)}{(N)}$ Mdf. is Medium Floe–>300 ft.

$\dfrac{C_{my}\ C_{sy}\ .\ C_{fy}\ C_{gw}\ C_g\ C_n}{N_{my}\ N_{sy}\ \ N_{fy}\ N_{gw}\ N_g\ N_n}$

(Where N is in Tenths)

Example $\dfrac{20.3410}{1\ \ 23}$

$\frac{2}{1}$ – 2/10's Multi-Year Ice of which 1/10 (Half) is Medium Floe or Greater Size

0 – No Second-Year Ice

. – Decimal Point

$\frac{3}{2}$ – 3/10's First-Year Ice of Which 2/10's is Medium Floe or Greater Size

$\frac{4}{3}$ – 4/10's Grey-White Ice of Which 3/10's is Medium Floe or Greater Size

1 – 1/10 Grey Ice, No Medium Floe or Greater Size

0 – No New Ice or Nilas

ICE OF LAND ORIGIN

Δ – (n) Icebergs

BOUNDARY

—— Observed visually

– – Assumed

TOPOGRAPHY

$\frac{\Lambda\Lambda}{(n)}$ Rafting/extent

$\frac{\Lambda\Lambda\Lambda}{(n)}$ Ridging/extent

$\frac{\cap\cap}{(n)}$ Hummocks/extent

$\frac{Pd}{(n)}$ Puddling/extent

Source: Atmospheric Environment, <u>Ice Summary and Analysis, Canadian Arctic 1969</u>, (Ottawa: Information Canada, 1971), p. 4.

data, as well as predicted conditions based on analysis of past climatic data.*

Ministry of Transport ice advisory and shipping support services range from radio broadcasts of up to date general information on ice conditions, to detailed advice on routing of ships proceeding independently, to the provision of icebreaker escort, if available and considered necessary. Arctic waters are under the surveillance of area Ice Operations Offices and Ice Information Offices, to which Masters should report before their ships enter waters where ice may be encountered.

Specifically by area, service is provided in Hudson Strait and Hudson Bay through an Ice Operations Office at Frobisher Bay and an Ice Information Office at Churchill, Manitoba. In areas north of Hudson Strait a service on ice information, routing advice and icebreaker support is provided through Frobisher Bay and Resolute Radio Station.**

Little information is available on year-round ice conditions, due to visibility problems. The ERTS satellite provides complete coverage every eighteen days, with its nearest point to earth at 650 miles; however, cloud cover at any time and poor winter light levels reduce the amount of information available from satellite photographs during the period September to March.***

Beginning in early 1974, the Canada Center for Remote Sensing (EMR), who are responsible for handling the data from the ERTS satellite, plan to start receiving signals from the U.S. NOAA-2 meteorological satellite. The NOAA satellite gives daily coverage and is equipped with infra-red instruments enabling it to produce pictures at night.****

Degrees of ice severity are reflected in the zonal boundaries of the Arctic Waters Pollution Prevention Act (AWPPA), Shipping Safety Control Zones. Boundaries were determined principally by ice conditions, and as the zonal number decreases from 16 to 1, from east to west, ice severity increases, and the allowable navigation season shortens.

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* Atlantic Unit, Water Planning and Operations Branch, op. cit, p. 6 and 7.

** Canadian Coast Guard, Ice Navigation in Canadian Waters, (Ottawa: Information Canada, 1972), p. 1, 7 and 8.

*** William H. German, op. cit., p. 696.

**** "Quick Look System Could Make Arctic Shipping Safer, Less Costly", Toronto Globe and Mail, February 13, 1974.

There are two ice types in Arctic waters: glacier ice and sea ice. Glacier ice is ice originating from a glacier, such as icebergs,and sea ice is any form of ice originating from the freezing of sea water. Sea ice is further classified as first-year ice or multi-year ice, according to thickness, a function of the freezing period. First-year ice refers to sea ice of not more than one winter's growth. Multi-year ice is ice which has survived at least two summers. Areas of multi-year ice occur principally in the western Arctic and those of first-year ice in the eastern Arctic. (See Map IV-5).

Sea ice probably accounts for about 99% of the ice met with at sea. Icebergs are important in that they are a danger to navigation, but they occur in a limited number of localities.* Size of glacier ice and thickness of sea ice are detailed in Appendix 6, "Ice Glossary".

Possibly the most important ice influence on navigation is the formation of ice pressure ridges, which are lines or walls of broken ice forced upwards by pressure. The submerged volume of broken ice under a ridge forced downward by pressure is termed an ice keel, and may extend as much as 50 metres below sea level. It appears that location of land-fast pressure ridges is fairly predictable, whereas open water ridges are not. The Northern Associates (Holdings) Limited report <u>Arctic Resources by Sea</u> contains maps of sitings of pressure ridges as well as density of iceberg sitings.

Long lasting anomalies exist in the general ice pattern over time, such as the "North Water", an area of water between Ellesmere Island and Greenland, which is open almost all year. When there is any ice cover, it appears to be only a foot or two in thickness. Map V-8 illustrates the position of the North Water in late winter and spring. The northerly boundary of the open water remains fairly constant, whereas the southerly boundary increases southward until it opens on Jones and Lancaster Sounds. The North Water coulf facilitate westward vessel passage through Jones and Lancaster Sounds.

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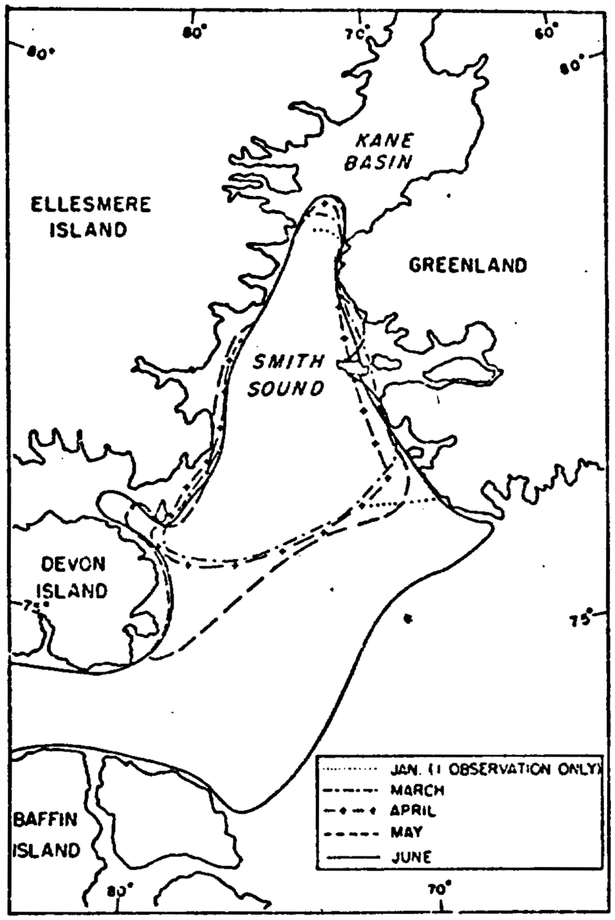
* Canadian Hydrographic Service, Department of the Environment, <u>Pilot of Arctic Canada</u>, Volume 1, Second Edition, (Ottawa: Information Canada, 1970), p. 89.

MAP V-8

EXTENT OF THE NORTH WATER
IN LATE WINTER AND SPRING



Source: Moira Dunbar, The Geographical Position of the North Water, Arctic, December 1969, p. 439.

SECTION VI THE INFLUENCE OF MARINE INSURANCE ON NORTHERN HARBOUR AND PORT DEVELOPMENT

SECTION VI INFLUENCE OF MARINE INSURANCE ON NORTHERN HARBOUR AND PORT DEVELOPMENT

The cost of marine insurance is a major factor determining the economic feasibility of vessel movements in the Arctic, and thus development of marine terminal facilities.

Provision of permanent docking facilities for supply cargo to the Arctic would probably lower the cost of supplies received in the Arctic. The lowered cost would primarily be a result of lowered cargo insurance, rather than a reduction in vessel insurance. The wharf facility would reduce cargo handling and the time supplies sit on the beach, (after being lightered ashore), before being picked up by land transport. Whether provision of a permanent wharf facility would lower vessel insurance on vessels calling at that destination appears less likely, since hazards encountered by a supply vessel are encountered en route as well as at the discharge point.

Insurance of the vessels and cargoes of the Arctic resupply is a known situation, in that resupply has been going on for two decades and risk statistics are available. Insurance of vessels which will be used in the future to transport bulk resources out of the Arctic is something entirely different and at the present time prediction of rates is almost impossible.

A. THE HISTORY OF MARINE INSURANCE IN THE CANADIAN NORTH

Shipowners navigating in Arctic waters have been subject to additional premiums during certain seasons of the year due to the risk of ice damage, as well as due to the increased danger of stranding as a result of inadequate bathymetric data. It has been the practice of shipowners to charge the additional premiums directly to the charterer or shipper.

Until recently, decisions on the magnitude of additional premiums have been made outside Canada, primarily by Lloyd's of London. The Joint Hull Committee of Lloyd's determined the seasonal limits of Arctic navigation by geographical area and the magnitude of premiums to be paid.

After 1960, the basic hull rate and additional premiums for Arctic navigation were set out on an advisory basis. The exact rate was determined for each individual case through negotiations between the insurance underwriter and the shipping company and shipper. Arbitrary seasonal limits to navigation were retained. Differences between underwriters and shipowners as to rates charged focused on questions of size of additional premiums, period during which the premiums are payable and the geographic areas subject to additional premiums. Concern had also been expressed that the magnitude of the additional premiums charged for Arctic navigation were not directly justified on the basis of risks actually encountered.

Premium reductions were given for ice-strengthened ships. In 1970, for Lloyd's Class 1, additional premiums were reduced by 50%, for Class 2 by 20% and for Class 3 by 12.5%. However, premium reduction was, and still is, somewhat offset by the greater capital cost of ice-strengthened vessels, which results in turn in the value upon which the insurance is calculated being high.

B. THE PRESENT SITUATION

Marine insurance rates for vessels navigating in the Arctic continue to be high, since the risks of vessel damage are greater than for vessels navigating in ice free waters. Rates are also high due to past risk statistics originating from use of non-strengthened, low-powered vessels and in some cases, older vessels, which have suffered damage in Arctic waters.

Canadian marine insurance companies have shown increasing interest in the Canadian marine insurance market which is estimated to be in the $90-$100 million range. About one-third of this market is now arranged in Canada with the remaining two-thirds still arranged through foreign markets. The two committees determining marine insurance rates charged in Canada are The Hull Committee, Chairman, R.S. Byrch, and The Cargo Committee, Chairman, Wes Telling of the Canadian Board of Marine Underwriters.

On January 1, 1973, the Arctic Waters Pollution Prevention Act became effective, specifying minimum standards of vessel ice-strengthening and power, and corresponding allowable navigation season. In early 1973, an advisory scale of additional premiums was introduced in Canada, based on the time a vessel spends in the different areas of ice severity as outlined in the Arctic Waters Pollution Prevention Act. The premium is based on so much a gross registered ton for each day spent in a given ice zone. The lowest charge is 16¢/ton for an Ice Class 1 (the highest commercial ice class vessel to enter the Arctic to present) vessel going to the Hudson Bay. The Canadian scheme eliminates the Lloyd's system of extra charges according to the number of destination ports within an area.*

The London insurance industry lowered its rates in response to the Canadian developments, but kept the concept of a fixed season. Since there is free competition between Canadian and London markets for both the basic hull rate and the additional premiums charged for Arctic navigation, it is probable that the range of

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* Peter B. Smith, President, Canadian Board of Marine Underwriters, as reported in The Globe and Mail, July 19, 1973, p. B8.

rates charged is not too great and would depend largely on past experience of the individual underwriter with a particular shipowner.

C. PRESENT PROBLEMS

The Regulations of the Arctic Waters Pollution Prevention Act, specifying vessel ice-strengthening and power requirements for differing Arctic ice severity zones, should reduce damage claims by eliminating vessels not reaching minimum standards. However, the Regulations require a more costly vessel and the cost of the insurance is increased as a result of the higher capital value of the ship.

Some mechanism for pooling risk statistics is needed. At present, each marine underwriter bases his additional premium on the advisory rate scale, modified by his own company's pool of risk statistics. A common pooling of risk experience is difficult due to competitive caution.

Also, a way should be found to induce skippers of cargo ships to follow the advice of the Master of the Icebreaker as to when and where to proceed. Under the Canada Shipping Act, the Ministry of Transport has no authority to demand advance notice of shipments into the Arctic.

D. FUTURE PROBLEMS

The cost of marine insurance will be one of the principal factors on which the fate of year-round vessel transport of bulk resources out of the Arctic will depend. Assessment of possible rates for trades that may not operate on any large scale for several years is almost impossible, since marine underwriters have little or nothing to guide them except their own judgement and the experience of non-specialized carriers in the seasonable trade which currently exists. In general, rates have increased by 50% over the past five years due to bad experience.*

The Northern Associates (Holdings) Limited report "Arctic Resources by Sea" attempts an assessment of insurance costs for bulk cargo shipments out of the Arctic, using the London Market Advisory Scale for bulk carriers, tankers and super carriers. The premium is calculated by using two factors: a charge for total loss purposes based on the vessel's value, and a charge on a deadweight ton basis for coverage of other than total loss.

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* Northern Associates (Holdings) Limited, Arctic Resources by Sea, 1973.

The example insurance calculation in the report for a vessel of 150,000 dwt and a capital value of $60 million yields a total annual premium of $1,250,000, a rate of $2.08 per $100. These rates do not include vessels built for the carriage of liquified natural gas (LNG). Large LNG carriers are presently being rated 30% to 40% higher than super tankers, principally due to the effect of the higher value per deadweight on repair costs.

Several factors are mentioned by marine underwriters as principal reasons for the extra premiums charged for operation of large specialized vessels. These problems are further compounded by operation of these large, specialized vessels in Arctic waters. Cited are: the scarcity of salvage and repair facilities for vessels of this size; the shortage of fully trained personnel to handle ships of this size; the degree of "exposure", ie., the magnitude of insurable value concentrated in one vessel; and the lack of reliable bathymetric data. Operation in Arctic waters adds risks of hull ice damage, and operation of vessels in areas which are largely uncharted with insufficient navigational aids increases the risks of stranding or striking submerged obstacles. There is, as well, the fear that a relatively minor accident to vessel propulsion equipment or besetment by ice will result in total loss of the vessel as rescue may be impossible.

The Northern Associates report suggests that marine underwriters will require evidence of constant availability of icebreaking vessels of sufficient power, not only to assist occasionally in normal navigation through ice, but at times of distress to act in a salvage capacity. Associated with the need for icebreakers is a need for ancillary salvage equipment available for use in Arctic waters. Although the Arctic Shipping Pollution Prevention Regulations specify minimum standards of vessel power and hull strength, it is inevitable that certain damage will occur from time to time and it is suggested that this damage be considered an operating cost not chargeable to insurance and essentially eliminated from insurance coverage by substantial deductibles.

The report suggests that the most practical approach to improve navigation conditions in the field of hydrographic surveying will be to concentrate effort on areas of foreseeable trade. The primary role of the Government will be to ensure that requirements for supporting services are met. Even when services are provided and hydrographic charts are improved, it should be anticipated that underwriters will require additional premiums for Arctic navigation, as this is their customary approach when unproven areas are involved. Rates may be lowered later,dependent on damage statistics.

The report concludes by saying there is a good chance that by the time large scale resource movements commence, sufficient evidence will be available to lead to reasonable Arctic premiums. If not, some form of government insurance support would be necessary.

SECTION VII NORTHERN TRANSPORT POLICY DEVELOPMENT

SECTION VII NORTHERN TRANSPORT POLICY DEVELOPMENT*

A. HISTORY OF TRANSPORT PLANNING IN THE NORTH

1. Departmental Planning

Before World War II, transport facility investment was left largely to private enterprises. Since World War II, Government expenditures in the North have been increasing. By the 1960's, the objective of northern economic growth was given highest Federal Government priority, and subsidizing resource exploitation was seen as the chief means to accomplish this goal. During the period 1965-1970, Government expenditures in the North were about five times greater than revenues.

However, one of the most apparent problems in northern transportation development has been the fragmentation of decision-making within Federal agencies in the Arctic, who were basing their operations on differing factors, such as legislative instruments, investment criteria, non-identification of direct and indirect costs and differing administrative regions. The fragmentation of Government decision-making, and the encouragement of industry resource exploration and development with the use of incentive and subsidy programs, has led to development of a strong role for the private developer who can capitalize on ad hoc Government policy decisions.

2. Interdepartmental Planning

The Advisory Committee on Northern Development** was established after World War II to co-ordinate matters relating to northern development, at the Deputy Minister level,for advice to Cabinet. The Committee was chaired by the Deputy Minister of Indian and Northern Affairs. The ACND became increasingly inactive as the military significance of the North declined after World War II, and only a few meetings were held during 1960. The transportation committee was almost totally inactive. The main item of interest to the ACND during this period was territorial constitutional development,rather than matters of resource or infrastructure development.

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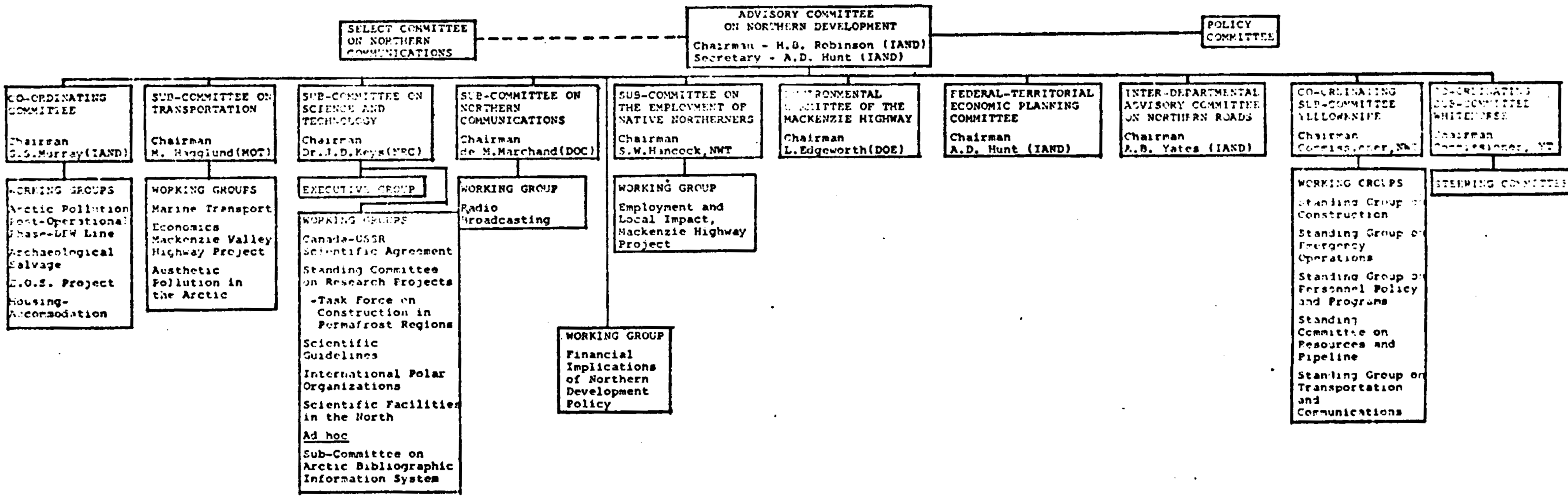
* Parts A, B and D of this Section are taken principally from a conference paper by E.J. Dosman, prepared for the Conference on Canadian National Transport Policy, May 23-25, 1972, at York University, and is used with the permission of the author.

** The current structure of the ACND is shown in Chart VII-1, "Organization Chart, ACND". Appendix 7 contains a "Directory of Representation" of the ACND.

CHART VII-1

ORGANIZATION CHART
ADVISORY COMMITTEE ON NORTHERN DEVELOPMENT
(ACND)



It has been suggested that the ACND, prior to 1970, had not been an effective advisory body due to two principal factors. Firstly, the feeling of Treasury Board officials that administrative machinery for effective co-ordination of northern policy already existed; and secondly, Government departments guarding their separate jurisdictions. Recommendations to the Treasury Board remained the responsibility of the individual department concerned. During the 1950's and 1960's, there was an absence of any crisis which would have forced the issue of cc-ordination of northern transport policy.

The Task Force on Northern Oil Development* was formed during the 1960's to facilitate interdepartmental co-operation on hydrocarbon development north of 60°, and is chaired by Energy, Mines and Resources.

3. Formation and Evolution of the Arctic Transportation Agency of the Ministry of Transport

The change in the structure of the Department of Transport to the Ministry concept was given official Cabinet assent in December 1969, and involved an attempt to rationalize planning and organization in the Federal transport sector. The Canadian Transport Commission, (CTC), was retained as a regulatory body.

In December 1970, just prior to the setting up of the MOT Arctic Transportation Agency in early 1971, an Arctic Transportation Conference was held in Yellowknife. Jointly sponsored by MOT and DIAND, it served a twofold purpose of dramatizing northern problems, and providing a compendium of information on northern transportation. The Conference brought together transport specialists from government, business, the universities and the northern community, and emphasized the Federal role in the Territories. It aroused public interest in northern sovereignty, resource policy, pollution and community development.

Two factors defined the limits of the new Arctic Transportation Agency. First of all, DINA emphasized it was responsible for setting out broad policy alternatives for northern activity and development to the Cabinet.** Secondly, the ACND Sub-Committee on Transportation was not replaced by ARTA, which led to some duplication of activity.

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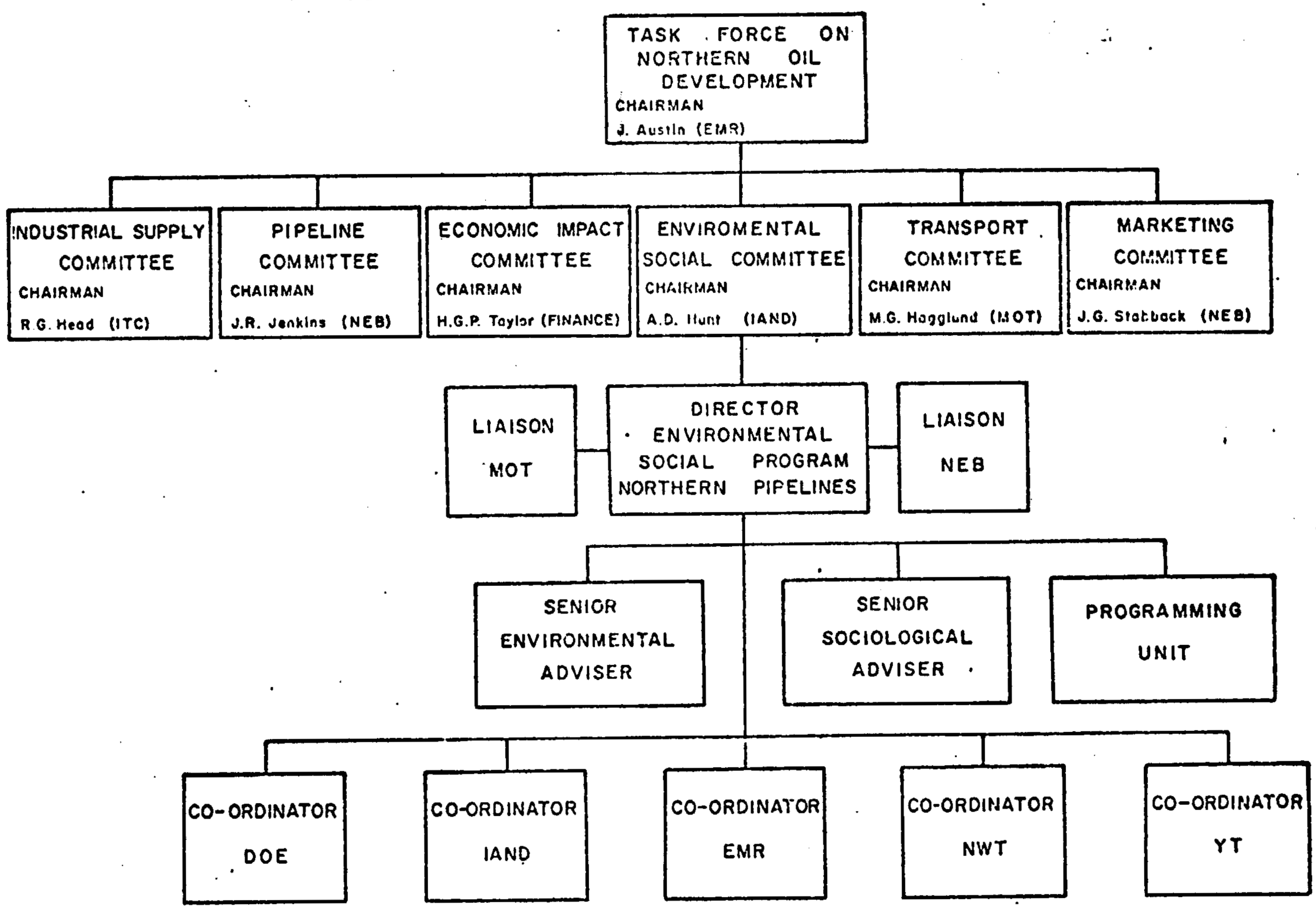
* The current structure of the TFNOD is shown in Chart VII-2, "Organization Chart, TFNOD".

** By the Government Organization Act of 1966, DINA was given general responsibility for the co-ordination of northern programs.

CHART VII-2

ORGANIZATION CHART, TASK FORCE ON NORTHERN OIL DEVELOPMENT (TFNOD)



Within MOT, ARTA is organized along different lines, in the sense that it is organized along regional as opposed to functional lines. The Agency is located in Ottawa with a planning officer in Yellowknife. ARTA performs an advisory role, identifying transport items and co-ordinating Arctic programs. The Agency can present northern budgets in a comparative manner with southern activities, and thus provide a framework for elaboration of a user beneficiary charge policy in the Arctic.

B. NORTHERN TRANSPORT POLICY -- THE PROBLEM

Less than 1% of the total population of Canada reside north of 60°, in an area comprising 40% of the entire area of Canada. The cost of maintaining services in the Arctic and keeping open communications with the south has been high. What are the justifications for special assistance to this underdeveloped area of Canada? Four general reasons have been advanced:

1. Federal Government strengthening its claim to sovereignty by establishing a permanent presence in the North;

2. DINA has an obligation to assist the scattered indigenous population in the Territories;

3. the belief that the area contained rich mineral deposits which led to Government incentives to companies for exploration and exploitation;

4. recently, protection of the environment.

Transportation is a key element in northern development, in that any solution or means to northern development must include transport policy, especially with respect to resource policy. The question is, what is the impact of Federal transportation policy on the North and northern planning?

The study of Federal policy development can be approached from several angles:

- activities of individual agencies dispensing transport services;

- analysis of the impact of a particular transportation mode, air, northern roads, shipping;

- rationale of Federal decisions with respect to transport investment and economic intervention.

The core issue about which decisions by the various Federal Government transport roles of operation, regulation and development cluster in the North, is the relationship between activities of the private (profit-oriented) transport and resource enterprise, and Federal Government objectives. Since transport is an intermediate good, the provision of transport infrastructure reflects the priorities and objectives of Government planners, and as such, transportation investment can never be "technical" or neutral. Control of infrastructure is part of the priority setting process.

Past tendency has been to evaluate proposals by the same criteria as those applicable to southern locations, and given scarce investment resources, the effect had been to attract available funds to southern locations. It can be argued that there is no logical conflict between the user charge principle and the development objective -- development costs can be borne by other agencies involved. However, the true costs of providing and operating northern transport facilities is often obscure, and thus charges to other Government programs are not easily discernible. A different investment criteria might ease the dilemna of trying to recover funds from other Government programs, for in effect subsidizing their operations.

C. EXISTING POLICY AND LEGISLATION

1. Current Ministry of Transport Northern Ports Policy and Approval Procedures*

Marine terminal facilities and port infrastructure can be dealt with under a number of headings, viz: as a designated national port subject to the requirements of the National Harbours Board Act; as a Commission Harbour subject to the several Harbour Commission Acts relating to the designated commission harbours; as a Public Harbour subject to the terms of the Canada Shipping Act, Part XII, and the Government Harbours and Piers Act; or, finally, as a private terminal facility. Given present circumstances, it can be assumed that Arctic marine terminal facilities and ports would be dealt with under either the Public Harbours heading or as a private venture.

The existing Ministry of Transport policy for the provision and administration of marine terminal facilities and port infrastructure in Arctic waters is identical with that applicable to

* Harbours and Ports Division, Ministry of Transport.

such facilities and infrastructure throughout the rest of Canada.

A port is conceived as consisting of terminal facilities, that is, wharves of various types, with sheds and berths for ships and their cargoes. Way facilities, that is, the aids to navigation, channels and general navigation services, such as marine traffic regulation and icebreaking, can extend into a port depending upon its nature but are generally found in the outer waters and approaches to the ports.

Generally, the proposal for new facilities is initiated by a local interest; this interest may be either a Federal Government entity, a Provincial or Municipal Government entity or a private entrepreneur. It may be that a combination of interests, including any two or all of the above may join together in the proposal.

In keeping with present procedures, the proposal is submitted to the Ministry of Transport where it is referred to the Canadian Ports and Harbours Planning Committee, (CPHPC), the Committee established pursuant to Cabinet Directive dated May 6, 1971. A private developer is required at the same time to file his proposal with the Ministry of Transport, Marine Services, and seek approval, as required by the terms of the Navigable Waters Protection Act, to build structures within navigable waters.

Concurrently there will be an engineering assessment of the proposed terminal facilities, as required by the Navigable Waters Protection Act and, as well, a determination of the Marine Services costs for such things as aids to navigation, traffic regulating and icebreaking services.

Appropriate contact is then made with the prospective shippers by the CPHPC to confirm: the purpose for the proposed facility; the volume of traffic expected; the arrangements for upland and waterlot requirements; the revenues to be derived from fees and charges on the users; the investment plans of the prospective developer; and the cost recovery prospects to cover MOT financial participation. Federal financial participation may range from nothing through partial aid to full Federal responsibility governed by the extent of Government responsibility and the range of public interest -- single or multi-user and shippers. Each case is considered on its own merits by the CPHPC and the executive offices responsible (National Harbours Board or Harbours and Ports Branch, CMTA).

For a particular class of facilities, such as deep water oil terminals, and particularly in new harbours, it may be necessary to conduct extensive studies in order to determine precisely what may be needed in the way of special navigation aids, rules, channel improvements and pilotage services.

As noted above, the cost of these services will be determined and will be considered to be a part of the total investment in the proposed project.

It is the normal practice of the Ministry of Transport, if facilities are provided for any company or group of companies, to do so only on the basis of long term guarantees to recover the capital and annual maintenance costs. Even if the wharf were to be used by one company only, the facility would remain the property of the Government of Canada, and operated as a public wharf available insofar as possible to all interested transportation users.

The general policy with respect to navigation aids is that the Ministry accepts responsibility of provision of navigation aids to public harbour facilities, but does not provide aids to private terminal developments.

2. Current Department of Indian and Northern Affairs Policy on Northern Development*

In a policy statement given recently, the Honourable Jean Chrétien, Minister of Indian and Northern Affairs, presented the Federal Government's northern policies and priorities for the 1970's. The essence of the Government's approach is to encourage and develop policies and programs that meet the needs of the native peoples, ensure viable economic development, maintain the ecological balance of the North and further the evolution of government in the NWT.

In this policy statement, the Government's order of priorities for the North for the next decade was laid down as follows:

> "1. To give rapid effect to guidelines for social improvement of native peoples in the North.
>
> 2. To maintain and enhance the natural environment through such means as intensifying ecological research, establishing national parks, and ensuring wildlife conservation.
>
> 3. To encourage and stimulate the development of renewable resources, light industries and tourism, particularly those which create job and economic opportunities for native northerners.

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* Environment Canada, The Mackenzie Basin, Proceedings of the Intergovernmental Seminar held at Inuvik, NWT, June 24-27, 1972, p. 107-108.

4. To encourage and assist strategic projects (key to increased economic activity in a region or territory with solid economic and social benefits) in the development of non-renewable resources and in which joint participation by government and private interests is generally desirable.

5. To provide necessary support for other non-renewable resource projects of recognized benefit to northern residents and Canadians generally."

3. Legislation

The main bodies of legislation administered by the Ministry of Transport governing marine transport in Arctic waters are: the Canada Shipping Act, with respect to movement of ships; the Navigable Waters Protection Act, with respect to the location of terminal structures; and the Arctic Waters Pollution Prevention Act.

Other legislation relevant to transport policy north of 60° are the Territorial Lands Act and the Northern Inland Waters Act, both administered by DINA.

Of the five Acts mentioned above, the latter three Acts were enacted or amended between 1968 and 1972, when resource developments were accelerating. These three Acts give the Federal Government broad control over activities that could lead to major changes in the environment.

The Territorial Lands Act allows the Government to set aside land management zones anywhere in the two Territories. Zones presently exist in the northern Yukon, the Mackenzie Valley and the western Arctic. A land use permit is required for "land use operations" in these zones. Operations are defined as any activity requiring a vehicle weighing more than 20,000 pounds, any earth-moving or land clearing, any clearing of a trail more than 5 feet wide or a campsite to be used for more than 300 man-days. Stipulations on land use operations can be added to the permit if issued and penalties for contravening them are $5,000 per day.

The Northern Inland Waters Act requires licences for any use of inland waters including industrial, commercial or municipal use, with the intent to control any activities that would remove water or dump wastes in it and any construction that would alter water conditions. Penalties are $5,000 per day.

The purpose of the Arctic Waters Pollution Prevention Act is to prevent spills or waste disposal that would pollute Arctic waters. The Act regulates standards of ship construction for ships travelling in Arctic waters (as defined in the Act), navigation zones and restricts the kinds of waste that can be dumped at sea. Financial liability for clean-up and damages is specified for accidental pollution and in addition, penalties for an offence are $5,000 per day for a person and $100,000 per day for a ship.

D. NORTHERN POLICY -- THE FUTURE

The existence of ARTA within the MOT is an advance in the direction of more effective northern policy. ARTA's presence focuses attention on the North and permits continuous attention to be given to developing northern policy.

Several areas critical to northern transportation can be identified, towards which the Arctic Transportation Agency can play a major role in the development of policy positions. These areas include Arctic resupply; the role of the Northern Transportation Company Limited; the future of the Mackenzie system; and most important, the delineation of a specific developmental approach for MOT in the North.

Future problems involve co-ordination of the regulatory role of the CTC and Ministry policy. At some point, Cabinet must decide on the kind of planning required in the North. If a highly centralized planning regime is developed, the CTC must be made less independent of the planning process. The ACND and the TFNOD can be vehicles for continuous interdepartmental discussion, and for the development of improved arrangements for joint planning.

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APPENDICES

APPENDIX 1

MINISTRY OF TRANSPORT PUBLIC WHARVES IN THE MACKENZIE RIVER BASIN

Source: Department of Public Works, Transfer Plans

MINISTRY OF TRANSPORT

PUBLIC WHARVES

IN THE

MACKENZIE RIVER BASIN

LOCATION

Great Bear Lake

1. Fort Franklin
2. La Bine Point

Great Slave Lake

3. Hay River
4. Fort Resolution
5. Yellowknife

MacKenzie River

6. Fort Providence
7. Fort Simpson
8. Wrigley Airport
9. Fort Norman
10. Fort Good Hope
11. Arctic Red River
12. Reindeer Station
13. Tuktoyaktuk
14. Aklavik
15. Inuvik
16. Fort McPherson

Slave River

17. Fort Smith (Bell Rock)

Great Bear River

18. Great Bear River

1. Fort Franklin, NWT (DPW Plans 1968)

Location: The structure (a T-shape pier) is located on the northwest shore of Keith Arm, Great Bear Lake and fronting Lot 1, Block 2 at Fort Franklin.

Construction: The pier is a rock-filled crib 23' wide by 40' long with a crib and span approach 12' wide by 72' long. The limiting load is 400 lbs/sq ft. There are no buildings or equipment stored on this structure. Depth alongside the 40' face is 5'.

2. La Bine Point, NWT (DPW Plans 1937)

Location: The structure (a marginal wharf) is located on the eastern shore of McTavish Arm, Great Bear Lake, on the south shore of La Bine Point.

Construction: The wharf is 113' long by 8' wide and consists of rock-filled log cribwork. The limiting load is 4,000 lbs/sq ft. There is no building or equipment on the wharf. Depth alongside is 6'.

3. Hay River, NWT (DPW Plans 1964)

Location: The structure (a marginal wharf extension) is located on the southwestern portion of Great Slave Lake on the Hay River at the settlement of Hay River, fronting Lot 4, Block F.

Construction: The wharf consists of a steel sheet pile retaining wall tied back to a concrete anchor wall. The wharf extends 216' upstream (west) from the present structure with a loading area extending 45' behind wall and an additional 130' behind the loading area for storage. The entire area has 1' of gravel surfacing. The limiting load on the wharf is 500 lbs/sq ft to within 3' of all faces. There is a Department of Transport warehouse on the storage area behind the wharf. Depth alongside is 9'.

4. Fort Resolution, NWT (DPW Plans 1962)

Location: The structure (an L-shaped pier of varying widths) is located on the southeast shore of Great Slave Lake opposite the Hudson Bay Company at Fort Resolution.

Construction: The pier is 796' long and of varying widths (36', 24' and 20'), running straight out from shore for 494' then at an angle easterly for 300'. It is constructed of rock-filled cribwork. The limiting load is 400 lbs/sq ft. There are no sheds or other structures on this wharf. Depth alongside is 6'.

5. Yellowknife, NWT (DPW Plans 1958)

Location: The structure (a marginal wharf) is located at the old settlement of Yellowknife on Yellowknife Bay opposite Block 4, Lots 9 to 18, on Great Slave Lake. (Lat. 62°27'47", Long. 114° 20'40").

Construction: The wharf is constructed in two sections. The first part was completed in 1948 and consists of rock-filled timber cribwork 343'7" long by 20' wide. The second section consists of untreated timber pile bent 151' long by 20' wide, which was completed in 1958. The two structures provide 11,090 sq ft of wharf area and serve to retain a fill of mine waste topped with gravel. The limiting loads are unlimited to within 10' of all faces and 400 lbs/sq ft on remaining portions. Depth alongside is approximately 5'.

6. Fort Providence, NWT (DPW Plans 1961)

Location: The structure (a marginal wharf) is located on the north bank of the MacKenzie River, fronting Lot 24 at Fort Providence.

Construction: The wharf consists of a rock-filled timber cribwork, 70' long by 24' wide. The approach consists of a loading and storage area extending 50' back from the rear of the wharf and 150' long, parallel to the wharf face. The limiting load on the wharf is 300 lbs/sq ft. There are no buildings or equipment on the wharf. Depth alongside is approximately 5'.

7. Fort Simpson, NWT (DPW Plans 1961)

Location: The structure (a floating wharf) is located on the west bank of the MacKenzie River fronting on Lot 23 at Fort Simpson.

. . . . 3

Construction: The wharf consists of eight 17' by 8' units arranged such that the wharf measures 70' long by 16' side. There is a 31' long by 16' wide ramp from the approach to the floating wharf which consists of two floating units. The approach is gravel surfaced and protected by rip-rap. The limiting load on the wharf is 10 tons per float. Depth alongside is about 6'.

8. Wrigley Airport, NWT (DPW Plans 1962)

Location: The structure (a floating gangplank) is located on the east bank of the MacKenzie River, one quarter of a mile northerly from Wrigley Airport.

Construction: The gangplank consists of one steel float 17'6" long by 8' wide by 4' deep. The float is connected to shore by a ramp section float 13' long by 8' wide by 4' deep. The limiting load on the gangplank is 10 tons. Depth alongside at the face is 5'.

9. Fort Norman, NWT (DPW Plans 1962)

Location: The structure (a floating wharf) is located on the east bank of the MacKenzie River, fronting Lot 16 at Fort Norman.

Construction: The wharf consists of eight steel float units (17'6" x 8' x 4') arranged such that the structure measures 70' long by 16' wide. The wharf is connected to shore by a ramp section made up of two steel floats 13' x 8' x 4'. The limiting load is 10 tons per float. Depth alongside is 5' at the wharf face.

10. Fort Good Hope, NWT (DPW Plans 1962)

Location: The structure (a floating wharf) is located on the east bank of the MacKenzie River fronting on Lot 3 at Fort Good Hope.

Construction: The wharf consists of ten steel float units (17'6" x 8' x 4') arranged such that the wharf measures 72' long by 16' wide. The wharf is connected to shore by a ramp section consisting of two steel floats 13' x 8' x 4'. The limiting load on the wharf is 10 tons per float. Depth alongside the 72' face is 4'.

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11. Arctic Red River, NWT (DPW Plans 1962)

Location: The structure (a floating gangplank) is located on the west bank of the MacKenzie River, fronting Lot 1 in the Arctic Red River.

Construction: The gangplank consists of one steel float 17'6" x 8' x 4' connected to shore by a ramp section of one float 13' x 8' x 4'. The limiting load on the gangplank is 10 tons. Depth alongside the face is 5'.

12. Reindeer Station, NWT (DPW Plans 1962)

Location: The structure (a floating gangplank) is located at the mouth of the MacKenzie River on the east bank at Reindeer Station.

Construction: The gangplank consists of one standard float unit 17'6" x 8' x 4', and is connected to shore by a ramp section consisting of one float 13' x 8' x 4'. The limiting load is 10 tons. Depth alongside is ?

13. Tuktoyaktuk, NWT (DPW Plans)

Location: The structure (a T-shaped pier) is located on the Beaufort Sea, east of the mouth of the MacKenzie River, fronting on Lot 3 at Tuktoyaktuk.

Construction: The pier consists of a steel sheet pile head, 40'9" long by 16'11" wide with a reinforced concrete deck and a timber pile bent approach with a plank deck 12' wide by 40'3" long. The limiting load is 500 lbs/sq ft. There are no buildings or equipment on this wharf. Depth alongside the face is about 7'.

14. Aklavik, NWT (DPW Plans 1965)

Location: The structure (an L-shaped floating wharf) is located on the west of the MacKenzie River opposite Lot 25 at Aklavik.

Construction: The wharf consists of ten standard steel float units 17'6" x 8' x 4' arranged such that the wharf measures 71' long by 16' wide on the portion parallel to shore and 33' by 17'6" wide on the portion connected to shore. The ramp section of the connecting portion consists of two steel floats 12' x 8' x 4'. The limiting load on this wharf is 10 tons per float. Depth alongside the face is about 15'.

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15. Inuvik, NWT (DPW Plans 1966)

Location: The structure (a marginal wharf) is located on the north bank of the east channel of the Mac-Kenzie River Delta opposite Lots 1 and 2 at Inuvik.

Construction: The wharf consists of 287' total length of steel sheet piling; one section 190' long with the other section forming a 45° angle to it and measuring 96' long. The area behind the piles is gravel-filled. The limiting load is 500 lbs/ sq ft. There are no buildings or equipment stored on this wharf. Depth alongside the face is less than 3 metres.

16. Fort McPherson, NWT (DPW Plans 1958)

Location: The structure (a marginal wharf) is located on the east bank of the Peel River on the northern edge of the settlement of Fort McPherson.

Construction: The wharf is constructed of continuous close faced timber piling and measures 60' by 16'. The limiting loads are 200 lbs/sq ft. There are no buildings or equipment on the wharf. The wharf almost dries at low water levels.

17. Fort Smith, NWT (DPW Plans 1960)

Location: The structure (a marginal wharf) is located on the south bank of the Slave River, 1,000' west of the westerly boundary of Lot 5, Group 765, at Bell Rock, 8 1/2 miles west of the Fort Smith settlement.

Construction: The wharf measures 457.9' long by 24' wide and is constructed of rock-filled log cribwork. The structure has a fixed slipway, a craneway and three openings for moveable slipways. The limiting load on the wharf is 600 lbs/sq ft to within 3' of all faces. There are no buildings or equipment on this wharf. Depth alongside is about 3'.

18. Great Bear River, NWT (DPW Plans 1936)

Location: The structure (a marginal wharf) is located on the south bank of the Great Bear River about two miles east of St. Charles Rapids.

6.

Construction: The wharf consists of a rock-filled crib 12' wide by 255' long. The limiting load is not to exceed 500 lbs/sq ft over outer 6' along the face of the wharf. There is no shed or other structure on the wharf. Depth alongside is ?

APPENDIX 2

OTHER MARINE TERMINAL FACILITIES IN THE MACKENZIE BASIN

Source: Swan Wooster Engineering Limited, Mackenzie Valley Water Transportation Study, 1972, p. 50, 53, 55, 58.

Marine Terminal Facilities in Great Slave Lake Area

	Wharf Type	Wharf Length (ft)	Minimum Water Depth (ft)	Storage Facilities
HAY RIVER:				
DPW Public Wharf	steel sheet pile	586	9	2.7 acres
Northern Transportation: Terminal No. 1	steel sheet pile, moveable ramp	270	6+	2 acres; 22,000 ft.^{2} warehouse.
Terminal No. 2	timber bulkhead	2 @ 50	8+	12 acres; 38,000 ft.^{2} warehouse
Island C & D Terminal	steel sheet pile	2490	8	max. of 50 acres
Kaps Transport	timber bulkhead	250	6+	8 acres; 4000 ft.^{2} warehouse
Imperial Oil-Bulk Pier	timber bulkhead	420	8+	3,500,000 gal.
Gulf Oil-Bulk Pier	timber bulkhead	250	10	300,000 gal.
Shell Oil-Bulk Pier	timber bulkhead	80	8	275,000 gal.
Pacific 66 Oil-Bulk Pier	timber bulkhead	200	5±	250,000 gal.
YELLOWKNIFE:				
Giant Mines	barge tie-up	-	-	900,000 gal.
Cons. Mining	barge tie-up	-	-	400,000 gal.
Imperial Oil	barge tie-up	-	-	7,500,000 gal.

Marine Terminal Facilities
In Upper Mackenzie Area

	Wharf Type	Wharf Length (ft)	Minimum Water Depth (ft)	Storage Facilities
FORT PROVIDENCE:				
D P W Public Wharf	timber crib	73	5	
Kaps Transport	Timber bulkhead	120	limited after Aug. 15	75 acres potential
FORT SIMPSON:				
D P W Public Wharf	floating	70	6 - 8 maintained	
Imperial Oil Bulk	barge tie-up			1,000,000 gal.
NCPC Bulk	barge tie-up			250,000 gal.

Marine Terminal Facilities
In Central Mackenzie Area

	Wharf Type	Wharf Length (ft)	Minimum Water Depth (ft)	Storage Facilities
FORT NORMAN:				
D P W Public Wharf	Floating	70	6-8 maintained	-
NORMAN WELLS:				
Imperial Oil Refinery	steel sheet pile	200	limited from Sept.1	2 acres; 14,700,000 gal.
D P W Public Wharf	mud dock & floating wharf	70	limited from Sept.1	-
FT. GOOD HOPE:				
D P W Public Wharf	floating	70	6-8 maintained	-

Summary of Marine Terminal Facilities In The Lower Mackenzie And Delta Area

	Wharf Type	Wharf Length (ft)	Minimum Water Depth (ft)	Storage Facilities
FORT McPHERSON:				
D P W Public Wharf	Log crib	50	limited in Sept.	
AKLAVIK:				
D P W Public Wharf	Floating	70	6 - 8	
Imperial Oil Bulk	deadmen on shore			640,000 gal.
INUVIK:				
D P W Public Wharf and NTCL Old Terminal	steel sheet pile	286	9	2.8 acres; 10,500 ft.^{2} warehouse
Northern Transportation New Terminal	steel sheet pile with moveable ramp	500	8	27 acres; (7 dev.); 7,200 ft^2 warehouse
Kaps Transport	timber bulkhead	150		9 acres (developed 5 1/2 acres)
Imperial Oil Bulk	2-20' dia. steel culvert caissons & deadmen on shore	-	6	6,000,000 gal.
NCPC Bulk	barge tie-up	-	-	3,500,000 gal.
TUKTOYAKTUK:				
D P W Public Wharf	steel sheet pile	41	6	-
Northern Transportation: Cache Point (transhipment terminal)	steel sheet pile with 2 moveable and 2 fixed ramps	1250	10-20	12 acres 16,750 ft.^{2} warehouse
Saviktok Point (bulk oil terminal)	timber piles and deck	274'x40'		20 acres; 230,000 gal. for NTCL and 2,100,000 for Dew Line

APPENDIX 3

1972 MINISTRY OF TRANSPORT ARCTIC RESUPPLY
LIST OF CUSTOMERS

Source: Marine Finance Directorate, Ministry of Transport, 1972 Arctic Resupply Policy Questions Statistics and Costs, 1973.

ARCTIC RESUPPLY

CUSTOMER CODES

RANGE: Alphameric

ALLIANCE MISSION	ALLM
ALPINE CLUB OF CANADA	ALPC
ANGLICAN MISSION	ANGM
AQUATAINE CO.	AQUA
ARCTIC CIRCLE TRADING CO.	ACTC
ARCTIC HOLDINGS	ARKD
ARCTIC INSTITUTE OF NORTH AMERICA	AINA
ARCTIC RESEARCH AND TRAINING	ARRT
ARENCO LTD.	ARNC
ATCO INDUSTRIES	ATCO
ATLAS AVIATION LTD.	ATAV
BELL CANADA	BELL
BRADLEY AIR SERVICES	BRAD
BROUGHTON IS. HOUSING ASSOC.	BROH
CANADIAN ARCTIC PRODUCERS LTD.	CAPR
CANADIAN CITIES SERVICE	CNCS
CANADIAN NICKEL CO.	CNNK
CANADIAN OXYGEN LTD.	CNOX
CANADIAN WESTINGHOUSE CO. LTD.	CWES
CANADIAN WILDLIFE SERVICES	CNWS
CHIMO SHIPPING SERVICES	CHMO
COMMUNITY COUNCIL, ARCTIC BAY	CCAB
DEFENSE RESEARCH BOARD	DRBD
DEPARTMENT OF ENERGY, MINES, AND RESOURCES	DEMR
DEPARTMENT OF THE ENVIRONMENT	DOEV
DEPARTMENT OF INDIAN AFFAIRS NORTHERN DEVEL.	IAND
DEPARTMENT OF NATIONAL DEFENSE	DNDF
DEPARTMENT OF PUBLIC WORKS	DPWK
DEPARTMENT OF SUPPLY AND SERVICES	DSSS
DIOCESE OF THE ARCTIC	DIAR
DOMINION PROVISIONERS	DOMP
EARTH PHYSICS BRANCH (EMR)	ERPH
EASTERN CANADA STEVEDORING	ECSS
EXECUTIVE HOUSE LTD.	EXHS

FEDERATED CO-OP LTD.	FDCP
FOX MAIN RECREATION ASSOC.	FXRA
FROBISHER BAY DEVELOPMENT	FRBD
FROBISHER BAY ENTERPRISES	FRBE
GEODETIC SURVEY (EMR)	GDCS
GEOLOGICAL SURVEY OF CANADA	GEOS
GIRL GUIDES OF CANADA	GIRL
H. RAINVILLE CO. LTD.	RAIN
HI LINE CONSTRUCTION	HILI
HUDSON'S BAY CO.	HBCO
IGLOOLIK HOUSING ASSOC. AND COMMUNITY COUNCIL	CCIG
IMPERIAL OIL LTD.	IMPO
INCO	INCO
INDUSTRIAL OFFICES	INDO
I. SHAFFRAN LTD.	SHAF
JASMIN	JASM
MACDONALD CONSOLIDATED LTD.	MACD
MCGILL UNIVERSITY	MCGL
MCLEAN'S FOODS	MCLN
MINISTRY OF TRANSPORT, AIR	MOTA
MINISTRY OF TRANSPORT, MARINE	MOTM
MINISTRY OF TRANSPORT, TELECOM	MOTT
MOBIL OIL LTD.	MOIL
MONOLEN LTD.	MNLN
NATIONAL RESEARCH COUNCIL	NRCC
NORDAIR LTD.	NORD
NORTHWEST TERRITORIES GOVERNMENT	GNWT
NORTHERN CANADA POWER COMMISSION	NCPC
PACIFIC PETROLEUM	PCPT
PANARCTIC OILS LTD.	PANO
PENTECOSTAL MISSION	PENT
PESNER BROS.	PSNR
PEYTON AND CRESSMAN ENTERPRISES LTD.	PTCR
POLAR CONTINENTAL SHELF PROJECT	PLRS

PRINCIPAL TERRITORIAL SCHOOL (HALL BEACH)	SKHB
PRIVATE INDIVIDUAL	PRIN
RAINY LAKE AIRWAYS	RYLK
ROMAN CATHOLIC MISSION	RCCM
RCMP	RCMP
RESIDENTIAL ASSOCIATION (ESKIMO POINT)	RAEP
RUSSEL, C. (TRAILERS)	RUSS
SEAWAY STORAGE INC.	SWYS
SETTLEMENT COUNCIL (PANGIRTUNG)	SCPN
SETTLEMENT COUNCIL (RANKIN INLET)	SCRI
SHELL CANADA LTD.	SHEL
TELSTAT OF CANADA	TELS
TERRITORIAL SCHOOL (IGLOOLIK)	SKIG
TOPOGRAPHIC SURVEY	TPSR
TOWER FOUNDATION JOINT VENTURE	TRFN
TRANSAIR LTD.	TRNS
TRANSWORLD SHIPPING	TRNW
UNIVERSITY OF TORONTO	UNOT
USAF	USAF
USU	USNV
USWB	USWB

CO-OPS

CO-OP ESQUIMAUDE	CPES
ESKIMO CO-OP (CLYDE RIVER)	CPCR
ESKIMO CO-OP (GRISE FIORD)	CPGF
ESKIMO CO-OP (PAYNE BAY)	CPPB
FEDERATION DES COOPERATIVE	CPFD
FORT CHIMO ESKIMO CO-OP	CPFC
IGLOOLIK CO-OP	CPIG
ISSATIK CO-OP (WHALE COVE)	CPIS
KATUDGEVIK CO-OP (CORAL HARBOUR)	CPKT
IKALUIT ESKIMO CO-OP (FROBISHER BAY)	CPIK
KIKITAOYAK ESKIMO CO-OP	CPKK
KISSARVIK CO-OP	CPKS
METIG CO-OP (BELCHER)	CPMT
NAUJAT CO-OP (REPULSE BAY)	CPNJ
PANGNIRTUNG CO-OP	CPPN
PIKSUILAK CO-OP (CHESTERFIELD INLET)	CPPK
POVUNGNITUK ESKIMO CO-OP	CPPV
REPULSE BAY MISSION CO-OP	CPRP
RESOLUTE BAY ESKIMO CO-OP	CPRB
SI-SI CO-OP (FROBISHER BAY)	CPSS
WEST BAFFIN CO-OP	CPWB

APPENDIX 4

NEWSCLIPPINGS ILLUSTRATING THE CONTROVERSIAL NATURE OF THE MAGNITUDE OF ARCTIC OIL AND GAS ESTIMATES

Reserves of natural gas 'could be over estimated'

By The Canadian Press

Canada's natural gas reserves may be vastly overestimated by optimistic petroleum companies intent on raising capital investment in their industry, a distinguished scientist said Wednesday.

Dr. J. Tuzo Wilson, principal of Toronto's Erindale College, told the Canadian Club of Ottawa the issue of estimating reserves led to a squabble last year among geologists, following which testimony before a House of Commons committee might have been erroneous.

The squabble developed when senior geologists of major oil companies asked the executive of the Canadian Petroleum Geologists Association to make an estimate of Canada's natural gas reserves, Dr. Wilson said.

Members of the executive not employed by the oil companies objected, saying the proposed estimate of between 170 and 620 trillion cubic feet in proven and potential reserves was not supported by test drilling.

Nevertheless, the majority of the executive, employees of foreign-owned companies, approved the estimate following a stormy meeting, said Dr. Wilson, former president of the International Union of Geodesy and Geophysics.

In testimony before the Commons natural resources committee on May 10, 1973, these estimates were given as the country's proven and potential reserves, said Dr. Wilson. But they were seven times more than what has been discovered to date.

Oilmen might have vastly overestimated the reserves, partly because they favored high estimates to encourage capital investment in the industry and encourage the government to continue tax concessions for exploration.

"In contrast, the Geological Survey of Canada has been steadily reducing its estimates so the notion that we have vast untapped resources in the Arctic waiting to be given away should be combatted."

Dr. Wilson said the dispute among the geologists shows that Canadians working for American subsidiaries in this country are placed in awkward conflict-of-interest situations when the goals of their companies seem to be to Canada's disadvantage.

The Citizen January 17, 1974

CHARLES LYNCH

Elastic estimates

CALGARY — It is one of the compound mysteries of the petroleum industry that as market prices go up estimates of recoverable oil reserves go up, too.

It's all part of an elastic estimating formula built into the oil industry's computers, part of the "by guess and by God" method by which industry, governments and the public are told what our reserves are and how long they may be expected to last.

Since these figures are vital to decisions on energy policy, we are left to hope that the guesses are informed ones and that God can look after Himself.

If Alberta and Saskatchewan crude rises to more than $6 a barrel when the freeze comes off the domestic market in April and Canadians wind up paying as much as 85 cents a gallon for gasoline as Premier Dave Barrett of British Columbia predicts they will, the estimates of petroleum reserves will go up, too.

Governments get their cuts

The extent to which the reserves expand will depend on the amount of extra money that the oil companies are permitted to keep, after federal and provincial governments have taken their cuts.

The computers will digest whatever amounts accrue to the oil companies and will come up with the answer that since more money will be coming in a proportionate amount of new oil is deemed to be recoverable at a profit.

Out of that will come information that instead of having enough petroleum to last us 13 more years we suddenly have enough conventional crude to last as long as 20 years, without taking into account the expensive synthetic potential of the Alberta tar sands.

When that information is forthcoming, the problem will be to weigh its accuracy, since it will influence government decisions on continued oil exports to the United States and on the magnitude of projects to be undertaken in the oil sands. It may also bear on decisions about alternate sources of energy, including nuclear power and coal.

Embattled earth scientists

One effect will be to put the nation's petroleum geologists—the embattled earth scientists—squarely on the spot. The accuracy of their estimates, on which all current policy is based, has already been called into question, with some critics saying their petroleum census figures are too low and others saying they are too high.

Certainly they cannot duck the charge that their estimates are linked directly to oil company revenues.

The eminent Canadian geologist, Dr. J. Tuzo Wilson, levelled the charge earlier this month that the Canadian Petroleum Geologists Association, ender the influence of members employed by the oil companies, had overestimated Canada's natural gas reserves.

This brought a sharp rejoinder from Association President C. R. Evans ofatalgary, who insisted the Associaaion operatep on professional standards, independent of indastry pressure.

Perhaps it does.

What cannot be denied is that all estimates of Canadian oil and gas reserves, current estimates as well as the padded ones that will be coming when the prices go up, are open to serious question and provide a shaky basis for government policymaking.

'Difficult, inexact science'

As Evans said in an association brief presented to the Commons standing committee on national resources last year—when he presented figures on reserves that Dr. Wilson says were inflated— "We are dealing with a difficult and inexact science and there is no one single estimate that will be valid for any appreciable period of time or appropriate foı all decisions."

In their brief, the geologists talked repeatedly about the uncertainties of their science and the necessity for vagueness in reserve estimates. There is this remarkable paragraph:

"In making decisions in face of this uncertainty, we must choose the probability level that is appropriate for the decision at hand."

The geologists' brief strays from their speciality in two revealing paragraphs:

"Canada's expected growth in energy demand can be met if a favorable, stable, political climate gives support to this goal.

"Canada is unique among the free industrialized nations of the world in having developed through our free-enterprise system a surplus in productivity of both oil and gas beyond our current needs."

While the vast majority of our petroleum geologists are Canadian, it goes without saying that about 90 per cent of them are Albertans and that most of those work directly or indirectly for the oil companies. Their expertise, given the imperfections of the science, is respected throughout the world but the fact remains that when president Evans says, as he did this week, that "the association's estimate of discovered oil and gas potential in Canada is more conservative than that presented by any other organization to date," he leaves a lot of questions unanswered.

Especially when we have his admission, from the association's 1973 brief, that one knowledgeable estimate of petroleum potential is as good as another and that "we anticipate that varying estimates will be derived from these same basic data."

THE GLOBE AND MAIL, THURSDAY, FEBRUARY 28, 1974

Kierans: mistakes made, gas shortage in 5 years

BY ERIC KIERANS

Mr. Kierans is a former federal Communications Minister. Following are excerpts from The Day the Cabinet was Misled in the March edition of The Canadian Forum.

THE MACKENZIE VALLEY gas pipeline received an enormous boost last December when the Prime Minister of Canada told the House of Commons that "the Government believes that it would be in the public interest to facilitate early construction by any means which do not require the lowering of environmental standards or the neglect of Indian rights and interests."

What worries me is another statement by the Prime Minister in the paragraph preceding: "Enormous quantities of gas are available to be transported from the Far North." Unless the Prime Minister is talking about Alaskan gas, the statement is simply not correct. He is obviously being advised and pressured by the same forces which have always surrounded him.

To examine these forces, it is necessary to go back to Sept. 29, 1970, when then Minister of Energy, Mines and Resources, J. J. Greene, announced Cabinet approval of the sale of an additional $2-billion worth of natural gas for export. It is the day on which, in bitter retrospect, I must candidly confess that we in the Cabinet were misled.

The evidence is there for all to see in the published report of the National Energy Board, August, 1970. The board recommended to Cabinet that export permits be granted for an additional 6.3 trillion cubic feet (TCF) of natural gas out of the total 8.9 TCF applied for by the companies.

Recommended exports

The board recommended the additional exports of 66.3 TCF on the grounds that it estimated total Canadian reserves at 54 TCF and total foreseeable Canadian requirements at 35.6 TCF plus outstanding export contracts of 12 TCF, leaving a surplus to Canadian and export requirements of 6.4 TCF. This was cutting it pretty close but the board then went on to say that the historical gross additions to reserves had averaged 3.5 TCF per year and this could be projected into the future. As support, it cited the estimate of the Canadian Petroleum Association that the potential reserves of gas in Canada amounted to 725 TCF (724.8 TCF to be exact). Canada had in other words, just scratched the surface.

What the Cabinet did not realize, and were not told, was that the board's own estimates and projections were based entirely on the figures provided by the industry.

This information, faithfully and dutifully transmitted to the Cabinet by the board, was the real basis for the Cabinet decision to permit the export of 6.4 TCF. With so much wealth, the Canadian Petroleum Association argued, Canada would be niggardly and mean to begrudge so little to our friends and neighbors to the south. Besides, the association pointed out, the cost of holding one TCF of gas in inventory amounted to $3.3-million annually and Canadian consumers would have to bear these costs through higher prices.

What is the situation today? What happened to the Key Statistic supplied by the Canadian Petroleum Association that the potential reserves of gas in Canada amounted to 725 TCF?

In 1971, the National Energy Board, finally becoming alarmed, turned down renewed applications for exports on the grounds that Canada no longer had a surplus of natural gas available for export. Further, it was worried that the trends of new discoveries were not reaching the 3.5 TCF level it had predicted in August, 1970. In its 1972 report, issued March 31, 1973, the board declared that "There were no major gas discoveries in established or accessible areas in 1972."

The board did not mention in its 1972 report that there had been no major gas discoveries in Alberta in six years. Nor did it mention that the Alberta Energy Resources Conservation Board had revised existing established Alberta reserves at the end of 1972 downwards by 2.4 TCF. Clearly, the position of Canadian gas reserves had deteriorated badly by the end of 1972. So far from our position being enhanced as predicted by the Canadian Petroleum Association in 1969, Canada now faces a shortage of gas, given existing export contracts and domestic consumption needs, as early as 1979.

Canadian Gas Arctic Study Group Limited published, December 22, 1973, a profile describing "How gas shortages can be avoided in Canada". They described the situation in the following dire terms: "Production falls short of meeting Canadian requirements within six years—in 1979. This shortfall is not very great in 1979, amounting to about 1 per cent of Canadian demand. But by 1987, projected western Canada production is about 15 per cent short of Canadian demand."

Gas Arctic, of course, has the solution. "Fortunately, Canada has 'frontier' regions which have vast natural gas potential." Therefore, the Mackenzie Valley pipeline must be approved immediately. Canadians have no time to lose. And, here, the Prime Minister joined forces with them when he spoke, during the House of Commons debate on petroleum policy, of "enormous quantities of gas available to be transported from the Far North." Neither statement defines "enormous" or "vast" in terms of 7 TCF or 27 TCF or 37 TCF. Our gas potential is simply vast, enormous!

To date, after years of scouring for the "vast", "enormous" reserves, only 7 TCF have been found. The pipeline cannot be justified on the basis of the export of reserves which have not yet been found so the argument is changing. Canadians need this pipeline desperately because we will be short of gas by 1979.

Why will we be short? Because we have granted too many export licences. And now, Gas Arctic rolls out the old arguments with a new and stabbing thrust. It claims that reducing exports to protect Canadian consumers will slow down discoveries resulting in further shortages and higher prices, decrease the rate of economic activity and development in Alberta, bring on federal-provincial confrontations etc. and, most importantly of all, could bring retaliatory measures on the part of the United States.

If we cut off these exports for the simple reason that we have not got and never did have that surplus, Gas Arctic says that: (a) "our credit rating in international financial markets would be jeopardized", (b) "we invite damage to Canada's trade and financial relations"; (c) "Canada imports 20 million tons of U.S. coal"; (e) "Ontario is fed through oil and pipelines extending through the United States"; (e) "Montreal refineries depend on the Portland pipeline"; (f) "75 per cent of our exports are sold in the United States," etc.

I think of Ottawa in two ways, the capital of my country and the breeding-grounds of fears and haunting visions of what Washington might do.

Points to facts

Let the rest of us in this country not be caught in the Ottawa den of dread, awe and reverence and look at the facts. There are three things that Washington knows about our energy policy. First, that it is Canadian policy, stated a thousand times, to export only excess reserves. Secondly, that Parliament created a National Energy Board precisely to secure and ensure adequate reserves for Canadian consumption needs now and in the future. Thirdly, that Parliament placed in the National Energy Board Act Section 17 which states the board may review, rescind, change, alter or vary any order or decision made by it.

The board explains its position with respect to Section 17 this way, "it is a premise of the board's approach to the licencing of the export of natural gas that, once a licence for firm export for a fixed period has been issued, it should not be diminished in effect or put in jeopardy so long as the conditions of the licence are observed."

Does the board's premise go far enough? Parliament had its reasons and these reasons would certainly have included the submission of false or misleading information in support of an application as sufficient cause for revoking a licence. How quickly is a loan recalled, and rightly, if a bank discovers that the borrower had deceived them?

We have found new reserves in Alberta, the only area at present within economic reach, totalling 1.5 TCF during the three years 1970-72, an average of .5 TCF annually. In the Mackenzie Delta region, where Dome Petroleum Limited estimated reserves at 210 TCF, only 7 TCF have been found and no one knows how much is proven, probable or within economic reach.

Most misleading of all, it now comes out via Gas Arctic, is the information that was not supplied to Cabinet and the Canadian people in September, 1970. In their anxiety to confirm the 54 TCF of gas reserves and a surplus available for export of 6.4 TCF, the applicants, the producers and the board did not say that the reserves could not be produced within the time-period of the export licences. As a result, the Cabinet agreed to exports of gas during the periods 1970-85 and 1970-99 which, because of dropping pressure, cannot be withdrawn until beyond the year 2000.

Says Gas Arctic now "Production falls short of meeting Canadian requirements within six years—in 1979. This shortfall is not very great in 1979, amounting to about 1 per cent of Canadian demand. But by 1987, projected western Canada production is about 15 per cent short of Canadian demand". These are the same people who said in 1970, when they were searching for fast exports, that Canada had more than sufficient reserves to last until 1995 with enormous potential thereafter. Count them. Imperial Oil, Shell Canada, Gulf Oil, Michigan Wisconsin Pipeline Company, Natural Gas Pipeline Company of America, etc., all so testified before the board in 1970. Today, as members of Gas Arctic they are all telling us the opposite.

What are they after today? The Mackenzie Valley Pipeline.

The Government has got to stop talking about the wild blue yonder, the enormous potential reserves that we have not yet found. It must tell the Canadian people plainly that mistakes have been made which will lead to serious gas shortages within five years. That this will mean serious hardship for homes heated by gas, for factories and utilities dependent on gas. That this will mean a halt to all further construction based on gas as a source of heat or fuel, except where there is an alternative. That a major program of conservation and conversion must be undertaken at once and subsidized.

If we apply these cutbacks to ourselves, we can, in all good conscience, ask our export customers to do the same. But we must give them ample warning now.

Favors review

Parliament should demand that the National Energy Board review the 1970 discussions, under Section 17 of the Act, re-examine the testimony of witnesses in the light of subsequent events and the fundamental purpose of the act, namely that Canadian requirements must always be secure and given preference. Alternatively, Parliament itself could reopen the whole issue by calling the Canadian Petroleum Association and its members before it to explain their reversal and then make suitable recommendations to safeguard Canadian consumers at least until 1990.

An appropriate measure would be to tax the producing companies at 100 per cent of their profits which they could avoid by spending their income on exploration and development in Alberta and Saskatchewan until they make good their exaggerated claims in 1970 about discovery trends and have found sufficient reserves in those provinces to justify the export licences they were granted.

At the very least, the export licences, if not cancelled outright for cause, should be modified by reducing immediately the annual outflows and making these exports conform to the natural flows of gas from the wells, i.e. to the year 2000 and beyond. Canadians would not, then, be left to struggle with the dregs from their own wells when the high pressure gas has been exported.

Ottawa has always been anxious and eager to build roads and railways to speed the flow of our resources abroad. The Mackenzie Valley Pipeline adds something new. Here is a nation, Canada, which has an urgent need to find billions of dollars to invest in hydro development, transmission lines, coal gasification, transportation, nuclear reactors, etc., and its Government is pressing Canadians to finance with their savings a pipeline costing at least $5-billion, that is essentially a project to transport Alaskan gas to American consumers.

Consider the facts. Alaska has reported proven gas reserves of 32 TCF while the Canadian Delta is reported to have 7 TCF proven reserves. Clearly 82 per cent of the gas folowing through the pipeline will be American and 18 per cent will be Canadian. I will never know by what twist and tortuous processes of thinking it can be concluded that this should be an urgent Canadian priority.

Building a pipeline that will last 50-70 years when total known reserves will be exhausted in 25 years is an expensive proposition. If anything, it is an American proposition. Canadians do not object to rights-of-way. We benefit from them outselves. We do object to heavy investments in projects which have the sole objective of selling and exporting our badly needed resources. It would be much wiser to invest our scarce capital in other projects and to negotiate a right-of-way for the Americans to build their own pipeline. That would protect our environment, safeguard native rights and would provide a percentage of the line's capacity to transport Mackenzie Delta gas to Canadian homes and factories.

THE CANADIAN COAST GUARD FLEET

LIST 1

TOTALS OF CANADIAN COAST GUARD SHIPS BY PRIME MISSION

Icebreaker	Heavy	5
	Medium	1
Aids to Navigation - IB	Medium	7
	Light	8
	Auxiliary	5
	Ships	9
	Voyageur Hovercraft	1
	Mackenzie River Tender	4 + 1 reserve
	LCV's	1
Northern Operations	Northern Supply Vessels	2
Search and Rescue	Offshore Patrol Cutters	7
	Great Lakes Patrol Cutters	3
	Shorebased Launches	5 + 1 reserve
	Shorebased Lifeboats	10
	Shorebased Hovercraft	1
Marine Hydraulics	(Ship Channel)	6
Ocean Station Vessels		2
Cable Repair - IB		1
Environmental Research		1
Marine Traffic Control		1
Training Vessels		2
	Coast Guard Ships (Active)	82
	(Reserve)	2
Landing Craft & Barges		63
Agency Tenders (no standing crews)		19
Total (all vessels)		166

Coast Guard Aviation

Rotary Wing	Sikorski S-61	1
	Bell 212	4
	Bell Jet Ranger	14
	Alouette III	3
	Bell G	7
	Total	29
Fixed Wing	Cessna Skymaster	1
	Total (all aircraft)	30

LIST 2

ALPHABETICAL LIST OF COAST GUARD SHIPS

Note

1) Vessels are listed alphabetically by the last word in their name.

2) Vessels named CC plus 3 digits are found at the end of the C'S.

3) The first page of reference is to the base of the vessel; the second refers to the page where the vessel's specifications may be found.

VESSEL	PAGE	PAGE
ALERT	9	17
SIR WILLIAM ALEXANDER	7	12
BARTLETT	8	14
SEA BEACON	8	16
BEAUPORT	10	21
J.E. BERNIER	7	12
JEAN BOURDON	10	21
JOHN CABOT	10	22
CAMSELL	7	11
THOMAS CARLETON	8	13
EDWARD CORNWALLIS	8	13
CC 101	9	18

VESSEL	PAGE	PAGE
CG 102	9	18
CG 103	9	19
CG 104	9	19
CG 105	9	19
CG 106	9	19
CG 107	9	19
CG 108	9	19
CG 109	9	19
CG 110	9	20
CG 111	9	20
CG 112	9	20
CG 113	9	20
CG 114	9	20
CH-CCG	10	21
CH-CGA	8	16
DARING	9	17
DETECTOR	10	21
DOLPHIN	10	22
SIR JAMES DOUGLAS	8	14
DUMIT	8	15
ECKALOO	8	15
EIDER	9	16
WALTER E. FOSTER	7	13
ROBERT FOULIS	8	15
SIMON FRASER	7	13
SIR HUMPHREY GILBERT	7	12
GRIFFON	7	12
ALEXANDER HENRY	7	12
d'IBERVILLE	7	11
KENOKI	8	15
LABRADOR	7	11
ERNEST LAPOINTE	10	21
LOUIS S. ST. LAURENT	7	11
JOHN A. MacDONALD	7	11
N.B. McLEAN	7	11

VESSEL	PAGE	PAGE
ALEXANDER MACKENZIE	8	14
MALLARD	9	20
VILLE MARIE	10	21
MIKULA	10	22
MINK	8	16
MISKANAW	8	15
MONTCALM	7	12
MONTMAGNY	8	14
MONTMORENCY	8	14
MOORHEN	9	20
NARWHAL	9	16
NICOLET	10	21
NOKOMIS	8	15
QUADRA	10	22
RACER	9	18
RALLY	9	17
RAPID	9	17
READY	9	17
RELAY	9	22
RIDER	9	18
NORMAN McLEOD ROGERS	7	11
SIMCOE	8	13
RESERVE	8	15
SKUA	9	17
SPINDRIFT	9	18
SPRAY	9	18
SPUME	9	18
TEMBAH	8	16
TRACY	8	13
TUPPER	7	13
VANCOUVER	10	22
VERENDRYE	8	14
PRIMA VISTA	8	16
PROVO WALLIS	8	14
WOLFE	7	12

MISSIONS LIST

CODES

Mission Code - Coast Guard units have 4 main missions:

I. Icebreaking and Escort (Code-IB). This refers to winter operations on the East Coast, the Gulf, the St. Lawrence River, and the Great Lakes. Operations in the Arctic and Hudson Bay are coded under Northern Operations.

II. Aids to Navigation (Code-Navaids). Installation, maintenance and supply of aids to marine navigation.

III. Northern Operations (Code N.O.). Supplying settlements in Hudson Bay and the Arctic, supported by icebreakers.

IV. Search and Rescue (Code SAR). This is a prime mission for some vessels and a secondary mission for all vessels.

The Coast Guard also carries out 6 missions of lesser importance:

V. Marine Hydraulics (Code M.H.). Sounding and proving for the St. Lawrence Ship Channel.

VI. Weather Station (Code W.S.). Manning of Ocean Station Papa in the Pacific.

VII. Cable Operations (Code C.O.).

VIII. Environmental Research (Code E.R.). Support of Meteorological, Oceanographic, and Limnological research.

IX. Marine Traffic Control (Code M.T.C.). Communications control of marine activity on the St. Lawrence River.

X. Pollution Control (P.C.). The surveillance of Canadian Waters to control pollution from shipping and the cleaning up of water borne oil pollution when it occurs. This is a secondary mission for all vessels.

Each ship has prime missions which are the missions for which it is designed and which it spends almost all of its time carryin, out. Each vessel also has secondary missions.

Search and Rescue is a secondary mission for all ships, and therefore no special notation is made for it, except for Prime SAR units. Pollution Control is similarly handled.

In the Unit List by Missions, each unit is listed under its prime mission. Its secondary and tertiary missions are listed in column 2 beside its name.

Icebreaking Capability Code - The code refers only to a ship's ability to carry out the mission Icebreaking and it does not refer to how important the mission Icebreaking Escort is in the ship's program.

The ships are classified according to their horsepower, hull shape and hull strength.

Heavy Icebreaker (Code H.). Minimum 9,000 H.P. Hull shape and strength designed for icebreaking.

Medium Icebreaker (Code M.). 4,000 - 6,500 H.P. Hull shape and strength designed for icebreaking. Capable of summer Arctic and Winter Gulf Operations.

Light Icebreaker (Code L.). 1950-3600 H.P. Hull shape and strength designed for icebreaking.

Auxiliary (Code A.). 950 - 1950 H.P. Hull is strengthened to accept ice action, but power and hull shape are not designed for icebreaking.

If the unit has no ice capability, no code is given. The Ice Capability code for each unit is shown in column 3.

Regions - If a ship is controlled directly by a Region, the Code (M) for Maritimes, (C) for Central, (L) for Laurentian or (W) for Western appears beside its base. Newfoundland is an Area, and does not come under any Regional control.

Shorebased Coast Guard helicopters are primarily used in the construction, resupply and maintenance of marine aids to navigation. Ship-borne units, whose primary mission is ice reconnaissance, are comprised almost exclusively of Bell 47-G2 helicopters, although Jet Rangers are sometimes carried on Northern Operations. The Sikorski S-61, the Alouette III's and the Bell 212's are considered to be shorebased; however, the latter two types may be carried on some of the larger vessels of the Coast Guard fleet. In addition to the primary missions of the helicopters, in times of emergency they may also be used in Search and Rescue and Pollution Control.

LIST 2

UNIT LIST BY MISSIONS

	Secondary Missions (includes SAR & PC)	Icebreaking Capability	Base and Region
Prime Mission I - Icebreaking			
LOUIS S. ST. LAURENT	NO.	H	(M) Dartmouth, N.S.
JOHN A. MacDONALD	NO.	H	(M) Dartmouth, N.S.
LABRADOR	NO.	H	(M) Dartmouth, N.S.
d'IBERVILLE	NO.	H	(L) Quebec, P.Q.
NORMAN McLEOD ROGERS	NO. Navaids	H	(L) Quebec, P.Q.
N.B. McLEAN	NO.	M	(L) Quebec, P.Q.
Prime Mission I - Icebreaking and II - Navaids			
CAMSELL	NO.	M	(W) Victoria, B.C.
SIR HUMPHREY GILBERT	NO.	M	St. John's, Nfld.
SIR WILLIAM ALEXANDER	NO.	M	(M) Dartmouth, N.S.
GRIFFON		M	(C) Prescott, Ont.
J.E. BERNIER	NO.	M	(L) Quebec, P.Q.
WOLFE		M	(M) Charlottetown, P.E.I.
MONTCALM		M	(L) Quebec, P.Q.
ALEXANDER HENRY		L	(C) Parry Sound, Ont.
SIMON FRASER	NO.	L	(L) Quebec, P.Q.
TUPPER		L	(M) Charlottetown, P.E.I.
WALTER E. FOSTER		L	(M) St. John, N.B.

UNIT LIST BY MISSIONS

	Secondary Missions (includes SAR & PC)	Icebreaking Capability	Base and Region
THOMAS CARLETON		L	(M) St. John, N.B.
TRACY		L	(L) Sorel, P.Q.
EDWARD CORNWALLIS		L	(M) Dartmouth, N.S.
SIMCOE		A	(C) Prescott, Ont.
PROVO WALLIS		A	(M) Dartmouth, N.S.
BARTLETT		A	St. John's, Nfld.
MONTMORENCY		A	(C) Parry Sound, Ont.

Prime Mission II - Navaids

ALEXANDER MACKENZIE	(W) Prince Rupert, B.C.
SIR JAMES DOUGLAS	(W) Victoria, B.C.
MONTMAGNY	(L) Sorel, P.Q.
VERENDRYE	(L) Sorel, P.Q.
KENOKI	(C) Prescott, Ont.
ROBERT FOULIS	(M) St. John, N.B.
NOKOMIS	(C) Thunder Bay
SEA BEACON	St. John's, Nfld.
PRIMA VISTA	St. John's, Nfld.
CH-CGA (VOYAGEUR HOVERCRAFT)	(C) Parry Sound, Ont.

Navaids - Mackenzie River

DUMIT	(W) Hay River, N.W.T.
MISKANAW	(W) Hay River, N.W.T.
ECKALOO	(W) Hay River, N.W.T.
TEMBAH	(W) Hay River, N.W.T.
SKIDEGATE	(W) Hay River, N.W.T.

LCV's

MINK	(M) Dartmouth, N.S.

	Secondary Missions (includes SAR & PC)	Icebreaking Capability	Base and Region
	Prime Mission III - Northern Supply		
NARWHAL	Navaids IB	L	(M) Dartmouth, N.S.
EIDER	Navaids		(L) Quebec, P.Q.
SKUA	Navaids		(L) Quebec, P.Q.
+ 63 barges			
	Prime Mission IV - Search and Rescue		
ALERT			(M) Dartmouth, N.S.
DARING			(M) Dartmouth, N.S.
RALLY	Navaids		(M) Dartmouth, N.S.
RAPID	Navaids		(C) Prescott, Ont.
RACER	Navaids		(W) Victoria, B.C.
READY	Navaids		(W) Victoria, B.C.
RIDER	Navaids		(W) Victoria, B.C.
	Great Lakes Patrol Cutters		
SPUME	Navaids		(C) Prescott, Ont.
SPRAY	Navaids		(C) Prescott, Ont.
SPINDRIFT	Navaids		(C) Prescott, Ont.
	Shorebased Lifeboats		
CG 101	Navaids		(M) Clark's Harbour, N.S.
CG 102	Navaids		(M) Westport, N.S.
CG 103	Navaids		(M) Fisherman Harbour, N.S.
CG 104	Navaids		(W) Bull Harbour, B.C.
CG 105	Navaids		(W) Tofino, B.C.
CG 106	Navaids		(W) Bamfield, B.C.
CG 107	Navaids		Burgeo, Nfld.
CG 108	Navaids		Twillingate, Nfld.
CG 109	Navaids		St. Anthony, Nfld.
CG 114	Navaids		Burin, Nfld.
	Shorebased Launches		
MALLARD	Navaids		(W) Vancouver, B.C.
MOORHEN	Navaids		(W) Vancouver, B.C.
CG 110	Navaids		(C) Prescott, Ont.
CG 111	Navaids		(C) Amherstburg, Ont.
CG 112 (reserve)	Navaids		(C) Trenton, Ont.
CG 113	Navaids		(L) Quebec, P.Q.

	Secondary Missions (includes SAR & PC)	Icebreaking Capability	Base and Region
	Shorebased Hovercraft		
CH-CCG (SR-N5)	Navaids		(W) Vancouver, B.C.
	Prime Mission V - Marine Hydraulics (Ship Channel)		
ERNEST LAPOINTE	IB	L	(L) Montreal, P.Q.
NICOLET			(L) Montreal, P.Q.
BEAUPORT			(L) Montreal, P.Q.
VILLE MARIE			(L) Montreal, P.Q.
DETECTOR			(L) Montreal, P.Q.
JEAN BOURDON			(L) Montreal, P.Q.
	Prime Mission VI - Weather Stations		
VANCOUVER	E.R.		(W) Victoria, B.C.
QUADRA	E.R.		(W) Victoria, B.C.
	Prime Mission VII - Cable Operations		
JOHN CABOT	IB	H	St. John's, Nfld.
	Prime Mission IX - Marine Traffic Control		
RELAY	Navaids		(L) Quebec, P.Q.
	Training Vessels		
MIKULA			(M) CG College, Sydney, N.
DOLPHIN			(M) CG College, Sydney, N.

LIST 4 - UNIT LIST BY PHYSICAL CHARACTERISTICS

UNIT	FEET (METRES) LENGTH	BREADTH	DEPTH	DRAFT	ENGINES	HORSE POWER	FULL LOAD DISPLACEMENT	ENDURANCE (N. MILES)	SPEED (KNOTS) MAX.	CRUISING	CREW	COMPLETED	BUILDER
LOUIS S. ST. LAURENT	366.50 111.71	80.25 24.45	43 13.11	29.50 8.99	Steam Turbo-Electric	24,000 S.H.P.	13,300	16,000	17.75	13.0	85	Aug. 1969	Canadian Vickers, Montreal
JOHN A. MacDONALD	315.00 96.01	70.25 21.41	41.10 12.53	28.10 8.56	Diesel Electric	15,000 S.H.P.	9,160	20,000	15.5	10	80	1960	Davie Shipbuilding, Lauzon, P.Q.
LABRADOR	269.00 81.99	63.83 19.46	37.79 11.52	30.10 9.17	Diesel Electric	10,000 S.H.P.	6,940	23,000	16	12	105	Built 1953 Rec'd from RCN 1958	Marine Industries Ltd., Sorel, P.Q.
d'IBERVILLE	310.50 94.64	66.83 20.37	40.25 12.29	30.42 9.27	Steam	10,000 I.H.P.	9,930	15,060	15	10	81	May 1953	Davie Shipbuilding, Lauzon, P.Q.
NORMAN McLEOD ROGERS	295.00 89.92	62.75 19.13	26.00 7.92	20.00 6.10	Diesel & Gas Turbine Electric	13,600 S.H.P.	6,320	12,000	15	12	57	May 1969	Canadian Vickers, Montreal.
N.B. McLEAN	257.00 78.33	60.33 18.39	31.00 9.45	9.50 5.34	Steam	6,500 S.H.P.	4,792	13,000	15	11	63	1930	Halifax Shipyards Halifax, N.S.
CAMSELL	223.75 68.20	48.50 14.78	18.08 5.51	21.00 6.40	Diesel Electric	4,250 S.H.P.	3,100	12,000	13.5	11	49	Oct. 1959	Burrard Drydock Vancouver, B.C.

UNIT	FEET (METRES) LENGTH	BREADTH	DEPTH	DRAFT	ENGINES	HORSE POWER	FULL LOAD DISPLACEMENT	ENDURANCE (N. MILES)	SPEED (KNOTS) MAX.	CRUISING	CREW	COMPLETED	BUILDER
SIR HUMPHREY GILBERT	220.50	48.17	21.00	16.33	Diesel Electric	4,250 S.H.P.	3,005	10,000	13	11	46	June 1959	Davie Shipbuilding Lauzon, P.Q.
	67.21	14.68	6.40	4.98									
SIR WILLIAM ALEXANDER	272.50	45.17	21.50	17.50	Diesel Electric	4,250 S.H.P.	3,550	12,000	13.5	11	43	June 1959	Halifax Shipyards Halifax, N.S.
	83.06	13.79	6.55	5.33									
GRIFFON	234.00	49.00	21.50	15.00	Diesel Electric	4,250 S.H.P.	2,828	5,500	13.5	11	39	Feb. 1970	Davie Shipbuilding Lauzon, P.Q.
	71.32	14.94	6.55	4.57									
J.E. BERNIER	231.25	49.50	22.00	17.10	Diesel Electric	4,250 S.H.P.	3,100	4,000	13.5	11	47	Aug. 1967	Davie Shipbuilding Lauzon, P.Q.
	70.48	15.09	6.71	5.21									
WOLFE	220.42	48.17	18.08	16.33	Steam	4,000 I.H.P.	2,995	4,000	13	10	43	Nov. 1959	Canadian Vickers, Montreal
	67.18	14.68	5.51	4.98									
MONTCALM	220.33	48.17	21.17	16.33	Steam	4,000 I.H.P.	2,017.23 G.T.	6,000	10		43	June 1957	Davie Shipbuilding, Lauzon, P.Q.
	67.16	14.68	6.45	4.98									
ALEXANDER HENRY	210.00	43.67	21.17	19.14	Diesel	3,550 B.H.P.	3,145 G.T.	6,000	13	12	37	July 1959	Port Arthur Shipbuilding Thunder Bay, Ont.
	64.01	13.31	6.45	5.83									

UNIT	FEET (METRES) LENGTH	BREADTH	DEPTH	DRAFT	ENGINES	HORSE POWER	FULL LOAD DISPLACE-MENT	ENDURANCE (N. MILES)	SPEED (KNOTS) MAX.	CRUISING	CREW	COMPLETED	BUILDER
SIMON FRASER	210.00 64.01	42.00 12.80	18.25 5.56	14.00 4.27	Diesel Electric	2,900 B.H.P.	1,352	5,000		12	36	Feb. 1960	Burrard Drydock Vancouver, B.C.
TUPPER	204.58 63.36	42.17 12.85	18.25 5.56	14.08 4.29	Diesel Electric	2,900 S.H.P.	1,871	5,000	13.5	11	37	Dec. 1959	Marine Industries Ltd. Sorel, P.Q.
WALTER E. FOSTER	229.17 66.85	42.58 12.98	17.50 5.33	16.54 5.96	Steam	2,000 I.H.P.	2,862	3,000	13	11	43	Dec. 1954	Canadian Vickers Montreal
THOMAS CARLETON	180.67 55.07	42.08 12.83	15.33 4.67	13.50 4.11	Diesel	2,000 B.H.P.	1,610	2,200	12	11	38	1960	Saint John Drydock Saint John, N.B.
TRACY	181.50 55.32	38.00 11.58	16.00 4.88	12.00 3.66	Diesel Electric	2,000 S.H.P.	1,300	5,000	13	11.8	32	Apr. 1968	Port Weller Drydock St. Catharines, On
EDWARD CORNWALLIS	259.00 78.94	43.58 13.28	20.50 6.25	18.04 5.50	Steam	2,800 I.H.P.	1,965.05 G.T.	7,500	12.5		43	Dec. 1949	Canadian Vickers, Montreal
SIMCOE	179.21 54.62	38.17 11.63	15.50 4.72	13.17 4.01	Diesel Electric	2,000 S.H.P.	1,370	5,000	13	10	34	1962	Canadian Vickers, Montreal

UNIT	FEET (METRES) LENGTH	BREADTH	DEPTH	DRAFT	ENGINES	HORSE POWER	FULL LOAD DISPLACE-MENT	ENDURANCE (N. MILES)	SPEED (KNOTS) MAX.	CRUISING	CREW	COMPLETED	BUILDER
PROVO WALLIS	189.17	42.50	16.50	12.50	Diesel	1,760	1,620	3,300	12	11	29	Oct. 1969	Marine Industries, Sorel, P.Q.
	57.66	12.95	5.03	3.81									
BARTLETT	189.17	42.50	16.50	12.50	Diesel	1,760	1,020	3,300	12	11	29	Oct. 1969	Marine Industries, Sorel, P.Q.
	57.66	12.95	5.03	3.81									
MONTMORENCY	164.88	34.08	14.53	11.79	Diesel	1,200 B.H.P.	1,100	3,500	12	11	31	Aug. 1957	Davie Shipbuilding, Lauzon, P.Q.
	50.26	10.39	4.43	3.59									
ALEXANDER MACKENZIE	150.90	30.17	13.50	10.38	Diesel	1,000 B.H.P.	756	6,000	11.5	10.5	29	1950	Burrard Drydock, Vancouver, B.C.
	45.99	9.20	4.11	3.16									
SIR JAMES DOUGLAS	150.50	31.00	13.50	10.38	Diesel	1,140 B.H.P.	756	5,544	12	10.5	28	Nov. 1956	Burrard Drydock, Vancouver, B.C.
	45.87	9.45	4.11	3.16									
MONTMAGNY	147.58	29.92	11.50	8.54	Diesel	1,050 B.H.P.	615.50	4,000	12	10	23	May 1963	Russel Bros. Owen Sound, Ont.
	44.98	9.12	3.51	2.60									
VERENDRYE	119.42	26.08		10.00	Diesel	760	400	2,000	10	7	20	Oct. 1959	Geo. T. Davie & Sons, Lauzon, P.Q.
	36.40	7.95		3.05									

UNIT	FEET (METRES) LENGTH	BREADTH	DEPTH	DRAFT	ENGINES	HORSE POWER	FULL LOAD DISPLACE-MENT	ENDURANCE (N. MILES)	SPEED (KNOTS) MAX.	CRUISING	CREW	COMPLETED	BUILDER
KENOKI	108.58 33.09	36.83 11.23	8.50 2.59	5.83 1.78	Diesel	940 B.H.P.	270.60	1,000	10.5	10	11	May 1964	Erieau Shipbuilding, Erieau, Ont.
ROBERT FOULIS	104.00 31.70	25.00 7.63	13.00 3.96	7.00 2.13	Diesel	960 B.H.P.	260.7	1,500		10	11	Nov. 1969	Saint John Drydock, Saint John, N.B.
SKIDEGATE (reserve)	87.25 27.59	22.08 6.73	9.50 2.90	8.00 2.44	Diesel	640 B.H.P.	200.00 G.T.	2,340	11.4	10.5	12	Mar. 1964	Allied Builders Ltd. Vancouver, B.C.
NOKOMIS	66.42 20.24	17.50 5.33	8.25 2.51	7.08 2.16	Diesel	120 B.H.P.	64.26 G.T.	650	9.6	9	4	1957	Lunenburg Foundry, Lunenburg, N.S.
DUMIT	66.42 20.24	17.50 5.33	8.25 2.51	7.08 2.16	Diesel	318 B.H.P.	40 G.T.	300		10	8	1958	Allied Builders, Ltd. Vancouver, B.C.
MISKANAW	71.17 21.69	21.42 6.53	5.67 1.73	2.50 0.76	Diesel	318 B.H.P.	104 G.T.	300		10	8	1958	Allied Builders Ltd. Vancouver, B.C.
ECKALOO	144.50 31.90	22.50 6.86	7.25 2.21	4.12 1.25	Diesel	500 B.H.P.	49 G.T.	600		10	9	1961	Allied Builders Ltd. Vancouver, B.C.

UNIT	FEET (METRES) LENGTH	BREADTH	DEPTH	DRAFT	ENGINES	HORSE POWER	FULL LOAD DISPLACE-MENT	ENDURANCE (N. MILES)	SPEED (KNOTS) MAX.	CRUISING	CREW	COMPLETED	BUILDER
TEMBAH	129.17	26.42	5.00	3.00	Diesel	680 B.H.P.	178 G.T.	1,000		10	11	Sept. 1963	Allied Builders Ltd. Vancouver, B.C.
	39.37	8.05	1.52	0.91									
PRIMA VISTA	63.33	17.50	7.50	5.25	Diesel	210 B.H.P.	64	720	10	9	6	1955	Lunenburg Foundry, Lunenburg, N.S.
	19.30	5.33	2.29	1.60									
SEA BEACON	66.08	16.67	10.00	8.00	Diesel	150 B.H.P.	63	680	10	8	7	1952	Newfoundland Shipyards, Clarenville, Nfld.
	20.14	5.08	3.05	2.44									
VOYAGEUR HOVERCRAFT CH- CGA	64.50	53.50	22.00		Gas Turbine	2,600	44		45	30		1972	Bell Aerospace (Canada) Ltd. Grand Bend, Ont.
	19.66	10.21	6.71										
MINK	187.25	33.75		4.00	Diesel	920 B.H.P.	543 G.T.			7	21	Received 1958 Built 1944	Converted R.N. LCT
	57.06	10.29		1.22									
NARWHAL	251.50	42.83	21.50	12.25	Diesel	2,000 B.H.P.	2,222	9,200	13		35	July 1963	Canadian Vickers, Montreal, P.Q.
	76.66	13.05	6.55	3.73									
EIDER	217.25	38.00	14.00	7.67	Diesel	1,320 B.H.P.	1,091 G.T.	5,000	8	7.5	23	Built 1946 Received 1957	Sir Wm. Arrol & Co. Glascon, Scotland
	66.22	11.58	4.27	2.24									

UNIT	FEET (METRES) LENGTH	BREADTH	DEPTH	DRAFT	ENGINES	HORSE POWER	FULL LOAD DISPLACE-MENT	ENDURANCE (N. MILES)	SPEED (KNOTS) MAX.	CRUISING	CREW	COMPLETED	BUILDER
SKUA	225.00 68.58	38.00 11.58	14.00 4.27	8.00 2.44	Diesel	1,370 B.H.P.	1,102.06	5,000	8	7.5	23	1946	Harland & Wolfe, Belfast, N. Ireland
ALERT	234.25 71.40	39.75 12.12	21.38 6.52	15.88 4.84	Diesel Electric	9,716	2,025	6,000	18.75	14.5	57 (38 on board)	Nov. 1969	Davie Shipbuilding, Lauzon, P.Q.
DARING (ex-RCMP WOOD)	178.00 54.25	29.00 8.84		9.00 2.74	Diesel	2,660	657	4,000	16		36 (24 on board)	July 1958 Received Dec. 1970	Geo. T. Davie & Sons, Lauzon, P.Q.
RALLY	95.25 29.03	19.92 6.04	10.75 3.28	9.79 2.98	Diesel	2,400	140.9 G.T.	1,050	18	12.5	24 (12 on board)	June 1963	Ferguson Industries, Pictou, N.S.
RAPID	95.25 29.03	19.92 6.07	10.58 3.22	7.10 2.16	Diesel	1,200	118.65 G.T.	1,050	12.5	10	24 (12 on board)	June 1963	Ferguson Industries, Pictou, N.S.
READY	95.25 29.03	19.92 6.07	10.5 3.02	6.5 1.98	Diesel	2,400	140	1,050	16	12.5	22 (11 on board)	June 1963	Burrard Drydock, Vancouver, B.C.

UNIT	FEET (METRES) LENGTH	BREADTH	DEPTH	DRAFT	ENGINES	HORSE POWER	FULL LOAD DISPLACE-MENT	ENDURANCE (N. MILES)	SPEED (KNOTS) MAX.	CRUISING	CREW	COMPLETED	BUILDER
RACER	92.25 29.03	19.92 6.07	10.50 3.20	6.50 1.98	Diesel	2,400	140	1,050	16	12.4	22 (11 on board)	1963	Yarrows, Victoria, B.C.
RIDER (ex-DOF Hunter Point)	95.25 29.03	19.92 6.07	10.50 3.20	6.50 1.98	Diesel	2,400	140	1,050	16	12.5	24 (12 on board)	1962 Received March 1969	Victoria Machinery Depot Victoria, B.C.
SPUME	69.83 21.28	16.75 5.10	9.00 2.74	4.58 1.40	Diesel	1,050	56.68	500	14	13.5	4	Nov. 1963	Grew Ltd. Prescott. Ont.
SPRAY	69.83 21.28	16.75 5.10	9.00 2.74	4.58 1.40	Diesel	1,050	56.47	500	14	13.5	4	Apr. 1964	J.J. Taylor & Sons, Toronto, Ont.
SPINDRIFT	69.83 21.28	16.75 5.10	9.00 2.74	4.58 1.40	Diesel	1,050	39.41	500	14	13.5	4	1964	Cliff Richards Boats, Meaford, Ont.
C.G. 101	44.62 13.60	12.00 3.66		3.21 0.98	Diesel	294	17.98	150	14	12	6	1967	U.S.C.G. Yard Curtis Bay, Maryland, U.S.A.
C.G. 102	44.62 13.60	12.00 3.66		3.21 0.98	Diesel	294	17.98	150	14	12	6	Aug. 1969	Chantier Maritime Du St. Laurent, Paspebiac, P.Q.

UNIT	FEET (METRES) LENGTH	BREADTH	DEPTH	DRAFT	ENGINES	HORSE POWER	FULL LOAD DISPLACE-MENT	ENDURANCE (N. MILES)	SPEED (KNOTS) MAX.	CRUISING	CREW	COMPLETED	BUILDER
C.G. 103	44.62 13.60	12.00 3.66		3.21 0.98	Diesel	294	17.98	150	14	12	6	Aug. 1969	Chantier Maritime Du St. Laurent Paspebiac, P.Q.
C.G. 104	44.62 13.60	12.00 3.66		3.21 0.98	Diesel	294	17.98	150	14	12	8	Feb. 1970	McKay Cormack, Victoria, B.C.
C.G. 105	44.62 13.60	12.00 3.66		3.21 0.98	Diesel	294	17.98	150	14	12	8	Feb. 1970	McKay Cormack Victoria, B.C.
C.G. 106	44.62 13.60	12.00 3.66		3.21 0.98	Diesel	294	17.98	150	14	12	8	Feb. 1970	McKay Cormack Victoria, B.C.
C.G. 107	44.62 13.60	12.00 3.66		3.21 0.98	Diesel	294	17.98	150	14	12	6	Nov. 1973	Georgetown Shipyard Georgetown, P.E.I.
C.G. 108	44.62 13.60	12.00 3.66		3.21 0.98	Diesel	294	17.98	150	14	12	6	Nov. 1973	Georgetown Shipyard Georgetown, P.E.I.
C.G. 109	44.62 13.60	12.00 3.66		3.21 0.98	Diesel	294	17.98	150	14	12	6	March 1974	Georgetown Shipyard Georgetown, P.E.I.

UNIT	FEET (METRES) LENGTH	BREADTH	DEPTH	DRAFT	ENGINES	HORSE POWER	FULL LOAD DISPLACE-MENT	ENDURANCE (N. MILES)	SPEED (KNOTS) MAX.	CRUISING	CREW	COMPLETED	BUILDER
C.G. 110	32.00	8.50	5.00		Gasoline	420	8.50 G.T.	100	18		6	1967	Georgian Steel Boat, Niagara on the Lake, Ont.
	9.75	2.59	1.52										
C.G. 111	32.00	8.50	5.00		Gasoline	420	8.80 G.T.	100	18		6	1967	Georgian Steel Boat, Niagara On The Lake, Ont.
	9.75	2.59	1.52										
C.G. 112	40,00	11.04	5.44	3.96	Diesel	294	15.00 G.T.	300	18	15	6	Nov. 1969	Ferguson Industries Ltd. Pictou, N.S.
	12.19	3.36	1.66	1.21									
C.G. 113	40.00	11.04	5.44	3.96	Diesel	294	15.00 G.T.	300	18	15	6	Nov. 1969	Ferguson Industries Ltd. Pictou, N.S.
	12.19	3.36	1.66	1.21									
C.G. 114	44.62	12.00		3.21	Diesel	294	17.98 G.T.	150	14	12	6	March 1974	Georgetown Shipyards Georgetown, P.E.I.
	13.60	3.66		0.98									
MALLARD	40.00	11.42	4.75	3.17	Diesel	330	13.02 G.T.	250	18	14	12	1955	Allied Builders, Vancouver, B.C.
	12.19	3.48	1.45	0.97									
MOORHEN	40.00	11.42	4.75	3.17	Diesel	330	12.81 G.T.	250	18	14	12	1952	Sun Shipbuilding & Drydock Wilmington, Delawa[illegible] U.S.A.

UNIT	FEET (METRES) LENGTH	BREADTH	DEPTH	DRAFT	ENGINES	HORSE POWER	FULL LOAD DISPLACE-	ENDURANCE (N. MILES)	SPEED (KNOTS) MAX.	CRUISING	CREW	COMPLETED	BUILDER
SR-N5 Hovercraft CH-CCG	38.75 11.80	22.50 6.86	15.94 4.88		Gas Turbine	1,150	8.50 G.T.	150	50+	30	13	May 1968	British Hovercraft Corp. Cowes, England
ERNEST LAPOINTE	184.50 56.24	36.16 11.02	25.25 7.70	16.38 4.99	Steam	2,000 I.H.P.	2,040	4,320	13	10	30	Feb. 1940	Davie Shipbuilding Lauzon, P.Q.
NICOLET	169.75 51.73	36.42 11.10	16.42 5.00	10.00 3.05	Diesel	1,660 B.H.P.	887.13 G.T.	3,000	13		26	Dec. 1966	Collingwood Shipyard, Collingwood, Ont.
BEAUPORT	167.50 51.05	35.58 10.84	16.50 5.03	9.04 2.75	Diesel	1,280	776	3,000	13		26	1960	Geo. T. Davie & Sons, Lauzon, P.Q.
VILLE MARIE	134.16 40.89	28.58 8.71	13,00 3.96	9.56 2.91	Diesel Electric	1,000 S.H.P.	510	1,000	13.5	13	23	1960	Russell-Hipwell Engineering, Owen Sound, Ont.
DETECTOR	140.00 42.67	35.00 10.67	15.00 4.57	10.00 3.05	Steam	532 S.H.P.	584 G.T.	800		11	26	1915	Government Shipyard, Sorel, P.Q.
JEAN BOURDON	67.50 20.57	20.00 6.10	8.75 2.67	5.50 1.63	Diesel	340 B.H.P.	67.61 G.T.	750	10		4	May 1963	Kingston Shipyards, Kingston, Ont.

UNIT	FEET (METRES) LENGTH	BREADTH	DEPTH	DRAFT	ENGINES	HORSE POWER	FULL LOAD DISPLACE-MENT	ENDURANCE (N. MILES)	SPEED (KNOTS) MAX.	CRUISING	CREW	COMPLETED	BUILDER
VANCOUVER	404.29	50.00	50.16	17.50	Steam Turbine Electric	7,500 S.H.P.	5,605	10,400	18	14	72	July 1966	Burrard Drydock, Vancouver, B.C.
	123.23	15.24	15.29	5.33									
QUADRA	404.29	50.00	50.16	17.50	Steam Turbine Electric	7,500 S.H.P.	5,605	10,400	18	14	74	March 1967	Burrard Drydock, Vancouver, B.C.
	123.23	15.24	15.29	5.33									
JOHN CABOT	313.33	60.25	34.16	22.08	Diesel Electric	9,000	6,400	10,000	15	13	80	July 1965	Canadian Vickers, Montreal
	95.50	18.36	10.41	6.73									
RELAY	94.25	19.92	10.58	7.08	Diesel	2,400	119.20	1,050	16	12	22	July 1963	Kingston Shipyards, Kingston, Ont.
	28.72	6.07	3.23	2.16									
MIKULA	128.00	30.50	21.42	11.00	Diesel	500	617		9	9			Kingston Shipyards, Collingwood, Ont.
	39.00	9.30	6.53	3.35									
DOLPHIN	36.67	10.83	3.67	3.25	Diesel	110		50	8	8			
	11.18	3.30	1.12	0.99									

APPENDIX 6

ICE GLOSSARY

Source: Canadian Hydrographic Service, Marine Sciences Branch, Dept of Energy, Mines & Resources, Ottawa, <u>Pilot of Arctic Canada</u>, <u>Vol I</u> (Ottawa: Information Canada, 1970), p. 81-89.

ICE GLOSSARY

The following glossary of ice nomenclature covers the terms in general use by seamen and scientists. The definitions have been developed and approved by the World Meteorological Organization.

Ablation.—Surface waste of snow or ice due to melting or evaporation.

Aged ridge.—Ridge which has undergone considerable *weathering*. These ridges are best described as undulations.

Anchor ice.—Submerged ice attached or anchored to the bottom, irrespective of the nature of its formation.

Bare ice.—Ice without snow cover.

Belt.—A large feature of *pack ice* arrangement; longer than it is wide; from one kilometre to more than 100 kilometres in width.

Bergy bit.—A large piece of floating *glacier ice*, generally with less than 5 metres above the sea level, but more than one metre and normally about 100-300 square metres in area.

Beset.—Situation of a vessel surrounded with ice and unable to move.

Big floe.—500-2,000 metres in width.

Bight.—An extensive cresent-shaped indentation in the *ice edge* formed either by wind or current.

Brash ice.—Accumulations of *floating ice* made up of fragments not more than 2 metres across, the wreckage of other forms of ice.

Bucking the ice.—A term employed by icebreakers to describe the process of ramming heavy ice in an attempt to break it, backing off, and continually repeating the operation until forward progress can be made.

Bummock.—From the point of view of the submariner a downward projection from the underside of the ice canopy; the counter part of a hummock.

Calving.—The breaking away of a mass of ice from an *ice wall, ice front,* or *iceberg.*

Cirque.—A rock amphitheatre at the head of a mountain glacier. It contains the snowfield.

Close pack ice.—*Pack ice* in which the ice *concentration* is 6/8 to 7/8 (7/10 to 8/10) composed of floes mostly in contact.

Compact pack ice.—*Pack ice* in which the *concentration* is 8/8 (10/10) and no water is visible.

Compacted ice edge.–Close clear-cut *ice edge* compacted by wind or current, usually on the windward side of an area of *pack ice.*

Compacting.–Pieces of floating ice are said to be compacting when they are subjected to a converging motion, which increases *ice concentration.*

Concentration.–The ratio in eighths or tenths of the sea surface actually covered by ice to the total area of sea surface; both ice-covered and *ice free*, at a specific location or over a defined area.

Concentration boundary.–A line approximating the transition between two areas of *pack ice* with distinctly different concentrations.

Consolidated pack ice.–*Pack ice* in which the *concentration* is 8/8 (10/10) and the floes are frozen together.

Consolidated ridge.–A *ridge* in which the base has frozen together.

Crack.–Any *fracture* which has not parted.

Dark nilas.–*Nilas* which is under 5 centimetres in thickness and is very dark in colour.

Deformed ice.–A general term for ice which has been squeezed together and forced upward (and downward) in places. Subdivisions are *rafted ice, ridged ice* and *hummocked ice.*

Difficult area.–A general qualitative expression to indicate in a relative manner, that the severity of ice conditions prevailing in an area are such that navigation in it is difficult.

Diffuse ice edge.–Poorly defined *ice edge* limiting an area of dispersed ice, usually on the leeward side of an area of *pack ice.*

Diverging.–*Ice fields* or *floes* in an area are subject to diverging or dispersive motion, thus reducing *ice concentration* and/or relieving stresses in the ice.

Dried ice.–*Sea ice* from the surface of which melt water has disappeared after the formation of *cracks* and *thaw holes.* During the period of drying the surface whitens.

Easy area.–A general qualitative expression to indicate, in a relative manner, that ice conditions prevailing in an area are such that navigation in it is not difficult.

Fast ice.–*Sea ice* which forms and remains fast along the coast, where it is attached to the shore, to an *ice wall,* to an *ice front,* between shoals or grounded icebergs. Vertical fluctuations may be observed during changes of sea level. Fast ice may be formed *in situ* from sea water or by freezing of *pack ice* of any age, to the shore, and it may extend a few metres or several hundred kilometres from the coast. Fast ice more than a year old may be prefixed with the appropriate age category, *old second year.* or *multi-year.* If it is thicker than about 2 metres above sea level, it is called an *ice shelf.*

Fast ice boundary.–The *ice boundary* at any given time between *fast ice* and *pack ice*

Fast ice edge.–The demarcation at any given time between *fast ice* and *open water.*

Finger rafted ice.–Type of *rafted ice* in which *floes* thrust "fingers" alternatively over and under the other.

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Finger rafting.–Type of *rafting* whereby interlocking thrusts are formed, each *floe* thrusting "fingers" alternatively over and under the other. Common in *nilas* and *gray ice.*

Firn.–Old snow that has recrystallized into a dense material. Unlike snow, the particles are to some extent joined together; but unlike snow, the air spaces in it still connect with each other.

First year ice.–*Sea ice* of not more than one winter's growth, developing from *young ice;* thickness from 30 centimetres to 2 metres. May be subdivided into *thin first-year ice/white ice, medium first-year ice,* and *thick first-year ice.*

Flaw.–A narrow separation zone between *pack ice* and *fast ice,* where the pieces of ice are in a chaotic state, that forms when *pack ice* shears under the effect of a strong wind or current along the *fast ice* boundary.

Flaw lead.–A passage between *pack ice* and *fast ice* which is navigable by surface vessels.

Flaw polynya.–A *polynya* between *pack ice* and *fast ice.*

Floating ice.–Any form of ice floating on water. The principal forms of floating ice are *lake ice, river ice, sea ice,* which forms by the freezing of water at the surface, and *glacier ice (ice of land origin)* formed on land or in an *ice shelf.* This also includes ice that is stranded or grounded.

Floe.–Any relatively flat piece of *sea ice* 20 metres or more across. Floes are subdivided according to horizontal extent.

Floeberg.–A massive piece of *sea ice* composed of a *hummock,* or a group of hummocks, frozen together and separated from any ice surroundings. It may float up to 5 metres above sea level.

Flooded ice.–*Sea ice* which has been flooded by melt water or river water and is heavily loaded by water and wet snow.

Fracture.–Any break or rupture through *very close pack ice, compact pack ice, fast ice,* or a single floe resulting from deformation processes. Fractures may contain *brash ice* and/or be covered with *nilas* and/or *young ice.* Length may vary from a few metres to many kilometres.

Fracture zone.–An area which has a great number of *fractures.*

Fracturing.–Pressure process whereby the ice is permanently deformed and rupture occurs. Most commonly used to describe breaking across *very close pack ice, compact ice* and *consolidated pack ice.*

Frazil ice.–Fine spicules or plates of ice suspended in water.

Friendly ice.–From the point of view of the submariner, an *ice canopy* containing many large *skylights* or other features which permit a submarine to surface.

Frost smoke.–Fog-like clouds due to contact of cold air with relatively warm water, which can appear over openings in the ice or leeward of the *ice edge* and may persist while ice is forming.

Giant floe.–Over 10 kilometres across.

Glacier.–A mass of snow and ice continually moving from higher to lower ground, or if afloat, continually spreading. The principal forms of glaciers are: inland ice sheets, *ice shelves, ice streams,* ice caps, ice piedmonts, cirque glaciers, and various types of mountain (valley) glaciers.

Glacier berg.–An irregularly shaped *iceberg.*

Glacier ice.–Ice in or originating from a *glacier,* whether on land or floating on the sea, as *icebergs, bergy bits,* or *growlers.*

Glacier tongue.–Seaward projecting extension of a glacier usually afloat. In the Antarctic, glacier tongues may extend over many tens of kilometres.

Grey ice.–*Young ice* 10 to 15 centimetres thick. Less elastic than *nilas* and breaks on swell. Usually rafts under pressure.

Grey-white ice.–*Young ice* 15 to 30 centimetres thick. Under pressure more likely to ridge than to raft.

Grease ice.–A later stage of freezing than *frazil ice* when the crystals have coagulated to form a soupy layer on the surface. Grease ice reflects little light, giving the sea a matte appearance.

Grounded hummock.–Hummocked *grounded ice* formation. There are single grounded *hummocks* and lines (or chains) of grounded *hummocks.*

Grounded ice.–Floating ice aground in shoal water (see also stranded ice).

Growler.–Smaller piece of ice than a *bergy bit* or *floeberg,* often transparent but appearing green or almost black in colour, extending less than one metre above the sea surface and normally occupying an area of about 20 square metres.

Hostile ice.–From the point of view of the submariner, an *ice canopy* containing no large *skylights* or other features which permit a submarine to surface.

Hummock.–A hillock of broken ice which has been forced upward by pressure. May be fresh or weathered. The submerged volume of broken ice under the hummock, forced downward by pressure is termed a bummock.

Hummocked ice.–*Sea ice* piled haphazardly one piece over another to form an uneven surface. When weathered it has the appearance of smooth hummocks.

Hummocking.–The pressure process by which *sea ice* is forced into *hummocks.* When the floes rotate in the process, it is termed screwing.

Iceberg.–A massive piece of ice of varying shape, more than 5 metres above sea level which has broken away from a *glacier,* and which may be afloat or aground. Icebergs may be described as *tabular,* dome- shaped, sloping, pinnacled, weathered, or *glacier bergs.*

Iceberg tongue.–A major accumulation of *icebergs* projecting from the coast, held in place by grounding and joined together by *fast ice.*

Icebound.–A harbour, inlet, etc., is said to be icebound when navigation by ships is prevented by ice, except possibly with the assistance of an icebreaker.

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Icefoot.–A narrow fringe of ice attached to the coast, unmoved by tides, and remaining after the *fast ice* has moved away.

Iceport.–An embayment in an *ice front*, often of a temporary nature, where ships can moor alongside and unload directly onto the *ice shelf*.

Ice blink.–A whitish glare on low clouds above an accumulation of distance ice.

Ice breccia.–Ice pieces of different age frozen together.

Ice boundary.–The demarcation at any given time between *fast ice* and *pack ice*, or between areas of *pack ice* of different *concentrations* (see ice edge).

Ice cake.–Any relatively flat piece of *sea ice* less than 20 metres across.

Ice canopy.–*Pack ice* from the viewpoint of the submariner.

Ice cover.–The ratio of an area of ice of any *concentration* to the total area of sea surface within a large geographic locale; this locale may be global, hemispherical, or prescribed by a specific oceanographic entity such as Baffin Bay.

Ice edge.–The demarcation at any given time, between the open sea and *sea ice* of any kind, whether fast or drifting. It may be termed compacted or diffuse (see also *ice boundary)*.

Ice field.–Area of *pack ice* consisting of any size of *floes*, which is greater than 10 kilometres across (see also *ice patch*).

Ice free.–No *sea ice* present. There may be some *ice of land origin* (see also *open water)*.

Ice front.–The vertical cliff forming the seaward face of an *ice shelf* or other floating *glacier*, varying in height.

Ice island.–A large piece of floating ice extending about 5 metres above sea level which has broken away from an arctic *ice shelf*, having a thickness of 30 to 50 metres and an area of a few thousand square metres to 500 or more square kilometres, usually characterized by a regularly undulating surface which gives it a ribbed appearance from the air.

Ice jam.–An accumulation of broken *river ice* or *sea ice* caught in a narrow channel.

Ice keel.–From the point of view of the submariner, a downward projecting ridge on the underside of the *ice canopy;* the counterpart of a ridge. Ice keels may extend as much as 50 metres below sea level.

Ice limit.–Climatological term referring to extreme minimum or the extreme maximum extent of the *ice edge* in any given month or period based on observations over a number of years. Term should be preceded by "minimum" or "maximum" (see also *mean ice edge*).

Ice of land origin.–Ice formed on land or in an *ice shelf* and floating in water. The concept includes ice that is stranded or grounded.

Ice massif.–A concentration of *sea ice* covering hundreds of square kilometres found in the same region every summer.

Ice patch.–An area of *pack ice* less than 10 kilometres across.

Ice rind.–A brittle shiny crust of ice formed on a quiet surface by direct freezing or from *grease ice*, usually in water of low salinity. Thickness to about 5 centimetres. Easily broken by wind or swell, commonly breaking into rectangular pieces.

Ice shelf.–A floating ice sheet of considerable thickness showing 2 to 50 metres or more above sea level and attached to the coast.

Ice stream.–Part of an inland ice sheet in which the ice flows more rapidly and not necessarily in the same direction as the surrounding ice. The margins are sometimes clearly marked by a change in direction of the surface slope, but may be indistinct.

Ice under pressure.–Ice in which deformation processes are actively occurring, hence a potential impediment or danger to shipping.

Ice wall.–An ice cliff forming the seaward margin of a *glacier* which is not afloat. An ice wall is aground, the rock basement being at or below sea level (see also *ice front*).

Lake ice.–Ice formed on a lake, regardless of observed location.

Large fracture.–More than 500 metres wide.

Large ice field.–An *ice field* over 20 kilometres across.

Lead.–Any fracture or passage through *sea ice* which is navigable by surface vessels.

Level ice.–*Sea ice* which is unaffected by deformation.

Light nilas.–*Nilas* which is more than 5 centimetres in thickness and rather lighter in colour than *dark nilas*.

Mean ice edge.–Average position of the *ice edge* in any given month or period, based on observations over a number of years. Other terms which may be used are *mean maximum ice edge* and *mean minimum ice edge*.

Medium first year ice.–*First year ice* 70 to 120 centimetres thick.

Medium floe.–100 to 500 metres across.

Medium fracture.–200 to 500 metres wide.

Medium ice field.–An *ice field* 15 to 20 kilometres across.

Multi-year ice.–*Old ice* up to 3 metres or more thick which has survived at least two summers. *Hummocks* smoother than in *second year ice*, and the ice is almost salt-free. Colour where bare, is usually blue. Melt pattern consists of large interconnecting irregular *puddles* and a well- developed drainage system.

New ice.–A general term for recently formed ice which includes *frazil ice, grease ice, slush* and *shuga*. These types of ice are composed of ice crystals which are only weakly frozen together (if at all) and have a definite form only while they are afloat.

New ridge.–*Ridge* newly formed with sharp peaks; slope of side usually 40°. Fragments are visible from the air at low altitude.

Nilas.–A thin elastic crust of ice, easily bending on waves and swell and under pressure, thrusting in a pattern of interlocking "fingers" (finger rafting). Has a matte surface and is up to 10 centimetres in thickness. May be subdivided into *dark nilas* and *light nilas*.

Nip.—Ice is said to nip when it forcibly presses against a ship. A vessel so caught, though undamaged, is said to have been nipped.

Old ice.—*Sea ice* which has at least survived one summer's melt. Most topographic features are smoother than on *first year ice*. May be subdivided into *second-year ice* and *multi-year ice*.

Open pack ice.—*Pack ice* in which the *concentration* is 3/8 to 6/8 (4/10 to 6/10) with many *leads* and *polynyas* and the *floes* are generally not in contact with one another.

Open water.—A large area of freely navigable water in which *sea ice* is present in *concentrations* less than 1/8 (1/10). When there is no *sea ice* present, the area should be termed *ice free*, even though *icebergs* are present.

Pack ice.—Term used in a wide sense to include any accumulation of *sea ice* other than *fast ice*, no matter what form it takes or how disposed.

Pancake ice.—Predominately circular pieces of ice from 30 centimetres to 3 metres in diameter, and up to about 10 centimetres in thickness, with raised rims due to the pieces striking against one another. It may be formed on a slight swell from *grease ice, shuga*, or *slush*, or as a result of the breaking of *ice rind, nilas*, or under severe conditions of swell or wave action, of *grey ice*. It sometimes forms at some depth also, at an interface of water bodies of different physical characteristics, from where it floats to the surface; it may rapidly cover wide areas of water.

Polynya.—Any nonlinear-shaped opening enclosed in ice. Polynyas may contain *brash ice* and/or be covered with *new ice, nilas*, or *young ice*; submariners refer to these as skylights. At times the polynya is limited on one side by the coast and is called a shore polynya, or by *fast ice* and is called a *flaw polynya*. If it recurs in the same position every year, it is called a *recurring polynya*.

Puddle.—An accumulation of melt water on the ice, mainly due to melting snow but in the more advanced stages also to the melting of ice. Initial stage consists of patches of melted snow.

Rafted ice.—Type of deformed ice formed by one piece of ice overriding another (see also *finger rafted ice*).

Rafting.—Pressure processes whereby one piece of ice overrides another. Most common in *new* and *young ice* (see also *finger rafting*).

Ram.—An underwater ice projection from an *ice wall, ice front, iceberg* or *floe*. Its formation is usually due to more intensive melting and erosion of the unsubmerged part.

Recurring polynya.—A *polynya* which recurs in the same position every year.

Ridge.—A line or wall of broken ice forced up by pressure. May be fresh or weathered. The submerged volume of broken ice under a ridge forced downward by pressure is termed an *ice keel*.

Ridged ice.—Ice piled haphazardly one piece over another in the form of ridges or walls. Usually found in *first year ice* (see also *ridging*).

Ridged ice zone.–An area in which much *ridged ice* with similar characteristics has formed.

Ridging.–The pressure process by which *sea ice* is forced into *ridges*.

River ice.–Ice formed on a river, regardless of observed location.

Rotten ice.–*Sea ice* which has become honeycombed and which is in an advanced state of disintegration.

Sastrugi.–Sharp irregular ridges formed on a snow surface by wind erosion and deposition. On mobile *floating ice* the ridges are parallel to the direction of the wind at the time they are formed.

Sea ice.–Any form of ice originating from the freezing of sea water.

Second year ice.–*Old ice* which has survived only one summer's melt. Because it is thicker and less dense than *first-year ice*, it stands higher out of the water. In contrast to *multi-year ice*, summer melting produces a regular pattern of numerous small *puddles*. Bare patches and *puddles, are usually greenish-blue.*

Shearing.–An area of pack ice is subject to shear when the ice motion varies significantly in the direction normal to the motion, subjecting the ice to rotational forces. These forces may result in a phenomenon similar to a *flaw*.

Shore lead.–A lead between *pack ice* and the shore, or between *pack ice* and an *ice front*.

Shore polynya.–A *polynya* between *pack ice* and the coast or between *pack ice* and an *ice front.*

Shuga.–An accumulation of spongy white ice lumps a few centimetres across; formed from *grease ice* or *slush* and sometimes from *anchor ice* rising to the surface.

Skylight.–From the point of view of the submariner, thin places in the *ice canopy*, usually less than one metre in thickness and appearing from below as relatively light translucent patches in dark surroundings. The under surface of an ice skylight is normally flat. Skylights are called large if big enough for a submarine to attempt to surface through them (120 metres) or small if not.

Slush.–Snow that is saturated and mixed with water on land or ice surfaces, or as a viscous floating mass in water, after a heavy snowfall.

Small floe.–20 to 100 metres across.

Small fracture.–50 to 200 metres wide.

Small ice cake.–An *ice cake* less than 2 metres across.

Small ice field.–An ice field 10 to 15 kilometres across.

Standing floe.–A separate *floe* standing vertically or inclined and enclosed by rather smooth ice.

Stranded ice.–Ice which has been floating and has been deposited on the shore by retreating high water.

Strip.–Long narrow area of *pack ice* about one kilometre or less in width, usually composed of small fragments detached from the main mass of ice, and run together under the influence of wind, swell or current.

Tabular berg.–A flat-topped *iceberg*. Most tabular bergs form by calving from an *ice shelf* and show horizontal banding (see also *ice island*).

Thaw holes.–Vertical holes in *sea ice* formed when surface *puddles* melt through to the underlying water.

Thick first year ice.–*First year ice* over 120 centimetres thick.

Thin first year ice/White ice.–*First year* ice 30 to 70 centimetres thick.

Tide crack.–Crack at the line of junction between an immovable *ice foot* or *ice wall* and *fast ice*.

Tongue.–A projection of the *ice edge* up to several kilometres in length caused by wind or current.

Vast floe.–2 to 10 kilometres across.

Very close pack ice.–*Pack ice* in which the concentration is 6/8 to less than 7/8 (9/10 to less than 10/10).

Very open pack ice.–*Pack ice* in which the *concentration* is 1/8 to less than 3/8 (1/10 to less than 3/10), and water preponderates over ice.

Very small fracture.–0 to 50 metres wide.

Very weathered ridge.–*Ridge* with very rounded top; slope of sides usually 20° to 30°.

Water sky.–Dark streaks on the underside of clouds indicating the presence of water features in the vicinity of sea ice.

Weathered ridge.–*Ridge* with slightly rounded peaks; slope of sides usually 30° to 40°. Individual fragments are not discernable.

Weathering.–Processes of ablation and accumulation which gradually eliminate irregularities in an ice surface.

Young coastal ice.–The initial stage of *fast ice* formation consisting of *nilas* or *young ice*, its width varying from a few metres to 200 metres from the shoreline.

Young ice.–Ice in the transition stage between *nilas* and *first year ice*, 10 to 30 centimetres in thickness. May be subdivided into *grey ice* and *grey-white ice*.

APPENDIX 7

ADVISORY COMMITTEE ON NORTHERN DEVELOPMENT
DIRECTORY OF REPRESENTATION

DEPARTMENT OR AGENCY		AGRICULTURE	CANADIAN BROADCASTING CORPORATION	CANADIAN NATIONAL TELECOMMUNICATIONS
Advisory Committee On Northern Developement	Chairman H.B. Robinson IAND 6-4114 Secretary A.D. Hunt IAND 6-6294	S.B. Williams Deputy Minister	L.A. Picard President	
Co-ordinating Committee	Chairman G.S. Murray IAND 2-1988 Secretary W.D. Mills IAND 2-5221	T.H. Anstey Assistant Director General, Western Research Branch	A. Cowan Director Northern Service	
Sub-Committee On Transportation	Chairman M. Hagglund MOT 2-4340 Secretary R.P. Sterling IAND 6-8514			
Sub-Committee On Science And Technology	Chairman Dr. J.D. Keys NRC 3-1926 Secretary G.L. Thompson IAND 6-8514	T.H. Anstey Assistant Director General, Western Research Branch		
Sub-Committee On Northern Communications	Chairman de M. Marchand DOC 5-6279 Secretary E.D. Rainboth IAND 6-8514		M. Ouimet Vice-President Special Service	
Sub-Committee On The Employment Of Native Northerners	Chairman S.W. Hancock Govt. of N.W.T. Secretary R.P. Sterling IAND 6-8514			
Enviornmental Committee Of The Mackenzie Highway	Chairman A.T. Davidson DOE 7-1253 Secretary G.L. Thompson IAND 6-8514			
Federal-Territorial Economic Planning Committee	Chairman A.D. Hunt IAND 6-6294 Secretary G.L. Thompson IAND 6-8514			
Federal Inter-Departmental Co-ordinating Committee Whitehorse	Chairman J. Smith Commissioner Govt. of Y.T. Secretary D. Morrison Govt. of Y.T.		R. Halliday Area Manager	J.L. Phelan Superintendent
Federal Inter-Departmental Co-ordinating Committee Yellowknife	Chairman S.M. Hodgson Commissioner Govt. of N.W.T. Secretary L. Elkin Govt. of N.W.T.		G. Frederick Area Manager	
Inter-Departmental Advisory Committee On Northern Roads	Chairman A.B. Yates IAND 2-5240 Secretary R.S. Fyfe IAND 5-8091			

AGENCY	CANADIAN TRANSPORT COMMISSION	CENTRAL MORTGAGE AND HOUSING CORPORATION	COMMUNICATIONS	ENERGY, MINES AND RESOURCES
Advisory Committee On Northern Development			M.F. Yalden Deputy Minister	J. Austin Deputy Minister
Co-ordinating Committee			deM. Marchand Senior Assistant Deputy Minister	J.P. Drolet Assistant Deputy Minister (Mineral Development) Y.O. Fortier Senior Advisor Earth Sciences
Sub-Committee On Transportation	E. Weinberg Transportation Analyst		T.E. Devey Spectrum Planning and Engineering	R.C. Race Chief, Material and Management R.B. Toombs Senior Adviser Oil and Gas Service
Sub-Committee On Science And Technology		S.A. Gitterman Senior Adviser Technology	J.H. Chapman Assistant Deputy Minister (Research)	C.H. Smith Assistant Deputy Minister Science & Technology D.W.G. White Executive Officer Science and Technology
Sub-Committee On Northern Communications			de M. Marchand Senior Assistant Deputy Minister	R.B. Toombs Senior Adviser Oil and Gas Service
Sub-Committee On The Employment Of Native Northerners				
Environmental Committee Of The Mackenzie Highway				G.M. MacNabb Senior Assistant Deputy Minister
Federal-Territorial Economic Planning Committee				
Federal Inter-Departmental Co-ordinating Committee Whitehorse		W.L. Pollock Manager	J.W.E. Hunter District Inspector	H. Gabrielse
Federal Inter-Departmental Co-ordinating Committee Yellowknife		P. Osborne Manager Edmonton Branch Office	W.A. Johnston Regional Director Central Region Winnipeg	J.C. McGlynn
Inter-Departmental Advisory Committee On Northern Roads				D.M. Watson Acting Chief Resource Management

DEPARTMENT OR AGENCY	ENVIRONMENT	EXTERNAL AFFAIRS	FINANCE	GOVERNMENT OF THE NORTHWEST TERRITORIES
Advisory Committee On Northern Development	R.F. Shaw Deputy Minister	A.E. Ritchie Under-Secretary	S.S. Reisman Deputy Minister	S.M. Hodgson Commissioner
Co-ordinating Committee	D.A. Munro Director General Liaison and Co-ordination Directorate	D.S. McPhail Director General Economic and Science Affairs	H.G.P. Taylor Director Resource Programs Division	J.H. Parker Deputy Commissioner
Sub-Committee On Transportation	R. Lee Atmospheric Environment Service E.A. Olafson, E.P.S. N. Novakowski, C.W.S. G. Ewing, M.S.D.	D.W. Fulford Director, Transport, Communications and Energy Division	A.W. Burges Economic Development Division	L. Elkin Executive Secretariat
Sub-Committee On Science And Technology	M.C.B. Hotz Science Policy Branch I.C.M. Place, C.F.S. M. Cameron, A.E.S. H.F. Fletcher, S.P.B. A.E. Collin, M.S.D. C.J. Kerswill, P.P.C.B.	M. Haffey Director, Scientific Relations Division	J. Dumoulin Economic Development Division	D.L. Stewart Executive Secretariat
Sub-Committee On Northern Communications	E.M. Elsley Atmospheric Environment Service	D.C. Arnould Transport, Communications and Energy Division	J. Dumoulin Economic Development Division	E.M.R. Cotterill Assistant Commissioner
Sub-Committee On The Employment Of Native Northerners				S.W. Hancock Assistant Commission T.G. Forth Department of Local Government
Environmental Committee Of The Mackenzie Highway	A.T. Davidson Assistant Deputy Minister			
Federal-Territorial Economic Planning Committee			H.G.P. Taylor Director Resource Programs Division	J.H. Parker Deputy Commissioner
Federal Inter-Departmental Co-ordinating Committee Whitehorse	G. Jones Fisheries and Marine Service			
Federal Inter-Departmental Co-ordinating Committee Yellowknife	G.T. Glazier District Manager Fisheries			S.M. Hodgson Commissioner J.H. Parker Deputy Commissioner
Inter-Departmental Advisory Committee On Northern Roads			A.W. Burges Economist	J.H. Parker Deputy Commissioner

DEPARTMENT OR AGENCY	GOVERNMENT OF THE YUKON TERRITORY	INDIAN AFFAIRS AND NORTHERN DEVELOPMENT	INDUSTRY, TRADE AND COMMERCE	JUSTICE
Advisory Committee On Northern Development	James Smith Commissioner	H.B. Robinson Deputy Minister		
Co-ordinating Committee		A.D. Hunt Assistant Deputy Minister (Northern Affairs Program)		
Sub-Committee On Transportation	K.J. Baker Territorial Engineer	A.D. Hunt Assistant Deputy Minister (Northern Affairs Program) A.T. Jordan, N.P.P.	K.J. White Office of the Transportation Policy Adviser	
Sub-Committee On Science And Technology	R. Raghunathan Statistical and Planning Advisor	A.D. Hunt Assistant Deputy Minister (Northern Affairs Program) G.W. Rowley, S.A. A.B. Yates, N.P.P.P.B.	R.E. Pomfret Scientific Consultant	
Sub-Committee On Northern Communications	D. Morrison Research Officer	A.D. Hunt Assistant Deputy Minister (Northern Affairs Program) R.J. Green, P.P.R.B.		
Sub-Committee On The Employment Of Native Northerners	P. Frankish Employment Liaison Officer	D.A. Davidson Director, Territorial and Social Development Branch A. Ouellette, S.S.G. P. Corlick, E.L.S. W. Lewis, I.E.E.D.B.		
Environmental Committee Of The Mackenzie Highway		A.D. Hunt Assistant Deputy Minister (Northern Affairs Program)		
Federal-Territorial Economic Planning		A.D. Hunt Assistant Deputy Minister (Northern Affairs Program)	D.G. Laplante General Director Regional Offices Branch	
Federal Inter-Departmental Co-ordinating Committee Whitehorse	James Smith Commissioner F.B. Fingland Assistant Commissioner (Executive)			P. Asselin Crown Attorney
Federal Inter-Departmental Co-ordinating Committee Yellowknife		G.B. Armstrong Regional Director of Resources Yellowknife W.A. Gryba Regional Representative Indian Affairs Yellowknife	W. MacKenzie Hall Regional Manager Edmonton	O. Troy Crown Attorney
Inter-Departmental Advisory Committee On Northern Roads	K.J. Baker Territorial Engineer	K.W. Stairs Acting Assistant Director Technical Services Branch R.S. Fyfe, Technical Services H.W. Woodward, N.N.R.& E. A.B. Yates, N.P.P.P.B.		

DEPARTMENT OR AGENCY	LABOUR	MANPOWER AND IMMIGRATION	MINISTRY OF STATE FOR SCIENCE AND TECHNOLOGY	MINISTRY OF TRANSPORT
Advisory Committee On Northern Development		A.E. Gotlieb Deputy Minister	A. Beaulnes Secretary	O.G. Stoner Deputy Minister
Co-ordinating Committee		E.M. Hutchinson Federal Liaison Division	D.A.W. Judd Senior Science Adviser	M. Hagglund Administrator Arctic Transport-ation Agency P.C. King Policy Adviser
Sub-Committee On Transportation			D.A.W. Judd Senior Science Adviser	M. Hagglund Administrator Arctic Transport-ation Agency W.G. Anderson Director of Planning
Sub-Committee On Science And Technology			D.A.W. Judd Senior Science Adviser	N.R. Core Transportation Development Agency
Sub-Committee On Northern Communications			D.A.W. Judd Senior Science Adviser	M. Hagglund Administrator Arctic Transport-ation Agency
Sub-Committee On The Employment Of Native Northerners	R.W. Traversy Fair Employment Practices Branch	E.M. Hutchinson Federal Liaison Division		
Environmental Committee Of The Mackenzie Highway				
Federal-Territorial Economic Planning Committee				
Federal Inter-Departmental Co-ordinating Committee Whitehorse		E. Standish Manager, Canada Manpower Centre Whitehorse		D. Bell Telecommunications Area Manager
Federal Inter-Departmental Co-ordinating Committee Yellowknife		D.W. Flexhaug Area Manager Northwest Territories		D.J. Dewar Western Regional Administrator G.W. Elliott Manager, Arctic Transport-ation Agency, Yellowknife
Inter-Departmental Advisory Committee On Northern Roads				A.L. Peel Director Highway Branch

AGENCY	MINISTRY OF TRANSPORT (CONTD)	NATIONAL DEFENCE	NATIONAL ENERGY BOARD
Advisory Committee On Northern Development		L.J. L'Heureux Chairman, Defence Research Board Gen. J.A. Dextraze Chief of Defence Staff S. Cloutier Deputy Minister	
Co-ordinating Committee		A.M. Pennie Deputy Chairman (Operations) Defence Research Board Col. A.Z. Sosnkowski, C.P.C. Col. D.P. Hall, D.N.A.D.P.	
Sub-Committee On Transportation	J.B. Lawrence, A.A.P. O.L. Lichtenwald, C.P.S. Capt. G. Brie, M.S. P.C. King, N.T. J.H. Galvin, S.P.E.O. W Jancewicz, T.D.A.	Lt.Col.J.B. Wallace Director, Transportation Resources and Plans Lt. Col. R. Hayman Director Air Operations	W. Rutherford Assistant Chief Engineer
Sub-Committee On Science And Technology		G.D. Watson Chief of Plans Defence Research Board	
Sub-Committee On Northern Communications		W.J. Surtees Defence Research Establishment Ottawa, Defence Research Board Brig. Gen. R.G. Christie, C.P. Col. D.F. Pruner, C.E.O.	
Sub-Committee On The Employment Of Native Northerners			
Environmental Committee Of The Mackenzie Highway			
Federal-Territorial Economic Planning Committee			
Federal Inter-Departmental Co-ordinating Committee Whitehorse		Major S. Deacon Detachment Commander Northern Region headquarters Whitehorse Detachment	
Federal Inter-Departmental Co-ordinating Committee Yellowknife		Brig. Gen. J.A. Fulton Commander Northern Region Headquarters Yellowknife	
Inter-Departmental Advisory Committee On Northern Roads			

DEPARTMENT OR AGENCY	NATIONAL HEALTH AND WELFARE	NATIONAL RESEARCH COUNCIL	NATIONAL REVENUE	NORTHERN CANADA POWER COMMISSION
Advisory Committee On Northern Development	J.H. LeClair Deputy Minister National Health	W.G. Schneider President		
Co-ordinating Committee	W.H. Frost Senior Medical Adviser	C.B. Crawford Assistant Director Division of Building Research		J.H. Love General Manager
Sub-Committee On Transportation	W.H. Frost Senior Medical Adviser			
Sub-Committee On Science And Technology	W.H. Frost Senior Medical Adviser	C.B. Crawford Assistant Director Division of Building Research		
Sub-Committee On Northern Communications	W.H. Frost Senior Medical Adviser	F.R. Hunt Radio and Electronic Engineering Division		
Sub-Committee On The Employment Of Native Northerners				
Environmental Committee Of The Mackenzie Highway				
Federal-Territorial Economic Planning Committee				
Federal Inter-Departmental Co-ordinating Committee Whitehorse	M.V. Norell Zone Director Yukon Zone of Medical Services Branch		F.N. Hackney Collector Customs and Excise, Whitehorse	F. Mooney Regional Manager
Federal Inter-Departmental Co-ordinating Committee Yellowknife	H.B. Brett Regional Director Medical Services Northern Regional Headquarters			A.O. Jones Regional Manager
Inter-Departmental Advisory Committee On Northern Roads				

DEPARTMENT OR AGENCY	NORTHERN TRANSPORTATION CO. LTD.	POST OFFICE	PRIVY COUNCIL OFFICE	PUBLIC SERVICE COMMISSION
Advisory Committee On Northern Development			R.C. Robertson Secretary to the Cabinet	
Co-ordinating Committee	R.W. Hyndman Assistant to the President		P.A. McDougall (Miss) Assistant Secretary to the Cabinet (Government Operations)	
Sub-Committee On Transportation	R.W. Hyndman Assistant to the President			
Sub-Committee On Science and Technology				
Sub-Committee On Northern Communications				
Sub-Committee On The Employment Of Native Northerners				R.C. Moses Native Employment Program
Environmental Committee Of The Mackenzie Highway				
Federal-Territorial Economic Planning Committee				
Federal Inter-Departmental Co-ordinating Committee Whitehorse		M. Stranach Postmaster Whitehorse		
Federal Inter-Departmental Co-ordinating Committee Yellowknife	L. Montpetit Executive Vice-President Edmonton	D.M. MacDonald Area Manager Alberta North District		
Inter-Departmental Advisory Committee On Northern Roads				

DEPARTMENT OR AGENCY	PUBLIC WORKS	REGIONAL ECONOMIC EXPANSION	ROYAL CANADIAN MOUNTED POLICE	SECRETARY OF STATE
Advisory Committee On Northern Development	J.A. MacDonald Deputy Minister		Commissioner W.L. Higgitt	
Co-ordinating Committee	W.R. Binks Program Manager (Civil)	W.W. Mair Senior Policy Advisor, West	Chief Superintendent A.M. Cart	W. Langford Arts and Culture Branch L. Millin Chairman, Citizenship Promotion
Sub-Committee On Transportation	K. Rowsell Program Manager (Marine)			
Sub-Committee On Science And Technology	M.W. Paul Assistant Director Resources (Marine)			
Sub-Committee On Northern Communications		E.L. Clement Planning Division	Superintendent R.S. Wood Superintendent L.E. Young	W. Langford Arts and Culture Branch
Sub-Committee On The Employment Of Native Northerners				L.S. Mandamin Native Citizens Group
Environmental Committee Of The Mackenzie Highway	G.B. Williams Senior Assistant Deputy Minister			
Federal-Territorial Economic Planning Committee		H.G. Mulder Director General Developmental Analysis and Liaison Branch		
Federal Inter-Departmental Co-ordinating Committee Whitehorse	R.K. Coates Manager, Civil Engineering (Yukon)		Inspector W.J. Hunter	
Federal Inter-Departmental Co-ordinating Committee Yellowknife	J.A. Brown Regional Director Western Region		Inspector H.A. Feagan	L. Millin Chairman, Citizenship Promotion R. O'Reilly Arts and Culture Branch
Inter-Departmental Advisory Committee On Northern Roads	W.R. Binks Program Manager (Civil)			

DEPARTMENT OR AGENCY	STATISTICS CANADA	SUPPLY AND SERVICES	TREASURY BOARD
Advisory Committee On Northern Development		J.M. DesRoches Deputy Minister (Supply)	G.F. Osbaldeston Secretary
Co-ordinating Committee		R. Male Operations Planning Branch	R. Richardson Director Industry and Natural Resources Division
Sub-Committee On Transportation	G.E. Clarey Director Transportation and Communications Division	R.A. Paskell Traffic Management	A. Douglas Transportation Communications and Science Division
Sub-Committee On Science And Technology			E. Palmer Transportation Communications and Science Division
Sub-Committee On Northern Communications		G. Chadwell Communications Division	R.M. Aldwinckle Transportation Communications and Science Division
Sub-Committee On The Employment Of Native Northerners			P.L. Rainboth Director Manpower Division
Environmental Committee Of The Mackenzie Highway			
Federal-Territorial Economic Planning Committee			
Federal Inter-Departmental Co-ordinating Committee Whitehorse			
Federal Inter-Departmental Co-ordinating Committee Yellowknife			
Inter-Departmental Advisory Committee On Northern Roads			D.G. McKinnon Program Analyst

APPENDIX 8

ARCTIC WATERS POLLUTION PREVENTION ACT

AND

ARCTIC SHIPPING POLLUTION PREVENTION REGULATIONS

Registration
No. Date
SOR/72-303 2 August, 1972

ARCTIC WATERS POLLUTION PREVENTION ACT

Shipping Safety Control Zones Order

P.C. 1972-1722 2 August, 1972

His Excellency the Governor General in Council, on the recommendation of the Minister of Transport, pursuant to section 11(1) of the Arctic Waters Pollution Prevention Act, is pleased hereby to make the annexed Order prescribing certain areas of the Arctic Waters as Shipping Safety Control Zones.

ORDER PRESCRIBING CERTAIN AREAS OF THE ARCTIC WATERS AS SHIPPING SAFETY CONTROL ZONES

Short Title

1. This Order may be cited as the *Shipping Safety Control Zones Order*.

Interpretation

2. In this Order "seaward boundary" means an imaginary line that is ~~measured seaward~~ from the nearest Canadian land a distance of one hundred nautical miles; except that in the area between the islands of the Canadian Arctic and Greenland, where the line of equidistance between the islands of the Canadian Arctic and Greenland is less than one hundred nautical miles from the nearest Canadian land, there shall be substituted for the line measured seaward one hundred nautical miles from the nearest Canadian land such line of equidistance.

Shipping Safety Control Zones

3. The areas of arctic waters shown in the Appendix and described in the zones set out in the Schedule are hereby prescribed as shipping safety control zones.

SCHEDULE

Zone 1

Commencing at latitude 76°40', longitude 99°00'; thence along parallel of latitude 76°40', to longitude 96°25'; thence along a line to latitude 80°25', longitude 88°00'; thence along a line to the intersection of latitude 82°00' with the seaward boundary in Robeson Channel; thence along the seaward boundary northerly and southwesterly to latitude 72°40' westerly of Banks Island; thence along a line to the most westerly intersection of latitude 74°20' with the shore of Banks Island, near Cape Prince Alfred; thence along the northerly and northeasterly shore of Banks Island to its most

Enregistrement
N° Date
DORS/72-303 2 août 1972

LOI SUR LA PRÉVENTION DE LA POLLUTION DES EAUX ARCTIQUES

Décret sur les zones de contrôle de la sécurité de la navigation

C.P. 1972-1722 2 août 1972

Sur avis conforme du ministre des Transports et en vertu du paragraphe 11(1) de la Loi sur la prévention de la pollution des eaux arctiques, il plaît à Son Excellence le Gouverneur général en conseil de prendre le Décret prescrivant certaines zones des eaux arctiques à titre de zones de contrôle de la sécurité de la navigation, ci-après.

DÉCRET PRESCRIVANT CERTAINES ZONES DES EAUX ARCTIQUES À TITRE DE ZONES DE CONTRÔLE DE LA SÉCURITÉ DE LA NAVIGATION

Titre abrégé

1. Le présent décret peut être cité sous le titre: *Décret sur les zones de contrôle de la sécurité de la navigation.*

Interprétation

2. Dans le présent décret, l'expression «limite au large» désigne une ligne imaginaire éloignée de cent milles marins vers le large du point le plus avancé de la côte du Canada; toutefois, dans la région située entre les îles de l'Arctique canadien et le Groenland, lorsque la ligne d'équidistance entre les îles de l'Arctique canadien et le Groenland est à moins de cent milles marins à partir du point le plus avancé de la côte du Canada, la ligne des cent milles marins vers le large établie à partir du point le plus avancé de la côte du Canada doit être remplacée par cette ligne d'équidistance.

Zones de contrôle de la sécurité de la navigation

3. Les zones des eaux arctiques indiquées dans l'appendice et décrites dans l'annexe sont par les présentes prescrites à titre de zones de contrôle de la sécurité de la navigation.

ANNEXE

Zone 1

Commençant au point 76°40' de latitude, 99°00' de longitude; continuant le long du parallèle 76°40' de latitude jusqu'à 96°25' de longitude; puis le long d'une ligne jusqu'à 80°25' de latitude, 88°00' de longitude; puis le long d'une ligne jusqu'au point d'intersection de 82°00' de latitude et de la limite au large dans le détroit de Robeson; puis le long de la limite au large vers le nord et vers le sud-ouest jusqu'à 72°40' de latitude à l'ouest de l'île Banks; puis le long d'une ligne jusqu'au point d'intersection le plus à l'ouest de la latitude 74°20' avec le littoral de l'île Banks, près du cap Prince-easterly intersection with latitude 73°30', near Russell Point; thence along a line to latitude 74°30', longitude 112°50'; thence along a line to latitude 75°30', longitude 106°10'; thence along a line to latitude 75°50', longitude 99°00'; thence along meridian of longitude 99°00' to the point of commencement;

Alfred; puis le long du littoral nord et nord-est de l'île Banks jusqu'à son point d'intersection le plus à l'est avec la latitude 73°30', près de la pointe Russell; puis le long d'une ligne jusqu'à 74°30' de latitude, 112°50' de longitude; puis le long d'une ligne jusqu'au point 75°30' de latitude, 106°10' de longitude; puis le long d'une ligne jusqu'au point 75°50' de latitude, 99°00' de longitude; puis le long du méridien 99°00' de longitude jusqu'au point de départ.

Zone 2

Commencing at latitude 74°30', longitude 99°00'; thence along parallel of latitude 74°30', to longitude 112°50'; thence along a line to the most easterly intersection of latitude 73°30' with the shore of Banks Island, near Russell Point; thence along the easterly shore of Banks Island to its most easterly intersection with latitude 72°45'; thence along parallel of latitude 72°45', to longitude 117°20'; thence along a line to latitude 70°00', longitude 110°00'; thence along parallel of latitude 70°00', to longitude 99°00'; thence along meridian of longitude 99°00' to the point of commencement;

Zone 2

Commençant au point situé à 74°30' de latitude, 99°00' de longitude; continuant le long du parallèle 74°30' de latitude jusqu'à 112°50' de longitude; le long d'une ligne jusqu'à l'intersection la plus à l'est de la latitude 73°30' avec le littoral de l'île Banks, près de la pointe Russell; puis le long du littoral est de l'île Banks jusqu'à son intersection la plus à l'est avec la latitude 72°45'; puis le long du parallèle 72°45' de latitude jusqu'à 117°20' de longitude; puis le long d'une ligne jusqu'au point 70°00' de latitude, 110°00' de longitude; puis le long du parallèle 70°00' de latitude jusqu'à 99°00' de longitude; puis le long du méridien 99°00' de longitude jusqu'au point de départ;

Zone 3

Commencing at latitude 76°40', longitude 96°25'; thence along parallel of latitude 76°40' to longitude 88°30'; thence along a line to latitude 79°15', longitude 75°30'; thence along parallel of latitude 79°15' to the seaward boundary in Nares Strait; thence along the seaward boundary to latitude 82°00' in Robeson Channel; thence along a line to latitude 80°25', longitude 88°00'; thence along a line to the point of commencement;

Zone 3

Commençant au point 76°40' de latitude, 96°25' de longitude; continuant le long du parallèle 76°40' de latitude jusqu'à 88°30' de longitude; puis le long d'une ligne jusqu'au point 79°15' de latitude, 75°30' de longitude; puis le long du parallèle 79°15' de latitude jusqu'à la limite au large dans le détroit de Nares; puis le long de la limite au large jusqu'à 82°00' de latitude dans le détroit de Robeson; puis le long d'une ligne jusqu'au point 80°25' de latitude, 88°00' de longitude; puis le long d'une ligne jusqu'au point de départ;

Zone 4

Commencing at latitude 70°30', longitude 141°00'; thence along parallel of latitude 70°30', to longitude 138°00'; thence along a line to latitude 72°00', longitude 127°00'; thence along a line to latitude 73°30', longitude 125°00'; thence along parallel of latitude 73°30', to its most westerly intersection with the shore of Banks Island, near Bernard Island; thence along the westerly shore of Banks Island to its most westerly intersection with latitude 74°20', near Cape Prince Alfred; thence along a line to the intersection of latitude 72°40' with the seaward boundary westerly of Banks Island; thence along the seaward boundary to longitude 141°00'; thence along meridian of longitude 141°00' to the point of commencement;

Zone 4

Commençant au point 70°30' de latitude, 141°00' de longitude; continuant le long du parallèle 70°30' de latitude jusqu'à 138°00' de longitude; puis le long d'une ligne jusqu'au point 72°00' de latitude, 127°00' de longitude; puis le long d'une ligne jusqu'au point 73°30' de latitude, 125°00' de longitude; puis le long du parallèle 73°30' de latitude jusqu'à son point d'intersection le plus à l'ouest avec le littoral de l'île Banks, près de l'île Bernard; puis le long du littoral ouest de l'île Banks jusqu'au point d'intersection le plus à l'ouest de 74°20' de latitude, près du cap Prince-Alfred; puis le long d'une ligne jusqu'au point d'intersection de la latitude 72°40' avec la limite au large à l'ouest de l'île Banks; puis le long de la limite au large jusqu'à 141°00' de longitude; puis le long du méridien 141°00' de longitude jusqu'au point de départ;

Zone 5

Commencing at latitude 69°30', longitude 84°00'; thence along parallel of latitude 69°30' to longitude 93°20'; thence along meridian of longitude 93°20' to latitude 67°00'; thence along parallel of latitude 67°00' to longitude 84°00'; thence along meridian of longitude 84°00' to the point of commencement;

Zone 5

Commençant au point 69°30' de latitude, 84°00' de longitude; continuant le long du parallèle 69°30' de latitude jusqu'à 93°20' de longitude; puis le long du méridien 93°20' de longitude jusqu'à 67°00' de latitude; puis le long du parallèle 67°00' de latitude jusqu'à 84°00' de longitude; puis le long du méridien 84°00' de longitude jusqu'au point de départ;

Zone 6

Commencing at latitude 76°40', longitude 99°00'; thence along meridian of longitude 99°00' to latitude 75°50'; thence

Zone 6

Commençant au point 76°40' de latitude, 99°00' de longitude; continuant le long du méridien 99°00' de longitude jusalong a line to latitude 75°30', longitude 106°10'; thence along a line to latitude 74°30', longitude 112°50'; thence along parallel of latitude 74°30' to longitude 99°00'; thence along meridian of longitude 99°00' to latitude 70°00'; thence along parallel of latitude 70°00' to longitude 93°20'; thence along meridian of longitude 93°20' to latitude 69°30'; thence along parallel of latitude 69°30' to longitude 84°00'; thence along meridian of longitude 84°00' to latitude 70°50'; thence along parallel of latitude 70°50' to longitude 87°00'; thence along meridian of longitude 87°00' to latitude 73°45'; thence along parallel of latitude 73°45' to longitude 95°00'; thence along meridian of longitude 95°00' to latitude 75°00'; thence along parallel of latitude 75°00' to longitude 82°00'; thence along a line to the intersection of latitude 76°30' with the seaward boundary in Baffin Bay; thence along the seaward boundary to latitude 79°15' in Nares Strait; thence along parallel of latitude 79°15', to longitude 75°30'; thence along a line to latitude 76°40', longitude 88°30'; thence along parallel of latitude 76°40' to the point of commencement;

Zone 7

Commencing at latitude 70°00', longitude 93°20'; thence along parallel of latitude 70°00', to longitude 104°50'; thence along meridian of longitude 104°50', to latitude 66°20'; thence along parallel of latitude 66°20', to longitude 93°20'; thence along meridian of longitude 93°20' to the point of commencement;

Zone 8

Commencing at latitude 64°20', longitude 93°20'; thence along parallel of latitude 64°20' to its most westerly intersection with the shore of Baffin Island, at Foxe Peninsula; thence along the westerly shore of Baffin Island to its most southerly intersection with longitude 84°00'; thence along meridian of longitude 84°00', to latitude 67°00'; thence along parallel of latitude 67°00', to longitude 93°20'; thence along meridian of longitude 93°20' to the point of commencement;

Zone 9

Commencing at the most easterly intersection of latitude 66°35' with the shore of Baffin Island, near Cape Dyer; thence along parallel of latitude 66°35' to the seaward boundary in Davis Strait; thence along the seaward boundary to latitude 73°15' in Baffin Bay; thence along a line to the most easterly intersection of latitude 72°30' with the shore of Baffin Island, near Cape Macculloch; thence along the easterly shore of Baffin Island to the point of commencement;

Zone 10

Commencing at latitude 66°35', longitude 69°00'; thence along meridian of longitude 69°00', to latitude 64°20'; thence along parallel of latitude 64°20' to the seaward boundary in Davis Strait; thence along the seaward boundary to latitude 66°35' in Davis Strait; thence along parallel of latitude 66°35' to the point of commencement;

qu'à 75°50' de latitude; puis le long d'une ligne jusqu'au point 75°30' de latitude, 106°10' de longitude; puis le long d'une ligne jusqu'au point 74°30' de latitude, 112°50' de longitude; puis le long du parallèle 74°30' de latitude jusqu'à 99°00' de longitude; puis le long du méridien 99°00' de longitude jusqu'à 70°00' de latitude; puis le long du parallèle 70°00' de latitude jusqu'à 93°20' de longitude; puis le long du méridien 93°20' de longitude jusqu'à 69°30' de latitude; puis le long du parallèle 69°30' de latitude jusqu'à 84°00' de longitude; puis le long du méridien 84°00' de longitude jusqu'à 70°50' de latitude; puis le long du parallèle 70°50' de latitude jusqu'à 87°00' de longitude; puis le long du méridien 87°00' de longitude jusqu'à 73°45' de latitude; puis le long du parallèle 73°45' de latitude jusqu'à 95°00' de longitude; puis le long du méridien 95°00' de longitude jusqu'à 75°00' de latitude; puis le long du parallèle 75°00' de latitude jusqu'à 82°00' de longitude; puis le long d'une ligne jusqu'au point d'intersection de la latitude 76°30' et de la limite au large dans la baie Baffin; puis le long de la limite au large jusqu'à 79°15' de latitude dans le détroit de Nares; puis le long du parallèle 79°15' de latitude jusqu'à 75°30' de longitude; puis le long d'une ligne jusqu'au point 76°40' de latitude, 88°30' de longitude; puis le long du parallèle 76°40' de latitude jusqu'au point de départ;

Zone 7

Commençant au point 70°00' de latitude, 93°20' de longitude; continuant le long du parallèle 70°00' de latitude jusqu'à 104°50' de longitude; puis le long du méridien 104°50' de longitude jusqu'à 66°20' de latitude; puis le long du parallèle 66°20' de latitude jusqu'à 93°20' de longitude; puis le long du méridien 93°20' jusqu'au point de départ;

Zone 8

Commençant au point 64°20' de latitude, 93°20' de longitude; continuant le long du parallèle 64°20' de latitude jusqu'à son point d'intersection le plus à l'ouest avec le littoral de l'île Baffin, à la péninsule Foxe; puis le long du littoral ouest de l'île Baffin jusqu'à son point d'intersection le plus au sud avec la longitude 84°00'; puis le long du méridien 84°00' de longitude jusqu'à 67°00' de latitude; puis le long du parallèle 67°00' de latitude jusqu'à 93°20' de longitude; puis le long du méridien 93°20' de longitude jusqu'au point de départ;

Zone 9

Commençant au point d'intersection le plus à l'est de la latitude 66°35' avec le littoral de l'île Baffin, près du cap Dyer; continuant le long du parallèle 66°35' de latitude jusqu'à la limite au large dans le détroit de Davis; puis le long de la limite au large jusqu'à 73°15' de latitude dans la baie Baffin; puis le long d'une ligne jusqu'au point d'intersection le plus à l'est de la latitude 72°30' avec le littoral de l'île Baffin, près du cap Macculloch; puis le long du littoral est de l'île Baffin jusqu'au point de départ;

Zone 10

Commençant au point 66°35' de latitude, 69°00' de longitude; continuant le long du méridien 69°00' de longitude jusqu'à 64°20' de latitude; puis le long du parallèle 64°20' de latitude jusqu'à la limite au large dans le détroit de Davis; puis le long de la limite au large jusqu'à 66°35' de latitude dans le détroit de Davis; puis le long du parallèle 66°35' de latitude jusqu'au point de départ.

Zone 11

Commencing at latitude 70°00', longitude 104°50'; thence along parallel of latitude 70°00' to longitude 110°00'; thence along a line to latitude 72°45', longitude 117°20'; thence along parallel of latitude 72°45' to its most easterly intersection with the shore of Banks Island; thence along the southeasterly shore of Banks Island to its most southerly intersection with longitude 123°00', near Cape Lambton; thence along a line to latitude 66°20', longitude 121°45'; thence along parallel of latitude 66°20' to longitude 104°50'; thence along meridian of longitude 104°50' to the point of commencement;

Zone 12

Commencing at latitude 70°30', longitude 141°00'; thence along meridian of longitude 141°00', to latitude 66°20'; thence along parallel of latitude 66°20', to longitude 121°45'; thence along a line to the most southerly intersection of longitude 123°00' with the shore of Banks Island, near Cape Lambton; thence along the southwesterly shore of Banks Island to its most westerly intersection with latitude 73°30', near Bernard Island; thence along parallel of latitude 73°30', to longitude 125°00'; thence along a line to latitude 72°00', longitude 127°00'; thence along a line to latitude 70°30', longitude 138°00'; thence along parallel of latitude 70°30', to the point of commencement, excluding the following waters:

(*a*) the waters of Shallow Bay, Shoalwater Bay, Trent Bay and Mackenzie Bay as far seaward as a line drawn along the parallel of latitude 69°00'; and

(*b*) the waters of Kugmallit Bay as far seaward as a line drawn along the parallel of latitude 69°31';

Zone 13

Commencing at the intersection of latitude 76°30' with the seaward boundary in Baffin Bay; thence along a line to latitude 75°00', longitude 82°00'; thence along parallel of latitude 75°00' to longitude 95°00'; thence along meridian of longitude 95°00' to latitude 73°45'; thence along parallel of latitude 73°45' to longitude 87°00'; thence along meridian of longitude 87°00' to latitude 70°50'; thence along parallel of latitude 70°50' to longitude 84°00'; thence along a line to the most easterly intersection of latitude 72°30' with the shore of Baffin Island, near Cape Macculloch; thence along a line to the intersection of latitude 73°15' with the seaward boundary in Baffin Bay; thence along the seaward boundary to the point of commencement;

Zone 14

Commencing at latitude 60°00', longitude 77°10'; thence along a line to the most westerly intersection of latitude 64°20' with the shore of Baffin Island, at Foxe Peninsula; thence along parallel of latitude 64°20' to its most westerly intersection with the shore of Southampton Island; thence along the westerly shore of Southampton Island to its most southerly intersection with longitude 87°10', near Cape Kendall; thence along a line

Zone 11

Commençant au point 70°00' de latitude, 104°50' de longitude; continuant le long du parallèle 70°00' de latitude jusqu'à 110°00' de longitude; puis le long d'une ligne jusqu'au point 72°45' de latitude, 117°20' de longitude; puis le long du parallèle 72°45' de latitude jusqu'à son point d'intersection le plus à l'est avec le littoral de l'île Banks; puis le long du littoral sud-est de l'île Banks jusqu'à son point d'intersection le plus au sud avec la longitude 123°00', près du cap Lambton; puis le long d'une ligne jusqu'au point 66°20' de latitude, 121°45' de longitude; puis le long du parallèle 66°20' de latitude jusqu'à 104°50' de longitude; puis le long du méridien 104°50' de longitude jusqu'au point de départ;

Zone 12

Commençant au point 70°30' de latitude, 141°00' de longitude; continuant le long du méridien 141°00' de longitude jusqu'à 66°20' de latitude; puis le long du parallèle 66°20' de latitude jusqu'à 121°45' de longitude; puis le long d'une ligne jusqu'au point d'intersection le plus au sud de la longitude 123°00' et du littoral de l'île Banks, près du cap Lambton; puis le long du littoral sud-ouest de l'île Banks jusqu'à son point d'intersection le plus à l'ouest avec la latitude 73°30', près de l'île Bernard; puis le long du parallèle 73°30' de latitude jusqu'à 125°00' de longitude; puis le long d'une ligne jusqu'au point 72°00' de latitude, 127°00' de longitude; puis le long d'une ligne jusqu'au point 70°30' de latitude, 138°00' de longitude; puis le long du parallèle 70°30' de latitude jusqu'au point de départ, à l'exclusion des eaux suivantes:

a) les eaux de la baie Shallow, de la baie Shoalwater, de la baie Trent et de la baie Mackenzie jusqu'à une ligne au large tirée le long du parallèle 69°00' de latitude; et

b) les eaux de la baie Kugmallit jusqu'à une ligne au large tirée le long du parallèle 69°31' de latitude;

Zone 13

Commençant au point d'intersection de la latitude 76°30' avec la limite au large dans la baie Baffin; continuant le long d'une ligne jusqu'au point 75°00' de latitude, 82°00' de longitude; puis le long du parallèle 75°00' de latitude jusqu'à 95°00' de longitude; puis le long du méridien 95°00' de longitude jusqu'à 73°45' de latitude; puis le long du parallèle 73°45' de latitude jusqu'à 87°00' de longitude; puis le long du méridien 87°00' de longitude jusqu'à 70°50' de latitude; puis le long du parallèle 70°50' de latitude jusqu'à 84°00' de longitude; puis le long d'une ligne jusqu'au point d'intersection le plus à l'est de la latitude 72°30' et du littoral de l'île Baffin, près du cap Macculloch; puis le long d'une ligne jusqu'au point d'intersection de la latitude 73°15' et de la limite au large dans la baie Baffin; puis le long de la limite au large jusqu'au point de départ;

Zone 14

Commençant au point 60°00' de latitude, 77°10' de longitude; continuant le long d'une ligne jusqu'au point d'intersection le plus à l'ouest de la latitude 64°20' et du littoral de l'île Baffin, à la péninsule Foxe; puis le long du parallèle 64°20' de latitude jusqu'à son point d'intersection le plus à l'ouest avec le littoral de l'île Southampton; puis le long du littoral ouest de l'île Southampton jusqu'à son point d'intersection le plus au sud avec la longitude 87°10', près du cap Kendall; puis le long d'une ligne jusqu'au point 60°00' de latitude, 92°00' de lonto latitude 60°00', longitude 92°00'; thence along parallel of latitude 60°00' to the point of commencement;

Zone 15

Commencing at latitude 60°00', longitude 77°10'; thence along parallel of latitude 60°00' to the seaward boundary in the Labrador Sea; thence along the seaward boundary, to latitude 64°20'; thence along parallel of latitude 64°20', to longitude 69°00'; thence along meridian of longitude 69°00', to latitude 65°00'; thence along parallel of latitude 65°00', to longitude 75°00'; thence along a line to the most westerly intersection of latitude 64°20' with the shore of Baffin Island, at Foxe Peninsula; thence along a line to the point of commencement;

Zone 16

Commencing at latitude 60°00', longitude 92°00'; thence along a line to the most southerly intersection of longitude 87°10' with the westerly shore of Southampton Island, near Cape Kendall; thence along the westerly shore of Southampton Island to its most westerly intersection with latitude 64°20'; thence along the parallel of latitude 64°20', to longitude 93°20'; thence along a line to latitude 60°00', longitude 95°00'; thence along parallel of latitude 60°00' to the point of commencement.

Note:

In the descriptions of the shipping safety control zones set out above
(*a*) all lines are the shortest lines between points named unless otherwise specified;
(*b*) "shore" means the upper limit of the shore;
(*c*) all latitudes and longitudes are based on the 1927 North American datum; and
(*d*) geographical names accord with the December 12, 1969 edition of the Arctic Islands Chart number 7000, published by the Canadian Hydrographic Service, Department of Energy, Mines and Resources at Ottawa.

gitude; puis le long du parallèle 60°00' de latitude jusqu'au point de départ;

Zone 15

Commençant au point 60°00' de latitude, 77°10' de longitude; continuant le long du parallèle 60°00' de latitude jusqu'à la limite au large dans la mer du Labrador; puis le long de la limite au large jusqu'à 64°20' de latitude, puis le long du parallèle 64°20' de latitude jusqu'à 69°00' de longitude; puis le long du méridien 69°00' de longitude jusqu'à 65°00' de latitude; puis le long du parallèle 65°00' de latitude jusqu'à 75°00' de longitude; puis le long d'une ligne jusqu'au point d'intersection le plus à l'ouest de la latitude 64°20' et du littoral de l'île Baffin, à la péninsule Foxe; puis le long d'une ligne jusqu'au point de départ.

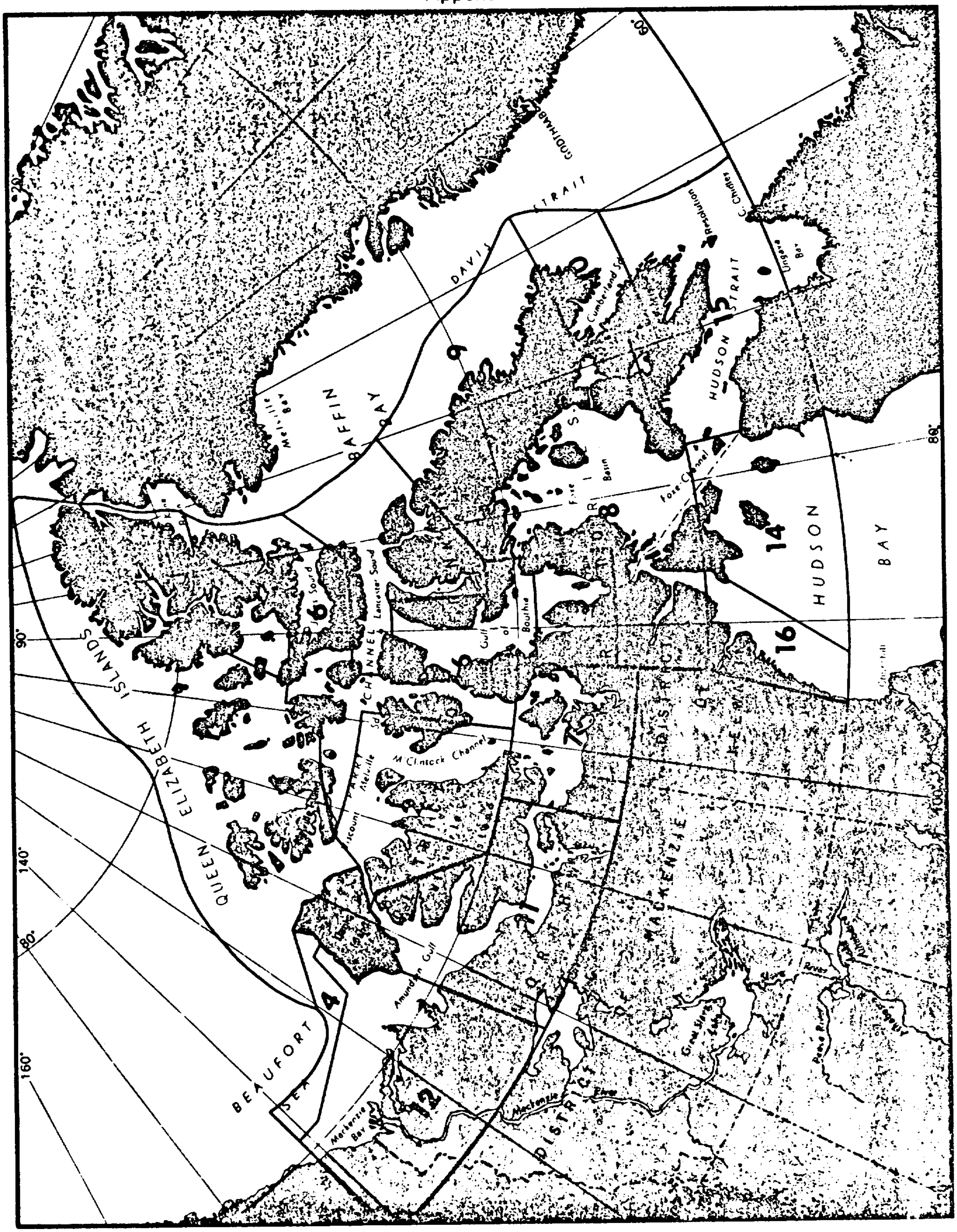
Zone 16

Commençant au point 60°00' de latitude, 92°00' de longitude; continuant le long d'une ligne jusqu'au point d'intersection le plus au sud de la longitude 87°10' et du littoral ouest de l'île Southampton, près du cap Kendall; puis le long du littoral ouest de l'île Southampton jusqu'à son point d'intersection le plus à l'ouest avec la latitude 64°20'; puis le long du parallèle 64°20' de latitude jusqu'à 93°20' de longitude; puis le long d'une ligne jusqu'au point 60°00' de latitude, 95°00' de longitude; puis le long du parallèle 60°00' de latitude jusqu'au point de départ.

Nota:

Dans les descriptions des zones de contrôle de la sécurité de la navigation établies ci-haut
a) toutes les lignes sont, sauf indication contraire, les lignes les plus courtes entre les points indiqués;
b) «littoral» signifie la limite extrême du littoral;
c) toutes les latitudes et les longitudes sont fondées sur la station origine de la triangulation américaine de 1927; et
d) les noms géographiques sont conformes à l'édition du 12 décembre 1969 de la carte n° 7000 des Îles de l'Arctique, publiée par le Service hydrographique du Canada, ministère de l'Énergie, des Mines et des Ressources, à Ottawa.

Appendix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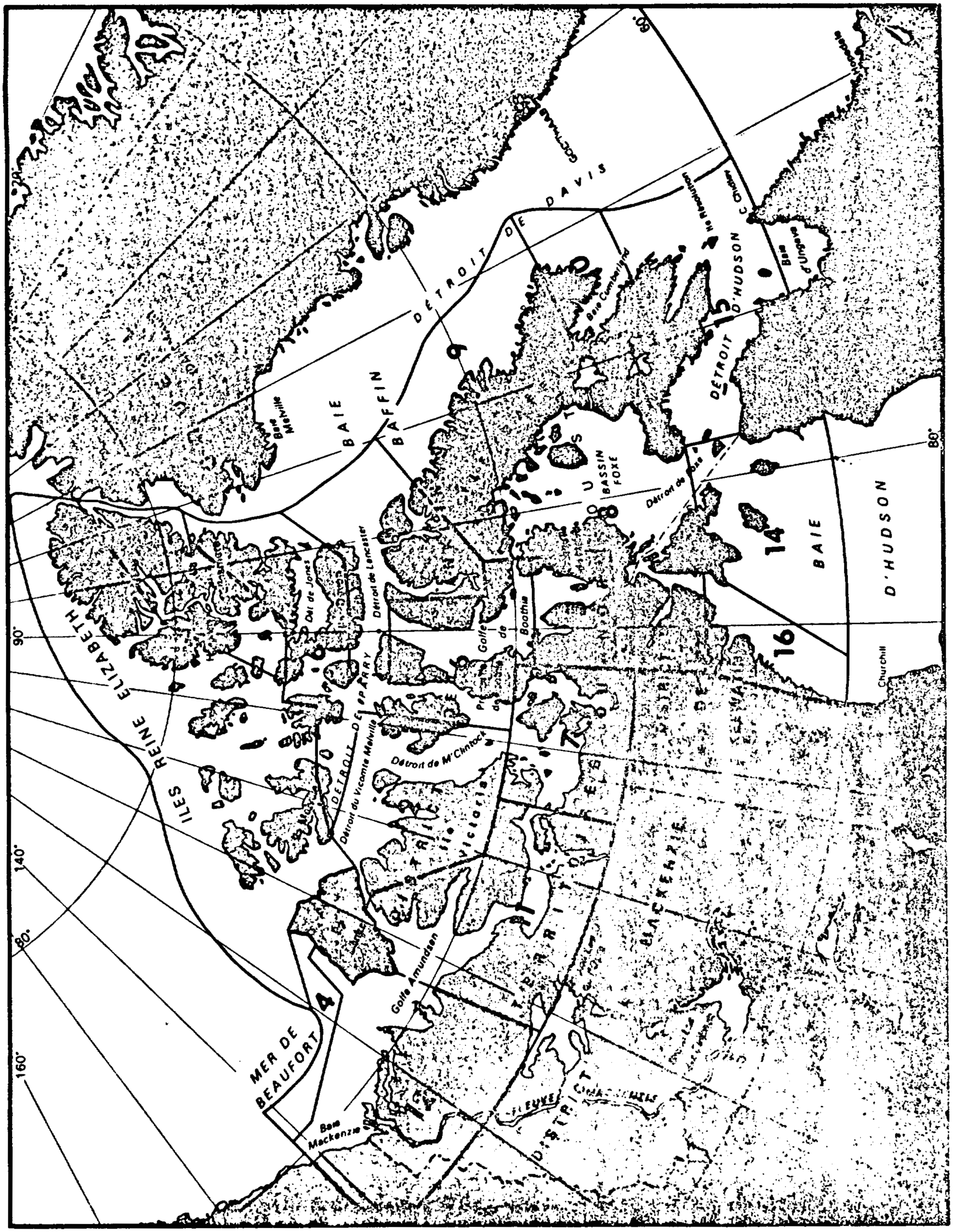
BEAUFORT SEA
BAFFIN BAY
DAVIS STRAIT
HUDSON STRAIT
HUDSON BAY
MACKENZIE
DISTRICT OF KEEWATIN
Melville Bay
Lancaster Sound
Jones Sound
M'Clintock Channel
Melville
Amundsen Gulf
Gulf of Boothia
Foxe Basin
Foxe Channel
Cumberland Sd.
Resolution
C. Chidley
Ungava Bay
GODTHAAB
Mackenzie Bay
Great Slave Lake
Peace River
160°
140°
80°
90°
20°
60°
80°
100°
4
6
9
12
14
15
16

Appendice


MER DE BEAUFORT
ILES REINE ELIZABETH
BAIE BAFFIN
DÉTROIT DE DAVIS
Baie Melville
Dét de Jones
Détroit de Lancaster
DÉTROIT DE PARRY
Détroit du Vicomte Melville
Détroit de M'Clintock
Golfe de Boothia
Golfe Amundsen
Baie Mackenzie
BASSIN FOXE
Baie Cumberland
Ile Résolution
C. Chidley
DÉTROIT D'HUDSON
Baie d'Ungava
BAIE D'HUDSON
Churchill
MACKENZIE
4
9
14
15
16
160°
140°
90°
80°
60°

ARCTIC SHIPPING POLLUTION PREVENTION REGULATIONS

P.C. 1972-2443 dated October 5, 1972

ENGLISH TEXT

ERRATUM

1.	Para. 7(1)(g)	"astronominal" should read "astronomical".
2.	Para. 29(c)	"...where such deposit in minimal..." should read "is"
3.	Schedule F, section 1	"length" means distance if feet".. but should be "in feet"
4.	Schedule F, section 1	"ice breaker" should be one word.
5.	Schedule F, para. 6(c)	second line, word "pentrated" should read "penetrated".
6.	Schedule F, subsection 8(2)	Formula "$\frac{b^2spk}{f}$ inches(cm^3) should read "$\frac{b^2spk}{f}$ inches^3(cm^3).
7.	Schedule F, subparagraph 8(2)(a)(ii)	Two sub-paragraphs (ii) printed. First one to be removed from text.
8.	Schedule F, Sub-paragraph 8(2)(b)(ii)	After the words "...units," insert the following: "the main longitudinal frame spacing in millimetres".
9.	Schedule F, Table 1	Under "Arctic Class Column" numbers 1, 1A, 2, etc. to be moved to the left under heading.
10.	Schedule G, Sub-section 3(2)	Formula should read "tonne metres units).
11.	Schedule G, Paragraph 6(4)(b)	1st line should read "have an average energy value..." not "energy valve".

Registration
No. Date
SOR/72-426 10 October, 1972

ARCTIC WATERS POLLUTION PREVENTION ACT

Arctic Shipping Pollution Prevention Regulations

P.C. 1972-2443 5 October, 1972

His Excellency the Governor General in Council, on the recommendation of the Minister of Transport, pursuant to subsections 4(3), 5(2), 12(1) and 12(3) of the Arctic Waters Pollution Prevention Act, is pleased hereby to make the annexed Regulations Respecting the Prevention of Pollution of Arctic Waters by Ships.

REGULATIONS RESPECTING THE PREVENTION OF POLLUTION OF ARCTIC WATERS BY SHIPS

Short Title

1. These Regulations may be cited as the *Arctic Shipping Pollution Prevention Regulations.*

Interpretation

2. In these Regulations,

"Act" means the *Arctic Waters Pollution Prevention Act;*

"Arctic Class ship" means a self-propelled ship that complies with the construction standards specified as Class 1, 1A, 2, 3, 4, 6, 7, 8 or 10 in Schedules F and G;

"category" in relation to a ship, means an Arctic Class ship or a Type A, B, C, D or E ship;

"complement" means the number of persons comprising the master and crew of a ship;

"deck watch" means that part of the complement that is required for the purpose of attending to the navigation or security of the ship;

"examiner" means a person appointed as an examiner pursuant to section 126 of the *Canada Shipping Act;*

"inspector" means a steamship inspector appointed pursuant to section 366 of the *Canada Shipping Act;*

"master" includes every person having command or charge of any ship, but does not include a pilot;

"oil" means oil of any kind or in any form and, without limiting the generality of the foregoing, includes petroleum, fuel oil, sludge, oil refuse, and oil mixed with wastes, but does not include dredged spoil;

"oily mixture" means a mixture with any oil content;

Enregistrement
N° Date
DORS/72-426 10 octobre 1972

LOI SUR LA PRÉVENTION DE LA POLLUTION DES EAUX ARCTIQUES

Règlement sur la prévention de la pollution des eaux arctiques par les navires

C.P. 1972-2443 5 octobre 1972

Sur avis conforme du ministre des Transports et en vertu des paragraphes 4(3), 5(2), 12(1) et 12(3) de la Loi sur la prévention de la pollution des eaux arctiques, il plaît à Son Excellence le Gouverneur général en conseil d'établir le Règlement concernant la prévention de la pollution des eaux arctiques par les navires, ci-après.

RÈGLEMENT CONCERNANT LA PRÉVENTION DE LA POLLUTION DES EAUX ARCTIQUES PAR LES NAVIRES

Titre abrégé

1. Le présent règlement peut être cité sous le titre: *Règlement sur la prévention de la pollution des eaux arctiques par les navires.*

Interprétation

2. Dans le présent règlement,

«capitaine» comprend toute personne, autre qu'un pilote, ayant le commandement ou la responsabilité d'un navire;

«catégorie», relativement à un navire, s'entend d'un navire de la côte arctique, ou d'un navire de type A, B, C, D ou E;

«Convention de sécurité» désigne la Convention internationale pour la sauvegarde de la vie humaine en mer de 1960, signée à Londres le 12 juin 1960;

«effectif» désigne le nombre de personnes, y compris le capitaine, qui constituent l'équipage d'un navire;

«effluents» s'entend des déjections humaines ou animales produites à bord d'un navire et comprend les excréments provenant des cabinets d'aisance, des urinoirs ou des installations sanitaires où est expulsée de la matière fécale;

«examinateur» désigne une personne nommée examinateur en vertu de l'article 126 de la *Loi sur la marine marchande du Canada;*

«fonctionnaire chargé de la prévention de la pollution» s'entend d'une personne désignée à titre de fonctionnaire chargé de la prévention de la pollution en application de l'article 14 de la Loi;

«hydrocarbures» désigne les hydrocarbures de toute sorte, ou de toute densité et, sans restreindre la portée générale de ce qui précède, comprend le pétrole, le mazout, le cambouis, les résidus d'hydrocarbures, le pétrole mêlé à des déchets, mais ne comprend pas les déchets de dragage;

"person in charge of the deck watch" includes every person who has immediate charge of the navigation or security of a ship, but does not include a pilot;

"pollution prevention officer" means a person designated as a pollution prevention officer pursuant to section 14 of the Act;

"Safety Convention" means the International Convention for the Safety of Life at Sea, 1960, signed at London on the 17th day of June 1960;

"sewage" means human or animal waste generated on board ship and includes wastes from water closets, urinals or hospital facilities handling fecal material;

"ship" includes any description of vessel or boat used or designed for use in navigation without regard to method or lack of propulsion;

"tanker" means a ship in which the greater part of the cargo space is constructed or adapted for the carriage of liquid cargo and is carrying oil in that part of the cargo space;

"Type A ship" means a self-propelled ship that complies with the construction standards specified as Type A in Schedule E;

"Type B, C, D or E ship" means

(a) a self-propelled ship that complies with the construction standards specified as Type B, C, D or E in Schedule E, or

(b) a ship that is not self-propelled, that compiles with the construction standards specified as Type B, C, D or E in Schedule E and that is towed on a line or cable by a tug;

"zone" means an area of the arctic waters prescribed as a shipping safety control zone under section 11 of the Act.

«inspecteur» désigne un inspecteur des navires à vapeur nommé en vertu de l'article 366 de la *Loi sur la marine marchande du Canada;*

«Loi» s'entend de la *Loi sur la prévention de la pollution des eaux arctiques;*

«mélange d'hydrocarbures» désigne un mélange ayant une teneur quelconque en hydrocarbures;

«navire» comprend toute sorte de bâtiments et bateaux servant ou conçus pour servir à la navigation, qu'ils soient ou non dotés d'un moyen de propulsion;

«navire de côte arctique» s'entend d'un navire autopropulseur qui satisfait aux normes de construction désignées comme ressortissant aux cotes 1, IA, 2, 3, 4, 6, 7, 8, ou 10 dans les annexes F et G;

«navire de type A» s'entend d'un navire autopropulsé qui satisfait aux normes de construction désignées comme ressortissant au type A dans l'annexe E;

«navire de type B, C, D ou E» s'entend:

a) d'un navire autopropulsé qui satisfait aux normes de construction désignées comme ressortissant aux types B, C, D ou E dans l'annexe E; ou

b) un navire qui n'est pas autopropulsé et qui satisfait aux normes de construction désignées comme ressortissant aux types B, C, D ou E dans l'annexe E et qui est tiré par un remorqueur au moyen d'une haussière ou d'un câble;

«personne responsable du quart de pont» comprend toute personne, autre qu'un pilote, qui est directement chargée de la navigation ou de la sécurité d'un navire;

«pétrolier» désigne un navire dont les locaux à marchandises sont en grande partie construits pour le transport de cargaisons liquides, ou adaptés à cet usage, et qui transporte des hydrocarbures dans lesdits locaux;

«quart de pont», désigne la partie de l'effectif qui est nécessaire pour assurer la navigation ou la sécurité du navire;

«zone» désigne une partie des eaux arctiques prescrite à titre de zone de contrôle de la sécurité de la navigation en vertu de l'article 11 de la Loi.

Application

3. (1) Subject to subsections (2) to (4) and sections 7, 8 and 19, these Regulations do not apply to a ship of 100 tons, gross tonnage, or less.

(2) Sections 20 to 22 apply to every self-propelled ship of more than 5 tons, gross tonnage, other than

(a) a ship of war;
(b) a pleasure yacht of 100 tons, gross tonnage, or less;
(c) a fishing vessel of 100 tons, gross tonnage, or less; or
(d) a ship that is securely made fast to the shore or laid up.

(3) Sections 28 to 30 apply to every ship.

(4) Sections 4 to 18 and 20 to 27 do not apply to any ship until January 1, 1973.

Application

3. (1) Sous réserve des dispositions des paragraphes (2) à (4) et des articles 7, 8 et 19, le présent règlement ne s'applique pas aux navires d'une jauge brute inférieure ou égale à 100 tonneaux.

(2) Les articles 20 à 22 s'appliquent à tout navire autopropulsé d'une jauge brute supérieure à 5 tonneaux, sauf

a) un navire de guerre;
b) un yacht de plaisance d'une jauge brute inférieure ou égale à 100 tonneaux;
c) un bateau de pêche d'une jauge brute inférieure ou égale à 100 tonneaux; ou
d) un navire solidement amarré au rivage ou désarmé.

(3) Les dispositions des articles 28 à 30 s'appliquent à tout navire.

(4) Les dispositions des articles 4 à 18 et 20 à 27 ne s'appliquent à aucun navire avant le 1er janvier 1973.

Construction of Ships

4. (1) No non-Canadian ship that is registered in a state that is not a signatory to the Safety Convention shall navigate

Construction des navires

4. (1) Il est interdit à un navire non canadien immatriculé dans un État qui n'a pas signé la Convention de sécurité de

in any zone unless it complies, as if it were a Canadian ship, with the following Regulations made pursuant to the *Canada Shipping Act*:

(*a*) *Hull Construction Regulations*;
(*b*) *Steamship Machinery Construction Regulations*;
(*c*) *Hull Inspection Regulations*; and
(*d*) *Steamship Machinery Inspection Regulations*.

(2) No non-Canadian ship of 500 tons, gross tonnage, or more, that is registered in a state that is a signatory to the Safety Convention shall navigate in any zone unless it complies with the requirements of the Safety Convention.

(3) A non-Canadian ship of 500 tons, gross tonnage, or more, shall be deemed to have complied with the requirements of the Safety Convention if it has on board and in force:

(*a*) a Passenger Ship Safety Certificate;
(*b*) a Cargo Ship Safety Construction Certificate; or
(*c*) where the ship has been exempted from any of the provisions of the Safety Convention, an Exemption Certificate.

5. (1) No non-Canadian ship, other than an Arctic class ship, that is registered in a state that is not a signatory to the *International Convention on Load Lines, 1966*, or the *International Load Line Convention, 1930*, shall navigate in any zone unless it complies, as if it were a Canadian ship, with the *Load Line Regulations*.

(2) No non-Canadian ship, other than an Arctic Class ship, that is registered in a state that is a signatory to the *International Convention on Load Lines, 1966* or the *International Load Line Convention, 1930*, shall navigate in any zone unless it complies with the requirements of the Convention to which its state is a signatory.

(3) No non-Canadian Arctic Class ship shall navigate in any zone unless it complies with the requirements of Annex I of the *International Convention on Load Lines 1966*.

(4) Every non-Canadian ship that has on board and in force a load line certificate showing that it complies with the *International Convention on Load Lines, 1966*, the *International Load Line Convention, 1930*, or Annex I of the *International Convention on Load Lines, 1966*, which certificate has been issued by

(*a*) an exclusive surveyor for
  (i) Lloyd's Register of Shipping,
  (ii) American Bureau of Shipping,
  (iii) Bureau Veritas,
  (iv) Det Norske Veritas,
  (v) Germanischer Lloyd, or
  (vi) Registro Italiano Navale,
(*b*) a surveyor of ships in the service of a state that is a signatory to the *International Convention on Load Lines, 1966*, or the *International Load Line Convention, 1930*, or
(*c*) an inspector,

shall be deemed to have complied with subsection (1), (2) or (3) as the case may be.

naviguer dans une zone, à moins qu'il ne satisfasse, au même titre qu'un navire canadien, aux prescriptions des règlements ci-après, qui ont été établis en vertu de la *Loi sur la marine marchande du Canada*:

a) *Règlement sur la construction des coques*;
b) *Règlement sur la construction des machines des navires à vapeur*;
c) *Règlement sur l'inspection des coques*; et
d) *Règlement sur l'inspection des machines des navires à vapeur*.

(2) Il est interdit à un navire non canadien d'une jauge brute égale ou supérieure à 500 tonneaux et qui est immatriculé dans un État signataire de la Convention de sécurité de naviguer dans une zone, à moins qu'il ne satisfasse aux dispositions de ladite Convention;

(3) Un navire non canadien d'une jauge brute égale ou supérieure à 500 tonneaux est réputé avoir satisfait aux dispositions de la Convention de sécurité s'il se trouve à son bord et en état de validité:

a) un certificat de sécurité pour navires à passagers;
b) un certificat de sécurité de construction des navires de charge; ou
c) dans le cas d'un navire affranchi de l'une quelconque des dispositions de la Convention de sécurité, un certificat d'exemption.

5. (1) Il est interdit à un navire non canadien autre qu'un navire de cote arctique, immatriculé dans un État qui n'a pas signé la *Convention internationale sur les lignes de charge, 1966*, ni la *Convention internationale sur les lignes de charge, 1930*, de naviguer dans une zone à moins qu'il ne satisfasse, au même titre qu'un navire canadien, aux dispositions du *Règlement sur les lignes de charge*.

(2) Il est interdit à un navire non canadien autre qu'un navire de la cote arctique, immatriculé dans un État signataire de la *Convention internationale sur les lignes de charge, 1966*, ou de la *Convention internationale sur les lignes de charge, 1930*, de naviguer dans une zone à moins qu'il ne satisfasse aux dispositions de la Convention dont son État est signataire.

(3) Il est interdit à un navire non canadien de cote arctique de naviguer dans une zone à moins qu'il ne satisfasse aux dispositions de l'annexe I de la *Convention internationale sur les lignes de charge, 1966*.

(4) Tout navire non canadien ayant à son bord un certificat de ligne de charge en vigueur attestant qu'il satisfait aux dispositions de la *Convention internationale sur les lignes de charge, 1966*, de la *Convention internationale sur les lignes de charge, 1930*, ou l'annexe I de la *Convention internationale sur les lignes de charge, 1966*, et délivré par

a) un visiteur particulier
  (i) du Lloyd's Register of Shipping,
  (ii) de l'American Bureau of Shipping,
  (iii) du Bureau Véritas,
  (iv) de Det Norske Veritas,
  (v) de Germanischer Lloyd, ou
  (vi) du Registro Italiano Navale;
b) un inspecteur des navires au service d'un État signataire de la *Convention internationale sur les lignes de charge, 1966*, ou de la *Convention internationale sur les lignes de charge, 1930*; ou
c) un inspecteur,

est réputé avoir satisfait aux exigences des paragraphes (1), (2) ou (3), selon le cas.

6. (1) No ship, carrying oil in a quantity in excess of 16,000 cubic feet (452.8 cubic metres), shall navigate in any zone unless

(*a*) it meets the standards of construction prescribed for any category of ship in Schedule E or Schedule F; and

(*b*) in the case of a self-propelled Arctic Class ship, it meets the standards of construction prescribed for that ship in Schedule G.

(2) No category of ship set out in Column I of an item of Schedule H, carrying oil in a quantity in excess of 16,000 cubic feet (452.8 cubic metres), shall navigate in any zone set out in the heading of any other Column of that item

(*a*) where the words "No Entry" are shown in that Column of that item; and

(*b*) where a period of time is shown in that Column of that item, except during that period of time.

Navigating Equipment

7. (1) Notwithstanding subsections 19(4) and (5), 20(3), 21(3) and (4) and 24(3) of the *Navigating Appliances Regulations*, no self-propelled ship shall navigate within any zone unless it complies with sections 4 to 13, 17, and 19 to 28 of Part I of the *Navigating Appliances Regulations* as if it were a ship to which Part I of those Regulations applies and within waters to which that Part applies, and unless it complies with the following standards:

(*a*) in the case of a ship of 500 tons, gross tonnage, or more, it shall be fitted with at least one efficient gyro compass described in subsection (3);

(*b*) in the case of a ship that is

(i) of 1,600 tons, gross tonnage, or more, and navigating in zone 1, 2, 3, 5, 6, 7 or 13,

(ii) of 5,000 tons, gross tonnage, or more, and navigating in zone 4, 8, 9, 11 or 16, and

(iii) of 50,000 tons, gross tonnage, or more, and navigating in zone 10, 12, 14, or 15,

it shall be fitted with at least two efficient gyro compasses described in subsection (3);

(*c*) in the case of a ship of 100 tons, gross tonnage, or more, it shall be fitted with at least one marine radar installation described in subsection (4);

(*d*) in the case of a ship of 1,600 tons, gross tonnage, or more, it shall be fitted with at least two marine radar installations described in subsection (4);

(*e*) in the case of a ship of 100 tons, gross tonnage, or more, it shall be fitted with at least one efficient echo sounding device;

(*f*) in the case of a ship of 1,600 tons, gross tonnage, or more, navigating in any zone other than zone 14, 15, or 16, it shall be fitted with at least two efficient echo sounding devices;

(*g*) in the case of a ship of 1,600 tons, gross tonnage, or more, it shall carry navigating instruments and publications

6. (1) Il est interdit à un navire qui transporte une quantité d'hydrocarbures supérieure à 16,000 pieds cubes (452.8 mètres cubes) de naviguer dans une zone sauf

a) s'il répond aux normes de construction prescrites pour chaque catégorie de navire dans l'annexe E ou dans l'annexe F; et,

b) s'il répond, dans le cas d'un navire autopropulsé de la cote arctique, aux normes de construction prescrites pour un tel navire dans l'annexe G.

(2) Il est interdit à toute catégorie de navire dont il est fait mention à l'un des articles de l'annexe H, dans la colonne I, et qui transporte des hydrocarbures en quantité supérieure à 16,000 pieds cubes (452.8 mètres cubes), de naviguer dans une zone mentionnée en rubrique d'une autre colonne à cet article

a) si les mots «Entrée interdite» figurent dans cette autre colonne au même article; et

b) si une période de temps est indiquée dans cette autre colonne, au même article, en d'autre temps que la période indiquée.

Équipement de navigation

7. (1) Nonobstant les dispositions des paragraphes 19(4) et (5), 20(3), 21(3) et (4) et 24(3) du *Règlement sur les appareils de navigation*, il est interdit à un navire autopropulsé de naviguer dans les limites d'une zone s'il ne satisfait pas aux dispositions des articles 4 à 13, 17 et 19 à 28 de la partie I du *Règlement sur les appareils de navigation* comme s'il s'agissait d'un navire et des eaux visés par la partie I dudit règlement, s'il ne satisfait pas aux normes ci-après:

a) dans le cas d'un navire d'une jauge brute égale ou supérieure à 500 tonneaux, il doit être équipé d'au moins un gyrocompas de fonctionnement sûr conforme à la description qu'en fait le paragraphe (3);

b) dans le cas d'un navire

(i) d'une jauge égale ou supérieure à 1,600 tonneaux naviguant dans les zones 1, 2, 3, 5, 6, 7 ou 13,

(ii) d'une jauge brute égale ou supérieure à 5,000 tonneaux naviguant dans les zones 4, 8, 9, 11 ou 16, et

(iii) d'une jauge brute égale ou supérieure à 50,000 tonneaux naviguant dans les zones 10, 12, 14 ou 15,

il doit être équipé d'au moins deux gyrocompas de fonctionnement sûr conformes à la description qu'en fait le paragraphe (3);

c) dans le cas d'un navire d'une jauge brute égale ou supérieure à 100 tonneaux, il doit être équipé d'au moins une installation de radar maritime conforme à la description qu'en fait le paragraphe (4);

d) dans le cas d'un navire d'une jauge brute égale ou supérieure à 1,600 tonneaux, il doit être équipé d'au moins deux installations de radar maritime conformes à la description qu'en fait le paragraphe (4);

e) dans le cas d'un navire d'une jauge brute égale ou supérieure à 100 tonneaux, il doit être équipé d'au moins un sondeur à ultra-sons de fonctionnement sûr;

f) dans le cas d'un navire d'une jauge brute égale ou supérieure à 1,600 tonneaux, naviguant dans des zones autres que les zones 14, 15 ou 16, il doit être équipé d'au moins deux sondeurs à ultra-sons de fonctionnement sûr;

g) dans le cas d'un navire d'une jauge brute égale ou supérieure à 1,600 tonneaux, il doit emporter les instruments et les documents de navigation nécessaires pour déterminer necessary to determine compass error and positions by astronominal means; and

(h) in the case of an Arctic Class ship or a Type A ship it shall be provided with a facsimile terminal capable of receiving transmission from stations Halifax CFH and Edmonton VFE and from ice reconnaissance aircraft on the frequencies listed in the publication *Radio Aids to Marine Navigation* published by the Department of Transport.

(2) Every self-propelled ship shall be provided with

(a) the manufacturer's operating and maintenance manuals for the navigational appliances and apparatus required by this section; and

(b) such spare parts as are recommended to be carried by the operating and maintenance manuals referred to in paragraph *(a)*.

(3) Every gyro compass required by paragraph (1)*(a)* or *(b)* shall

(a) provide gyro heading information at the normal steering position; and

(b) be capable of giving, according to the manufacturer's specifications, reliable heading information at the latitudes in which the ship is operating.

(4) Every marine radar installation required by paragraph (1)*(c)* or *(d)* shall

(a) comply with Schedule D to the *Navigating Appliances Regulations*; and

(b) be equipped with plotting facilities at or close to the position of the radar display unit.

Charts and Publications

8. No self-propelled ship shall navigate within any zone unless it complies with Part I of the *Charts and Publications Regulations*, as if it were a ship to which Part I of those Regulations ~~applies and within waters~~ to which that Part applies.

Ship Station Radio

9. (1) No ship of 300 tons, gross tonnage, or more, shall navigate within zone 1, 2, 3, 4, 5, 6, 8, 9, 10 or 13 unless it

(a) has on board a radiotelephone for which complete operational control is provided at the conning position and that is able to receive and transmit on at least the following frequencies:

(i) 2182 kHz;

(ii) 2638 kHz; and

(iii) two of the frequencies in the 2MHz band set out in the publication *Radio Aids to Marine Navigation*, published by the Department of Transport, for the radio stations that serve the area in which the ship is located; and

(b) has on board

(i) a radiotelegraph able to receive and transmit on frequencies in the 405 to 535 kHz band, or

(ii) a radiotelephone for which complete operational control is provided at the conning position and that is able to receive and transmit, with A3J, A3H and A3A types of emission, on frequencies in the 4 to 16 MHz band, including the frequencies set out in the publication *Radio Aids to Marine Navigation*, published by the Department

l'erreur du compas et sa position par relèvements astronomiques; et

h) dans le cas d'un navire de cote arctique ou d'un navire de cote A, il doit être pourvu d'un bélinographe récepteur capable de capter les émissions en provenance des stations CFH, d'Halifax, et VFE, d'Edmonton, ainsi que des aéronefs de reconnaissance des glaces, sur les fréquences dont la liste est donnée dans la publication intitulée *Aides radio à la navigation maritime* du ministère des Transports.

(2) Tout navire autopropulsé doit être muni

a) de manuels d'utilisation et d'entretien du constructeur, assortis aux moyens et apparaux de navigation que prescrit le présent article; et

b) de toutes pièces de rechange dont l'embarquement est préconisé dans les manuels d'utilisation et d'entretien dont il est question à l'alinéa *a)*.

(3) Tout gyrocompas exigé aux termes des alinéas 1*a)* ou *b)* doit

a) fournir des indications gyroscopiques de cap au poste de timonerie normal; et

b) pouvoir, selon les spécifications du constructeur, fournir avec certitude des indications de cap aux latitudes sous lesquelles navigue le navire.

(4) Toute installation de radar maritime exigée aux termes des alinéas 1*c)* ou *d)* doit

a) satisfaire aux dispositions de l'annexe D au *Règlement sur les appareils de navigation;* et

b) être dotée des moyens de pointage situés sur l'écran-récepteur ou à proximité de l'écran-récepteur.

Cartes et publications

8. Il est interdit à un navire autopropulsé de naviguer dans une zone s'il ne satisfait pas aux dispositions de la partie I du *Règlement sur les cartes et publications* au même titre que s'il s'agissait d'un navire et des eaux visés par ladite partie.

Station radio des navires

9. (1) Il est interdit à un navire d'une jauge brute égale ou supérieure à 300 tonneaux de naviguer dans les zones 1, 2, 3, 4, 5, 6, 8, 9, 10 ou 13 sans

a) avoir à bord un radiotéléphone dont l'ensemble des éléments nécessaires à la transmission des messages se trouve au poste de commandement et qui puisse capter et transmettre au moins sur les fréquences suivantes:

(i) 2182 kHz;

(ii) 2638 kHz; et

(iii) deux des fréquences situées dans la bande de 2MHz et indiquées dans la publication intitulée *Aides radio à la navigation maritime* du ministère des Transports, en ce qui a trait aux stations desservant la région dans laquelle se trouve le navire; et

b) avoir à bord

(i) un radiotélégraphe qui puisse capter et transmettre sur la bande des fréquences de 405 à 535 kHz, ou

(ii) un radiotéléphone dont l'ensemble des éléments nécessaires à la transmission des messages se trouve au poste de commandement et qui puisse capter et transmettre en émission de types A3J, A3H et A3A sur la bande des fréquences de 4 à 16 MHz, y compris les fréquences indiquées dans la publication intitulée *Aides radio à la navigation maritime* du ministère des Transports, en of Transport, for the radio stations located north of the sixtieth parellel of north latitude that serve the area in which the ship is located.

(2) No ship of 300 tons, gross tonnage, or more, shall navigate within zone 7, 11 or 12 unless it has on board a radiotelephone as described in paragraph (1)(*a*).

(3) No ship of 300 tons, gross tonnage, or more, shall navigate within zone 14, 15 or 16 unless it has on board

(*a*) a radiotelephone as described in paragraph (1)(*a*); or

(*b*) a radiotelegraph as described in subparagraph (1)(*b*)(i).

(4) No ship to which subsection (1), (2) or (3) applies shall navigate within any of the zones described in subsection (1), (2) or (3), whichever is applicable, unless a continuous listening watch for the radiotelephone is kept,

(*a*) in the case of a ship to which subsection (1) applies, on 2182 kHz, and where the ship has on board a radiotelephone as described in subparagraph (1)(*b*)(ii), on 4409.4 kHz;

(*b*) in the case of a ship to which subsection (2) applies on 2182 kHz; and

(*c*) in the case of a ship to which subsection (3) applies that has on board a radiotelephone as described in paragraph (1)(*a*), on 2182 kHz.

(5) Every radiotelegraph and every radiotelephone required by this section to be on board a ship shall comply with section 20 or 37 of the *Ship Station Radio Regulations*, Part II, whichever is applicable.

Bunkering Station

10. No Arctic Class ship shall navigate within any zone unless it is provided

(*a*) on each side of the deck with a bunkering station to which may be connected a bunkering hose with a flange that has the dimensions shown in Schedule J,

(*b*) with one or more lengths of bunkering hose, capable of being connected to the bunkering stations, the total length and bore of which shall be at least 100 feet and 4 inches respectively; and

(*c*) with such handling facilities as are necessary to permit the safe control of a bunkering hose link-up from one ship to another.

Equivalents

11. Where these Regulations require that a particular construction, machinery fitting, appliance, apparatus or material be fitted or carried in a ship or any particular provision to be made in a ship, a pollution prevention officer may allow any other construction, machinery fitting, appliance, apparatus or material to be fitted or carried, or any other provision to be made, if he is satisfied that such other construction, machinery, fitting, appliance, apparatus, material or provision is at least equivalent to that required by these Regulations.

ce qui concerne les stations situées au nord du soixantième parallèle de latitude nord et qui desservent la région dans laquelle se trouve le navire.

(2) Il est interdit à un navire d'une jauge brute égale ou supérieure à 300 tonneaux de naviguer dans les zones 7, 11 ou 12 à moins d'avoir à bord un radiotéléphone conforme à la description qu'en fait l'alinéa (1)*a*).

(3) Il est interdit à un navire d'une jauge brute égale ou supérieure à 300 tonneaux de naviguer dans les zones 14, 15 ou 16 à moins d'avoir à bord

a) un radiotéléphone conforme à la description donnée à l'alinéa (1)*a*); ou

b) un radiotélégraphe conforme à la description donnée au sous-alinéa (1)*b*)(i).

(4) Il est interdit à un navire auquel s'appliquent les dispositions des paragraphes (1), (2) ou (3) de naviguer dans l'une quelconque des zones indiquées, selon le cas, aux paragraphes (1), (2) ou (3), sans maintenir en permanence une veille radiotéléphonique,

a) s'il s'agit d'un navire auquel s'appliquent les dispositions du paragraphe (1), sur 2182 kHz et si le navire a à bord un radiotéléphone conforme à la description donnée au sous-alinéa (1)*b*)(ii), sur 4409.4 kHz;

b) s'il s'agit d'un navire auquel s'appliquent les dispositions du paragraphe (2), sur 2182 kHz; et

c) s'il s'agit d'un navire auquel s'appliquent les dispositions du paragraphe (3) et ayant à bord un radiotéléphone conforme à la description donnée à l'alinéa (1)*a*), sur 2182 kHz.

(5) Tout radiotélégraphe et tout radiotéléphone dont le présent article exige la présence à bord d'un navire doit, selon le cas, satisfaire aux dispositions de l'article 20 ou de l'article 37 du *Règlement sur les stations radio des navires*, partie II.

Poste de mazoutage

10. Il est interdit à un navire de la cote arctique de naviguer dans une zone s'il n'est pourvu

a) de chaque côté du pont, d'un poste de mazoutage auquel une manche de mazoutage pourra être raccordée au moyen d'une bride ayant les dimensions indiquées à l'annexe J;

b) d'une ou de plusieurs sections de manche de mazoutage pouvant être raccordées au poste de mazoutage et dont la longueur totale et le diamètre intérieur doivent être respectivement d'au moins 100 pieds et 4 pouces; et

c) des installations de manutention nécessaires pour permettre de raccorder sans danger sa manche de mazoutage à celle d'un autre navire.

Équivalences

11. Lorsque le présent règlement prescrit d'installer ou d'avoir à bord d'un navire un ouvrage, un accessoire de machine, un dispositif, un appareil ou un matériau, ou encore prescrit un quelconque aménagement à apporter au navire, un fonctionnaire chargé de la prévention de la pollution peut permettre d'installer tout autre ouvrage, accessoire de machine, dispositif, appareil ou materiau à installer ou à avoir à bord, ou encore d'apporter tout autre aménagement, s'il estime qu'un tel ouvrage, accessoire de machine, dispositif, appareil, matériau ou aménagement est au moins l'équivalent de ce que prescrit le présent règlement.

Arctic Pollution Prevention Certificate

12. The owner or master of any ship that proposes to navigate within any zone may apply to one of the persons referred to in section 13 for the issuance of an arctic pollution prevention certificate.

13. (1) Subject to section 14,
(*a*) an inspector, or
(*b*) an exclusive surveyor for
(i) Lloyd's Register of Shipping,
(ii) American Bureau of Shipping,
(iii) Bureau Veritas,
(iv) Det Norske Veritas,
(v) Germanischer Lloyd, or
(vi) Registro Italiano Navale
may issue an arctic pollution prevention certificate to the owner or master of a ship that is in non-Canadian waters.

(2) Subject to section 14, an inspector may issue an arctic pollution prevention certificate to the owner or master of a ship that is within Canadian waters.

14. No arctic pollution prevention certificate shall be issued to the owner or master of a ship unless the ship complies with the standards prescribed by these Regulations in respect of that ship.

15. An arctic pollution prevention certificate shall be in the form set out in Schedule A and shall specify
(*a*) the date of expiration of the certificate;
(*b*) the lightest operating draft, forward and aft;
(*c*) the deepest operating load draft, forward and aft; and
(*d*) the category, if any, into which the ship falls at those drafts.

16. Subject to sections 17 and 18, an arctic pollution prevention certificate issued to the owner or master of a ship pursuant to sections 12 to 14 is, in the absence of any evidence to the contrary, proof that such ship complies with such of the standards prescribed by these Regulations as are or would be applicable to it.

17. (1) Subject to subsection (2) and subsection 18(2), an arctic pollution prevention certificate is valid until the date of expiration shown on the certificate which date shall in no case be later than the 31st day of March next following the date of issue.

(2) When an inspector conducts an inspection of a ship and is of the opinion
(*a*) that the ship does not comply with the essential conditions subject to which the arctic pollution prevention certificate was issued, or
(*b*) that the ship is in danger of depositing or causing the deposit of waste into the water of a zone in violation of subsection 4(1) of the Act,
he may declare or endorse the arctic pollution prevention certificate invalid.

18. (1) Where any change affecting the essential conditions subject to which an arctic pollution prevention certificate was issued, occurs to a ship in respect of which the arctic pollution prevention certificate has been issued, the owner or master of the ship shall report the change to

Certificat de prévention de la pollution dans l'Arctique

12. Le propriétaire ou le capitaine de tout navire qui se propose de naviguer dans une zone peut s'adresser à l'une des personnes dont il est question à l'article 13 pour se faire délivrer un certificat de prévention de la pollution dans l'Arctique.

13. (1) Sous réserve de l'article 14,
a) un inspecteur; ou
b) un visiteur particulier
(i) du Lloyd's Register of Shipping,
(ii) de l'American Bureau of Shipping,
(iii) du Bureau Véritas,
(iv) de Det Norske Véritas,
(v) de Germanischer Lloyd, ou
(vi) du Registro Italiano Navale,
peuvent délivrer un certificat de prévention de la pollution dans l'Arctique au propriétaire ou au capitaine d'un navire qui se trouve hors des eaux canadiennes.

(2) Sous réserve de l'article 14, un inspecteur peut délivrer un certificat de prévention de la pollution dans l'Arctique au propriétaire ou au capitaine d'un navire qui se trouve dans les eaux canadiennes.

14. Aucun certificat de prévention de la pollution dans l'Arctique n'est délivré au propriétaire ou au capitaine d'un navire si ce navire n'est pas conforme aux normes que prescrit le présent règlement pour ce navire.

15. Un certificat de prévention de la pollution dans l'Arctique doit être établi selon la formule présentée à l'annexe A et doit préciser
a) la date d'expiration du certificat;
b) la ligne de charge minimale prévue, avant et arrière;
c) la ligne de charge maximale prévue, avant et arrière; et
d) s'il y a lieu, la catégorie à laquelle le navire appartient compte tenu de ces tirants d'eau.

16. Sous réserve des dispositions des articles 17 et 18, un certificat de prévention de la pollution dans l'Arctique délivré au propriétaire ou au capitaine du navire en application des articles 12 à 14 est un certificat qui, en l'absence de toute preuve du contraire, atteste que le navire est conforme aux normes prescrites par le règlement qui lui est ou pourrait lui être applicable.

17. (1) Sous réserve des dispositions du paragraphe (2) et du paragraphe 18(2), un certificat de prévention de la pollution dans l'Arctique est valide jusqu'à la date d'expiration qui s'y trouve mentionnée, date qui en aucun cas ne doit être postérieure au 31 mars qui suit la date de delivrance.

(2) Lorsqu'un inspecteur inspecte un navire et qu'il est d'avis
a) que le navire ne remplit pas les conditions essentielles auxquelles le certificat de prévention de la pollution a été délivré; ou
b) que le navire risque de déposer ou de faire déposer des déchets dans les eaux d'une zone, en violation des dispositions du paragraphe 4(1) de la Loi,
il peut déclarer le certificat de prévention de la pollution dans l'Arctique invalide ou l'annoter comme tel.

18. (1) Lorsqu'une modification de nature à influer sur les conditions essentielles auxquelles un certificat de prévention de la pollution dans l'Arctique a été délivré se produit dans le cas d'un navire pour lequel un certificat de prévention de la pollution dans l'Arctique a été délivré, le propriétaire ou le capitaine du navire doit signaler la modification

(a) the pollution prevention officer who, to the best of his knowledge, is nearest to the ship; or

(b) a pollution prevention officer at the nearest location listed in Schedule B.

(2) Where the owner or master of a ship fails to comply with subsection (1), without reasonable cause, the arctic pollution prevention certificate issued to him in respect of that ship is invalid if the ship navigates within a zone.

Dangerous Goods

19. No ship shall navigate within any zone unless it complies with the *Dangerous Goods Shipping Regulations*, as if it were a ship to which those Regulations apply and within waters to which those Regulations apply.

Navigation Personnel

20. No self-propelled ship shall navigate within any zone unless the ship complies with the standards set out in sections 21 to 25.

21. (1) Subject to subsection (2), at least two separate and distinct deck watches shall be established for every ship.

(2) At least one deck watch shall be established for a ship that is operated with a shift on board and a shift ashore daily work system.

(3) The master on board every ship shall be on duty as required by the ordinary practice of seamen.

(4) A deck watch that complies with section 22 shall be on duty on board every ship.

22. (1) Subject to subsection (2), the deck watch shall consist of at least each of the following persons:

(a) a person in charge of the deck watch;

(b) an additional person, except on

(i) a ship engaged in log sorting or yarding operations carried out without the use of lines or chains at a booming ground,

(ii) a ship of 100 tons, gross tonnage, or less, carrying 12 passengers or less, that is making a voyage of 5 nautical miles or less in good visibility between sunrise and sunset in any one day within the limits of a harbour and is not pushing or towing a floating object, or

(iii) a ship of 1,000 tons, gross tonnage, or less, that is securely moored or anchored;

(c) a second additional person on a ship of more than 1,000 tons, gross tonnage, that is not securely moored or anchored; and

(d) a person qualified, in accordance with section 24, in the use of a radiotelephone except on

(i) a ship of 100 tons, gross tonnage, or less, or

(ii) a ship of more than 100 tons, gross tonnage, where the person in charge of the deck watch is qualified in accordance with section 24.

(2) In the case of a ship of more than 1,000 tons, gross tonnage, that is not securely moored or anchored, the master shall not be included in the deck watch for the purposes of subsection (1).

a) au fonctionnaire chargé de la prévention de la pollution qui, à sa connaissance, se trouve le plus proche du navire; ou

b) au fonctionnaire chargé de la prévention de la pollution qui se trouve dans la plus proche des localités énumérées à l'annexe B.

(2) Lorsque le propriétaire ou le capitaine d'un navire manque, sans raison valable, de se conformer aux dispositions du paragraphe (1), le certificat de prévention de la pollution dans l'Arctique qui lui a été délivré relativement à ce navire est réputé invalide si le navire navigue dans une zone.

Marchandises dangereuses

19. Il est interdit à un navire de naviguer dans une zone s'il ne se conforme pas au *Règlement sur le transport maritime des marchandises dangereuses*, comme s'il s'agissait d'un navire et des eaux auxquels s'applique ledit règlement.

Personnel de navigation

20. Il est interdit à un navire automoteur de naviguer dans une zone si ce n'est en conformité avec les normes prescrites aux articles 21 à 25.

21. (1) Sous réserve des dispositions du paragraphe (2), au moins deux quarts de pont indépendants et distincts doivent être établis pour chaque navire.

(2) Dans le cas d'un navire exploité selon un régime répartissant le travail quotidien entre un poste à bord et un poste à terre, au moins un quart de pont doit être établi à bord du navire.

(3) Le capitaine, à bord de tout navire, doit être de service selon que l'exige la pratique ordinaire des marins.

(4) Un quart de pont conforme aux dispositions de l'article 22 doit être de service à bord de tout navire.

22. (1) Sous réserve des dispositions du paragraphe (2), le quart de pont doit comprendre au moins chacune des personnes suivantes:

a) une personne responsable du quart de pont;

b) une personne de plus, sauf dans le cas

(i) d'un navire qui effectue le triage ou le rassemblement de billes de bois sans utiliser de câbles ou de chaînes à l'estacade,

(ii) d'un navire d'une jauge brute inférieure ou égale à 100 tonneaux, transportant au plus 12 passagers, et effectuant un voyage de 5 milles marins au plus, par bonne visibilité, entre le lever et le coucher du soleil et ce quelque soit le jour, dans les limites d'un port et s'il ne pousse pas ni ne remorque un objet flottant, ou

c) une seconde personne de plus sur un navire d'une jauge brute égale ou supérieure à 1,000 tonneaux, s'il n'est pas solidement amarré ou ancré; et

d) une personne ayant qualité, conformément aux dispositions de l'article 24, pour utiliser un radiotéléphone, sauf dans le cas

(i) d'un navire d'une jauge brute de 100 tonneaux ou moins, ou

(ii) d'un navire d'une jauge brute de plus de 100 tonneaux, si la personne responsable du quart de pont est qualifiée conformément aux dispositions de l'article 24.

(2) Dans le cas d'un navire d'une jauge brute égale ou supérieure à 1,000 tonneaux, qui n'est pas solidement amarré ou ancré, le capitaine ne doit pas prendre part au quart de pont aux fins des dispositions du paragraphe (1).

Qualifications of Navigation Personnel

23. (1) Subject to subsection (2), no person shall act or be permitted to act as master or person in charge of the deck watch on a ship of more than 100 tons, gross tonnage, unless he is

(a) the holder of a valid certificate or licence that is

(i) accepted by the Minister of Transport, and

(ii) appropriate for the duties to be performed, the class of the ship and the area in which the ship operates; and

(b) capable of properly operating the navigational equipment with which the ship is fitted.

(2) Subject to section 109 of the *Canada Shipping Act*, an examiner may issue a warrant to a person to act, on a ship of 50,000 tons, gross tonnage, or less, as master or person in charge of the deck watch where

(a) no suitable person with the required certificate or licence is available; and

(b) the examiner is satisfied that the person is as a result of his experience capable of performing the duties of master or person in charge of the deck watch, as the case may be.

(3) A warrant issued by an examiner shall be valid for a period not exceeding two years from the date of issue and shall specify

(a) the capacity in which the holder of the warrant may serve;

(b) the class of ship on which the holder of the warrant may serve; and

(c) the class of voyage or geographical area to which the use of the warrant is limited, if the warrant is so limited.

24. (1) The person in the deck watch who is required to be qualified in the use of a radiotelephone shall be capable of using the radiotelephone for communications in accordance with international radiotelephone operating procedures.

(2) The person referred to in subsection (1) shall be able to demonstrate to the satisfaction of a pollution prevention officer that his proficiency in the English language is sufficient for the effective use of a radio-telephone in navigation.

Acceptance of Certificates, Licences and Warrants

25. (1) For the purposes of subsection 23(1), the Minister of Transport may accept any certificate or licence if he is satisfied that the standards required to obtain the certificate or licence are similar to

(a) the standards set out in Schedule C, with respect to a person in charge of the deck watch;

(b) the standards set out in Schedules C and D, with respect to a master; or

(c) the standards required to obtain an equivalent certificate under the *Canada Shipping Act*.

(2) The Minister of Transport may refuse to accept any certificate or licence, or may cancel any warrant, where in his opinion the holder of that certificate, licence or warrant does not possess the skills, abilities or experience for the performance of the duties of master or person in charge of the deck watch, as the case may be.

Qualités des membres du personnel de navigation

23. (1) Sous réserve des dispositions du paragraphe (2), nul ne doit remplir ou être autorisé à remplir les fonctions de capitaine ou de personne responsable du quart de pont à bord d'un navire d'une jauge brute de plus de 100 tonneaux, à moins d'être

a) titulaire d'un certificat ou d'une licence valide

(i) acceptée par le ministre des Transports, et

(ii) correspondant aux fonctions à remplir, à la classe du navire ainsi qu'à la zone d'exploitation du navire; et

b) capable de faire fonctionner correctement les instruments de navigation dont le navire est muni.

(2) Sous réserve des dispositions de l'article 109 de la *Loi sur la marine marchande du Canada*, un examinateur peut délivrer à une personne un brevet autorisant cette personne à remplir, à bord d'un navire d'une jauge brute de 50,000 tonneaux ou moins, les fonctions de capitaine ou de personne responsable du quart de pont lorsque

a) aucune personne titulaire du certificat ou de la licence exigée n'est disponible; et que

b) l'examinateur est convaincu que la personne est par expérience capable de remplir les fonctions de capitaine ou de responsable du quart de pont, selon le cas.

(3) Un brevet délivré par un examinateur doit avoir une durée de validité maximale de deux ans à compter de la date de délivrance du brevet et doit indiquer

a) en quelle qualité le titulaire peut agir;

b) la cote de navire sur lequel le titulaire peut agir; et

c) la classe de voyage ou la région géographique à laquelle les prérogatives du brevet sont limitées si le brevet porte de telles limitations.

24. (1) La personne membre du quart de pont qui doit être qualifiée pour utiliser un radiotéléphone doit être capable d'établir des communications radiotéléphoniques conformément aux méthodes internationales d'utilisation de la radiotéléphonie.

(2) La personne visée au paragraphe (1) doit pouvoir démontrer, à la satisfaction d'un fonctionnaire chargé de la prévention de la pollution, qu'elle connaît suffisamment bien la langue anglaise pour utiliser effectivement un radiotéléphone en cours de navigation.

Acceptation des certificats, licences et brevets

25. (1) Aux fins des dispositions du paragraphe 23(1), le ministre des Transports peut accepter un certificat ou une licence s'il constate que les conditions d'attribution du certificat ou de la licence sont semblables

a) à celles qui sont énoncées à l'annexe C dans le cas d'une personne responsable du quart de pont;

b) à celles qui sont énoncées aux annexes C et D dans le cas d'un capitaine; ou

c) à celles qui sont prescrites pour obtenir un certificat équivalent en vertu de la *Loi sur la marine marchande du Canada*.

(2) Le ministre des Transports peut refuser d'accepter un certificat ou une licence, ou peut annuler un brevet, lorsque, à son avis, le titulaire dudit certificat, de ladite licence ou dudit brevet ne possède ni les connaissances, ni les capacités, ni l'expérience voulues pour remplir les fonctions de capitaine ou de responsable du quart de pont, selon le cas.

(3) The Minister of Transport may, upon receipt of the report of an inquiry held pursuant to section 569 of the *Canada Shipping Act*, cancel or suspend the acceptance of any certificate or licence where he could, under Part X of the *Canada Shipping Act*, cancel or suspend a certificate or licence.

Ice Navigator

26. (1) No tanker shall navigate within any zone without the aid of an ice navigator who is qualified in accordance with subsection (3).

(2) No ship other than a tanker shall navigate in any zone set out in the heading to each of Columns II to XVII of Schedule H

(*a*) where the words "No Entry" are shown in that Column of item 14, and

(*b*) where a period of time is shown in that Column of item 14, except during that period of time,

without the aid of an ice navigator who is qualified in accordance with subsection (3).

(3) The ice navigator on a ship shall

(*a*) be qualified to act as master or person in charge of the deck watch in accordance with section 23; and

(*b*) have served in the capacity of master, person in charge of the deck watch or helmsman for a total period of at least five days while the ship on which he was serving was in ice conditions that required the ship to make extraordinary manoeuvres or to be assisted by an icebreaker.

Fuel and Water

27. (1) No self-propelled ship shall navigate within any zone unless the ship

(*a*) has on board sufficient fuel to enable it to

(i) complete its intended voyage within the zones and to leave all zones, or

(ii) reach a refueling place within any zone during its intended voyage; and

(*b*) has on board sufficient fresh water or equipment capable of producing sufficient fresh water during its intended voyage to enable the ship to

(i) complete its intended voyage within the zones and to leave all zones, or

(ii) reach a place where fresh water is obtainable within any zone during its intended voyage.

(2) The refueling place referred to in subparagraph (1)(*a*)(ii) and the place with fresh water referred to in subparagraph (1)(*b*)(ii) must have available for the use of that ship sufficient fuel or fresh water, as the case may be, to enable the ship to continue to navigate on its intended voyage in compliance with subsection (1).

(3) No Arctic Class ship shall navigate within any zone unless it has on board sufficient fuel for domestic purposes for 120 days and

(*a*) sufficient fresh water, or

(*b*) equipment capable of producing sufficient fresh water during its intended voyage,

for domestic purposes for 120 days.

(3) Le ministre des Transports, dès la réception du rapport d'une enquête menée en vertu de l'article 569 de la *Loi sur la marine marchande du Canada*, peut annuler ou suspendre l'acceptation d'un certificat ou d'une licence dans les cas où la partie X de la *Loi sur la marine marchande du Canada* l'autorise à annuler ou suspendre un certificat ou une licence.

Officier de navigation dans les glaces

26.(1) Il est interdit à un pétrolier de naviguer dans une zone quelconque sans l'aide d'un officier de navigation dans les glaces qualifié conformément aux dispositions du paragraphe (3).

(2) Il est interdit à un navire autre qu'un pétrolier de naviguer dans l'une des zones indiquées en tête de chacune des colonnes II à XVII de l'annexe H

a) si les mots «Entrée interdite» figurent dans cette colonne en regard de l'article 14, et

b) si une période de temps est indiquée dans cette colonne en regard de l'article 14, en d'autre temps que la période indiquée,

sans l'aide d'un officier de navigation dans les glaces qualifié conformément aux dispositions du paragraphe (3).

(3) L'officier de navigation dans les glaces d'un navire doit

a) avoir qualité pour remplir les fonctions de capitaine ou de responsable du quart de pont conformément aux dispositions de l'article 23; et

b) avoir rempli les fonctions de capitaine, de responsable du quart de pont ou de barreur durant au moins cinq jours au total pendant que le navire sur lequel il remplissait ces fonctions se trouvait dans les glaces au point de rendre nécessaire l'exécution de certaines manœuvres ou l'aide d'un brise-glace.

Mazout et eau

27. (1) Il est interdit à un navire autopropulsé de naviguer, dans une zone sans

a) avoir à bord une quantité de mazout suffisante pour lui permettre

(i) de terminer le voyage envisagé dans les zones et de quitter toutes les zones, ou

(ii) d'atteindre, au cours du voyage envisagé, un point d'avitaillement situé dans une zone quelconque; et

b) avoir à bord suffisamment d'eau douce ou un équipement capable de produire suffisamment d'eau douce durant le voyage envisagé pour pouvoir

(i) terminer le voyage envisagé dans les zones et quitter toutes les zones, ou

(ii) atteindre, au cours du voyage envisagé, un point d'eau douce situé dans une quelconque des zones.

(2) Le point d'avitaillement dont il est question au sous-alinéa (1)*a*)(ii) et le point d'eau douce que mentionne le sous-alinéa (1)*b*)(ii) doivent disposer pour les besoins de ce navire d'une quantité suffisante de mazout et d'eau douce, selon le cas, pour permettre audit navire de continuer à naviguer en vue de l'achèvement du voyage envisagé, conformément aux dispositions du paragraphe (1).

(3) Il est interdit à un navire de cote arctique de naviguer dans une zone s'il n'a pas à bord une quantité suffisante de mazout pour répondre à ses besoins pendant 120 jours et

a) suffisamment d'eau douce, ou

b) un équipement capable de produire assez d'eau douce durant le voyage envisagé, pour répondre à ses besoins pendant 120 jours.

Sewage Deposit

28. Any ship and any person on a ship may deposit in the arctic waters such sewage as may be generated on board that ship.

Oil Deposit

29. Any ship and any person on a ship may deposit in the arctic waters oil or an oily mixture where that deposit is

(*a*) for the purposes of saving life or preventing the immediate loss of a ship;

(*b*) due to damage to or leakage from the ship as a result of stranding, collision or foundering if all reasonable precautions were taken

(i) to avoid stranding, collision or foundering, and

(ii) to prevent or minimize the deposit; or

(*c*) through the exhaust of an engine or by leakage from an underwater machinery component where such deposit in minimal, unavoidable and essential to the operation of the engine or component.

Reporting

30. For the purposes of subsection 5(2) of the Act, where a ship in a zone has deposited waste in violation of subsection 4(1) of the Act or is in distress and for that reason is in danger of causing any deposit of waste in violation of subsection 4(1) of the Act, the master shall forthwith report the deposit of waste or the condition of distress by radio or, where such means of communication is not available, by the fastest means available to

(*a*) the pollution prevention officer who, to the best of his knowledge, is nearest to the ship; or

(*b*) a pollution prevention officer at the nearest location listed in Schedule B.

Dépôt d'effluents

28. Un navire ou toute personne à bord d'un navire peut déposer dans les eaux arctiques des effluents de la nature de ceux qui peuvent être produits à bord d'un navire.

Dépôt d'hydrocarbures

29. Un navire ou toute personne à bord d'un navire peut déposer dans les eaux arctiques des hydrocarbures ou un mélange d'hydrocarbures dans les cas où ce dépôt

a) a pour but de sauver une vie ou d'empêcher la perte immédiate d'un navire;

b) résulte des dégâts ou d'une fuite occasionnés par un échouement, un abordage ou un naufrage si toutes les précautions judicieuses ont été prises

(i) pour empêcher un échouement, un abordage ou un naufrage, et

(ii) pour empêcher ou minimiser le dépôt; ou

c) se produit par l'échappement d'un moteur ou du fait d'une fuite provenant d'un organe de machine qui se trouve sous l'eau, si un tel dépôt est le plus faible possible, inévitable et nécessaire au fonctionnement du moteur ou de l'organe.

Compte rendu

30. Aux fins du paragraphe 5(2) de la Loi, si un navire a, dans une zone, déversé des effluents en violation du paragraphe 4(1) de la Loi ou s'il est en détresse et, pour cette raison, menace de provoquer un dépôt de déchets en violation du paragraphe 4(1) de la Loi, le capitaine doit immédiatement signaler le dépôt de déchets ou l'état de détresse par radio ou, s'il ne dispose pas de ce moyen de communication, par le moyen le plus rapide dont il dispose,

a) au fonctionnaire chargé de la prévention de la pollution qui, à sa connaissance, se trouve le plus proche du navire; ou

b) au fonctionnaire chargé de la prévention de la pollution qui se trouve dans la plus proche des localités énumérées à l'annexe B.

Official Seal or Crest of Issuing Authority

SCHEDULE A

FORM OF ARCTIC POLLUTION PREVENTION CERTIFICATE

ARCTIC POLLUTION PREVENTION CERTIFICATE

issued under the provisions of the

ARCTIC WATERS POLLUTION PREVENTION ACT

by

....

(Name of Issuing Authority)

Name of Ship	Class of Ship (Dry cargo, tanker, tug, etc.)	Distinctive Number or Letters	Port and Country of Registry	Gross Tonnage

Lightest operating draft: (*a*) forward.......... (*b*) aft....................

Deepest operating load draft: (*a*) forward.......... (*b*) aft....................

Category at above-mentioned drafts:..............................

This certificate is valid until ....
(expiry date)

Issued at.............................. on..............................
(place) (date)

This is to certify that this ship has been surveyed and complies with the provisions of the *Arctic Shipping Pollution Prevention Regulations*.

....

(Surveyor's Name and Signature)

Sceau officiel ou armoiries de l'administration

ANNEXE A

FORMULE DE CERTIFICAT DE PRÉVENTION DE LA POLLUTION DANS L'ARCTIQUE

CERTIFICAT DE PRÉVENTION DE LA POLLUTION DANS L'ARCTIQUE

délivré en vertu des dispositions de la

LOI SUR LA PRÉVENTION DE LA POLLUTION DES EAUX ARCTIQUES

par

....

(nom de l'administration qui délivre le certificat)

Nom du navire	Type de navire (navire de charge sèche, pétrolier, remorqueur, etc.)	Numéros ou lettres distinctives	Port et pays d'immatriculation	Jauge brute

Ligne de charge minimale prévue: *a)* avant..........*b)* arrière..........

Ligne de charge maximale prévue: *a)* avant..........*b)* arrière..........

Catégorie selon les tirants d'eau susmentionnés..............................

Le présent certificat est valable jusqu'au..............................
(date d'expiration)

Délivré à..............................le..............................
(lieu) (date)

Je certifie par les présentes que ce navire a été visité et qu'il satisfait aux dispositions du *Règlement sur la prévention de la pollution des eaux arctiques par les navires*.

....

(Nom et signature du visiteur)

SCHEDULE B

LOCATION OF OFFICES AT WHICH POLLUTION PREVENTION OFFICERS MAY BE REACHED

British Columbia
- Nanaimo
- New Westminster
- Prince Rupert
- Vancouver
- Victoria

New Brunswick
- Saint John

Newfoundland
- Lewisporte
- Marystown
- St. John's

Nova Scotia
- Halifax
- North Sydney
- Yarmouth

ANNEXE B

LOCALITÉS OÙ SONT ÉTABLIS LES BUREAUX DES FONCTIONNAIRES CHARGÉS DE LA PRÉVENTION DE LA POLLUTION

Colombie-Britannique
- Nanaïmo
- New Westminster
- Prince Rupert
- Vancouver
- Victoria

Nouveau-Brunswick
- Saint-Jean

Terre-Neuve
- Lewisporte
- Marystown
- Saint-Jean

Nouvelle-Écosse
- Halifax
- Sydney-Nord
- Yarmouth

Ontario	*Quebec*
Collingwood	Baie-Comeau
Kingston	Montreal
Ottawa	Port-Cartier
St. Catharines	Quebec
Thunder Bay	Rimouski
Toronto	Sorel
Welland	Trois-Rivières

SCHEDULE C

PERSON IN CHARGE OF THE DECK WATCH

1. The standards required to obtain a certificate or licence that entitles a person to be in charge of a deck watch include an examination for satisfactory form and colour vision and a practical knowledge of

(*a*) the use and an appreciation of the capabilities, limitations and reliability of

(i) radar for navigation and collision avoidance,

(ii) ship-borne position fixing equipment,

(iii) echo-sounding devices,

(iv) magnetic and gyro compasses, and

(v) lights, buoys and similar aids to navigation;

(*b*) the *International Regulations for Preventing Collisions at Sea;*

(*c*) the *International Code of Signals;*

(*d*) fire, its danger, causes, prevention and detection and the action to be taken on its discovery;

(*e*) coastal navigation;

(*f*) the immediate actions to be taken by a person in charge of the deck watch with respect to

(i) collision,

(ii) grounding,

(iii) explosion,

(iv) dragging anchor, and

(v) vessels in distress; and

(*g*) ship handling and navigation in and near routing systems, in so far as the duties of the person in charge of the deck watch are affected.

SCHEDULE D

MASTER

1. The standards required to obtain a certificate or licence that entitles a person to be a master of a ship include, in addition to the requirements described in Schedule C, a practical knowledge of

(*a*) ocean navigation;

(*b*) firefighting;

(*c*) towing and being towed;

(*d*) damage control;

(*e*) assisting vessels in distress;

(*f*) weather information and its use;

(*g*) handling a ship in all circumstances;

(*h*) the use of stability information and the maintaining of adequate stability;

Ontario	*Québec*
Collingwood	Baie-Comeau
Kingston	Montréal
Ottawa	Port-Cartier
St. Catharines	Québec
Thunder Bay	Rimouski
Toronto	Sorel
Welland	Trois-Rivières

ANNEXE C

PERSONNE RESPONSABLE DU QUART DE PONT

1. Les conditions d'attribution d'un certificat ou d'une licence qui donne à une personne le droit de prendre la direction du quart de pont comprennent une épreuve optométrique subie avec succès, portant sur la perception du relief et des couleurs et une connaissance pratique

a) de l'utilisation, de l'évaluation des possibilités, des limitations et de la fiabilité

(i) du radar servant à la navigation et à la prévention des abordages,

(ii) des instruments de bord servant à faire le point,

(iii) des sondeurs à ultra-sons,

(iv) des compas magnétiques et des gyrocompas, et

(v) des feux, des bouées et des aides à la navigation analogues;

b) des *Règles internationales pour prévenir les abordages en mer;*

c) du *Code international des signaux;*

d) des dangers, des causes, de la prévention et de la détection des incendies, ainsi que des mesures à prendre dès la découverte d'un incendie;

e) de la navigation côtière;

f) des mesures que doit prendre sans tarder une personne responsable du quart de pont dans le cas

(i) d'abordage,

(ii) d'échouement,

(iii) d'explosion,

(iv) d'ancre qui drague, et

(v) de navires en détresse; et

g) de la manœuvre des navires et de la navigation dans les dispositifs d'organisation du trafic et dans leur voisinage, dans la mesure des attributions de la personne responsable du quart de pont.

ANNEXE D

CAPITAINE

1. Les conditions d'attribution d'un certificat ou d'une licence qui donne à une personne le droit de remplir les fonctions de capitaine d'un navire comprennent outre les conditions prescrites à l'annexe C, une connaissance pratique

a) de la navigation océanique;

b) de la lutte contre les incendies;

c) de la manœuvre d'un remorqueur et d'un bâtiment remorqué;

d) de la limitation des avaries;

e) de l'aide aux navires en détresse;

f) des renseignements météorologiques et de leur utilisation;

g) de la manœuvre d'un navire dans toutes les circonstances;

h) de l'utilisation des renseignements sur la stabilité et le maintien d'une stabilité suffisante;

(i) the safe stowage of cargoes; and
(j) pollution prevention measures.

SCHEDULE E

CONSTRUCTION STANDARDS FOR TYPE A, B, C, D, AND E SHIPS

1. Every ship of a Type set out in Column I of an item of the table to this Schedule shall comply with the standards of construction required of a ship by one of the organizations set out in the heading to each of Columns II to VII of the table for the assignment to that ship of the classification notation shown in that Column of that item.

2. The standards of construction referred to in section 1 of this Schedule shall be as listed in the 1972 publications of the applicable organization.

i) du bon arrimage des marchandises; et
j) des mesures de prévention de la pollution.

ANNEXE E

NORMES DE CONSTRUCTION DES NAVIRES DE TYPE A, B, C, D, ET E

1. Tout navire d'un type mentionné à l'un des articles du tableau de la présente annexe, dans la colonne I, doit satisfaire aux normes de construction d'un navire, prescrites par l'organisme dont le nom figure en tête de l'une des colonnes II à VII du tableau, pour l'attribution à ce navire de la cote indiquée dans la même colonne, à cet article.

2. Les normes de construction dont il est question à l'article 1er de la présente annexe dont celles qui sont établies dans les publications de 1972 de l'organisme intéressé.

TABLE

Column I Item	Column II Lloyd's Register of Shipping	Column III American Bureau of Shipping	Column IV Bureau Veritas	Column V Det Norske Veritas	Column VI Germanischer Lloyd	Column VII Registro Italiano Navale
Type A 1.	100A1 Ice Class 1*	A1 Ice Class 1AA	I 3/3E Ice I Super	Class 1A1 Ice A*	100A4E4	100A1.1 RG1
Type B 2.	100A1 Ice Class 1	A1 Ice Class 1A	I 3/3E Ice I	Class 1A1 Ice A	100A4E3	100A1.1 RG2
Type C 3.	100A1 Ice Class 2	A1 Ice Class 1B	I 3/3E Ice II	Class 1A1 Ice B	100A4E2	100A1.1 RG3
Type D 4.	100A1 Ice Class 3	A1 Ice Class 1C	I 3/3E Ice III	Class 1A1 Ice C	100A4E1 or 100A4E	100A1.1 RG4
Type E 5.	100A1	A1	I 3/3E	Class 1A1	100A4	100A1.1

TABLEAU

Colonne I Article	Colonne II Lloyd's Register of Shipping	Colonne III American Bureau of Shipping	Colonne IV Bureau Véritas	Colonne V Det Norske Veritas	Colonne VI Germanischer Lloyd	Colonne VII Registro Italiano Navale
Type A 1.	100A1 Glace Cote 1*	A1 Glace Cote 1AA	I 3/3E Glace I Super	Cote 1A1 Glace A*	100A4E4	100A1.1 RG1
Type B 2.	100A1 Glace Cote 1	A1 Glace Cote 1A	I 3/3E Glace I	Cote 1A1 Glace A	100A4E3	100A1.1 RG2
Type C 3.	100A1 Glace Cote 2	A1 Glace Cote 1B	I 3/3E Glace II	Cote 1A1 Glace B	100A4E2	100A1.1 RG3
Type D 4.	100A1 Glace Cote 3	A1 Glace Cote 1C	I 3/3E Glace III	Cote 1A1 Glace C	100A4E1 ou 100A4E	100A1.1 RG4
Type E 5.	100A1	A1	I 3/3E	Cote 1A1	100A4	100A1.1

SCHEDULE F

HULL DESIGN FOR ARCTIC CLASS SHIPS

Interpretation

1. In this Schedule,

"aft perpendicular" means a perpendicular that coincides with the after side of the rudder post, or where no rudder post is fitted, with the centreline of the rudder stock;

"amidships" means the middle of length (L);

"bilge boundary line" means a line, that in elevation, is parallel to the line of the keel and coincident amidships with the boundary between the side of the hull and the upper turn of bilge;

"breadth (B)" means the greatest moulded breadth in feet (meters);

"forward perpendicular" means a perpendicular erected at the intersection of the fore side of the stem and the deepest operating load waterline;

"length (L)" means the distance if feet (metres), on the summer load waterline from the fore side of stem to

(*a*) the after side of the rudder post, or

(*b*) to the centre of the rudder stock, if there is no rudder post,

which distance shall not be less than 96 per cent and need not be greater than 97 per cent of the extreme length on the summer load waterline;

"ice breaker" means a ship specially designed and constructed for the purpose of assisting the passage of other ships through ice.

Definitions

2. (1) Subject to subsection (2), in every Arctic Class ship other than a Class 1 ship,

(*a*) the bow, forefoot, mid-body and stern are the parts of the ship, and

(*b*) the bow area, lower bow area, mid-body area, stern area, upper transition area and lower transition area are the areas of the shell,

shown in the figure to this section. (*See* p. 1862)

(2) In every Arctic Class ship, other than a Class 1 ship

(*a*) the forward extremity of the upper transition area is the forward extremity of the bow;

(*b*) the aft extremity of the upper transition area is the aft extremity of the stern;

(*c*) the forward extremity of the forefoot is the point at which the line of the keel is tangent to the stem contour;

(*d*) the bow area includes the bottom of the hull over the length of the forefoot;

(*e*) the lower bow area includes the bottom of the hull between the aft end of the forefoot and the aft end of the bow; and

(*f*) the lower boundary of that part of the lower transition area that is forward of amidships is the shortest line on the outside of the hull between

(i) the intersection of the bilge boundary line with the aft boundary of the lower bow area, and

ANNEXE F

CONCEPTION DE LA COQUE DES NAVIRES DE LA COTE ARCTIQUE

Interprétation

1. Dans la présente annexe,

«brise-glace» désigne un navire spécialement conçu et construit pour frayer un passage à d'autres navires à travers les glaces;

«largeur (B)» désigne la largeur hors membrures au fort, en pieds (ou en mètres);

«ligne de démarcation du bouchain» désigne une ligne qui, en élévation, est parallèle à la ligne de la quille et coïncide, au milieu du navire, avec la ligne de rencontre de la muraille de la coque et de l'arrondi du bouchain;

«longueur (L)» désigne la distance en pieds (ou en mètres), mesurée sur la ligne de charge d'été, entre la face avant de l'étrave et

a) la face arrière de l'étambot, ou

b) l'axe de la mèche inférieure du gouvernail, s'il n'y a pas d'étambot,

cette distance ne devant pas être inférieure à 96 pour cent ni nécessairement supérieure à 97 pour cent de la longueur hors tout de la ligne de charge d'été;

«milieu du navire» désigne le milieu de la longueur (L);

«perpendiculaire arrière» désigne une perpendiculaire qui coïncide avec la face arrière de l'étambot ou, si le navire n'a pas d'étambot, avec l'axe de la mèche inférieure du gouvernail;

«perpendiculaire avant» désigne une perpendiculaire amenée à l'intersection de la face avant de l'étrave et de la ligne maximale de charge prévue;

Définitions

2. (1) Sous réserve des dispositions de l'article 2, dans tout navire de cote arctique autre qu'un navire de cote 1,

a) l'avant, le brion, le milieu de la coque et l'arrière sont les parties du navire; et

b) la section avant, la section avant inférieure, la section médiane, la section arrière, la section de transition supérieure et la section de transition inférieure constituent les sections de la coque,

comme l'illustre la figure de la présente section. (*Voir* p. 1862)

(2) Dans tout navire de la cote arctique autre qu'un navire de cote 1

a) l'extrémité avant de la section de transition supérieure constitue l'extrémité antérieure de l'avant;

b) l'extrémité arrière de la section de transition supérieure constitue l'extrémité postérieure de l'arrière;

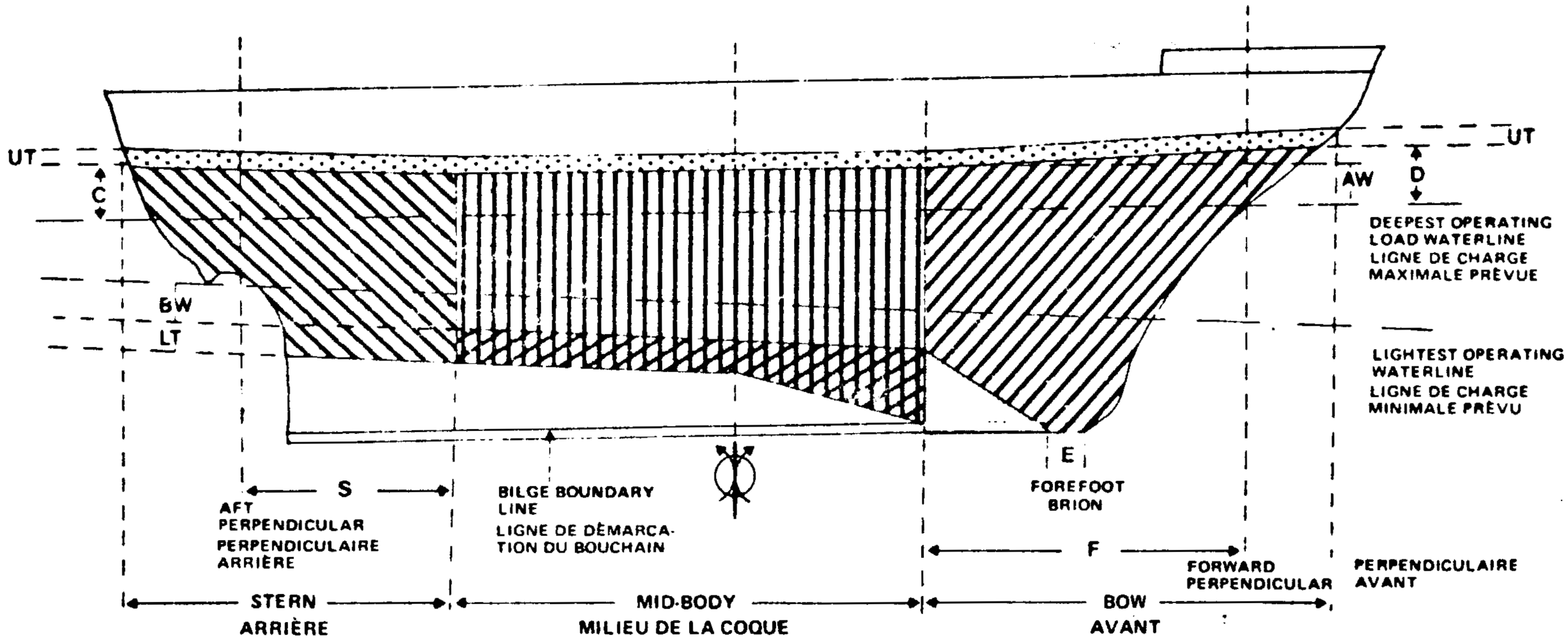
c) l'extrémité avant du brion est le point où la ligne de quille est tangente à la ligne d'étrave;

d) la section avant inclut le petit fond sur la longueur du brion;

e) la section avant inférieure inclut le petit fond compris entre la limite postérieure du brion et la limite arrière de l'avant; et

f) la limite inférieure de la partie de la transition inférieure située à l'avant du milieu du navire est la ligne la plus courte tracée, à l'extérieur de la coque, entre

(i) l'intersection de la ligne de démarcation du bouchain et de la limite arrière de la section avant inférieure, et



- Bow Area / Section avant
- Lower Bow Area / Section avant inférieur
- Mid-Body Area / Section médiane
- Stern Area / Section arrière
- Lower Transition Area / Section de transition inférieure
- Upper Transition Area / Section de transition supérieure

FIGURE

(ii) the forward end of that part of the lower boundary of the lower transition area that is aft of amidships.

(3) In every Arctic Class 1 ship the ice belt is that part of the shell that lies between

(*a*) a line that is 30 inches (762 mm) above and parallel to the deepest operating load waterline; and

(*b*) a line that is 24 inches (610 mm) below and parallel to the lightest operating waterline.

Dimensions

3. (1) For an Arctic Class ship set out in Column I of an item of Table 1,

(*a*) the vertical height (D) of the forward extremity of the bow area above the deepest operating load waterline is set out in Column II of that item;

(*b*) the vertical height (AW) of the upper boundary of the mid-body area above the deepest operating load waterline is set out in Column III of that item;

(*c*) the vertical depth (BW) of the lower boundary of the mid-body area below the lightest operating waterline is set out in Column IV of that item;

(*d*) the vertical height (UT) of the upper boundary of the upper transition area above the upper boundaries of the bow area, mid-body area and the stern area is set out in Column V of that item;

(*e*) the vertical depth (BW + LT) of the lower boundary of

(i) the stern area, and

(ii) that part of the lower transition area that is aft of amidships,

below the lightest operating waterline, is the value set out in Column VI of that item added to the value set out in Column IV of that item;

(*f*) the vertical height (C) of the aft extremity of the stern area above the deepest operating load waterline is set out in Column VII of that item;

(*g*) the length of the forefoot (E) is set out in Column VIII of that item;

(*h*) the horizontal distance (F) between the forward perpendicular and the aft end of the bow is set out in Column IX of that item; and

(*i*) the horizontal distance (S) between the aft perpendicular and the forward end of the stern is set out in Column X of that item.

(2) Notwithstanding paragraph (1)(*h*), the distance referred to in that paragraph need not be greater than the distance between the forward perpendicular and the point on the centreline that is 0.04L aft of the point at which, when proceeding aft from the stem, the breadth (B) is first reached.

4. (1) The bow of every Arctic Class ship shall be shaped so that it can break ice effectively.

(2) The stern of every Arctic Class ship shall be shaped so that it can displace broken ice effectively.

(ii) l'extrémité avant de la partie de la limite inférieure de la section de transition inférieure qui est située à l'arrière du milieu du navire.

(3) Dans les navires de la cote arctique 1, la zone renforcée est la partie de la coque comprise entre

a) une ligne parallèle à la ligne de charge maximale prévue, tracée à 30 pouces (762 mm) au-dessus de ladite ligne de charge maximale; et

b) une ligne parallèle à la ligne de charge prévue, tracée à 24 pouces (610 mm) au-dessous de la ligne de charge minimale.

Dimensions

3. (1) En ce qui concerne un navire de la cote arctique visé à l'un des articles du tableau 1, dans la colonne I,

a) la distance verticale (D) de l'extrémité avant de la section avant au-dessus de la ligne de charge maximale prévue est indiquée dans la colonne II, en regard de cet article;

b) la distance verticale (AW) de la limite supérieure de la section médiane de la coque au-dessus de la ligne de charge maximale prévue est indiquée dans la colonne III du tableau, en regard de cet article;

c) la distance verticale (BW) de la limite inférieure de la section médiane au-dessous de la ligne de charge minimale prévue est indiquée dans la colonne IV, en regard de cet article;

d) la distance verticale (UT) de la limite supérieure de la section de transition supérieure au-dessus de la limite supérieure de la section arrière est indiquée dans la colonne V, en regard de cet article;

e) la distance verticale (BW+LT) de la limite inférieure

(i) de la section arrière, et

(ii) de la partie de transition inférieure située à l'arrière du milieu du navire

au-dessous de la ligne de charge maximale prévue est le chiffre indiqué dans la colonne IV plus celui qui figure dans la colonne VI, en regard de cet article;

f) la hauteur verticale (C) de l'extrémité postérieure de l'arrière au-dessus de la ligne de charge maximale est indiquée dans la colonne VII, en regard de cet article;

g) la longueur du brion (E) est indiquée dans la colonne VIII, en regard de cet article;

h) la distance horizontale (F) entre la perpendiculaire avant et la limite arrière de l'avant est indiquée dans la colonne IX, en regard de cet article; et

i) la distance horizontale (S) entre la perpendiculaire arrière et la limite antérieure de l'arrière est indiquée dans la colonne X, en regard de cet article.

(2) Nonobstant la disposition de l'alinéa (1)*h*), il n'est pas nécessaire que la distance visée dans ledit alinéa excède la distance comprise entre la perpendiculaire avant et le point sur l'axe longitudinal qui est situé à 0.04L à l'arrière du premier point où la largeur (B) croise l'axe, la distance étant mesurée à partir de l'étrave.

4. (1) L'avant de tout navire de la cote arctique doit présenter une forme lui permettant de briser la glace de manière efficace.

(2) L'arrière de tout navire de la cote arctique doit présenter une forme lui permettant de déplacer de manière efficace les packs de glace brisée.

Shell Plating and Framing

5. (1) Subject to subsections (2) and (3), for each Arctic Class ship set out in Column I of an item of Table 2, the shell plating and main framing in each area specified in the heading to each of Columns II to VII shall, without exceeding the yield stress of the materials from which they are made, be capable of withstanding the ice pressure shown in that Column of that item.

(2) Where waste is stowed in direct contact with the shell plating in the bow of a ship, other than an Arctic Class 8 or 10 ship,

(*a*) the values shown in Columns II and III of an item of Table 2, and

(*b*) with respect to the bow, the values shown in Column VI of an item of Table 2

do not apply and the values shown in those Columns of the next following item apply in substitution therefor.

(3) Where the total length of the mid-body of a ship, other than an Arctic Class 1 ship, is fitted with side tanks that comply with section 6 of this Schedule

(*a*) the values shown in Column IV of an item of Table 2, and

(*b*) with respect to the mid-body, the values shown in Columns V and VI of an item of Table 2

do not apply and the values shown in those Columns of the preceeding item apply in substitution therefor.

(4) Subject to subsection (5), for each Arctic Class ship in Column I of an item of Table 3,

(*a*) the web frames supporting main longitudinal frames, and

(*b*) the stringers supporting main transverse frames

in each area specified in the heading to each of Columns II to IV shall, without exceeding the yield stress of the materials from which they are made, be capable of withstanding the ice loading shown in that Column of that item.

(5) Where the flare of the side shell plating is less than 8 degrees outboard from the vertical for a distance of 5 per cent or more of the length of the mid-body of an Arctic Class ship between the lower boundary of the lower transition area and the lower boundary of the upper transition area, the ice loadings shown in Column III of an item of Table 3 do not apply and the ice loadings shown in Column II of that item apply in substitution therefor.

6. The side tanks referred to in subsection 5(3) of this Schedule and fitted in an Arctic Class ship set out in Column I of an item of Table 4 shall

(*a*) have a width measured from the outer shell of not less than that shown in Column II of that item;

(*b*) extend vertically from the outer bottom of the ship up to the deck at which the main watertight bulkheads of the ship terminate;

(*c*) be so constructed that, if the shell plating or turn of bilge plating is deformed or pentrated by ice, any internal stiffening structure will buckle before it penetrates the inner side of the tank; and

(*d*) contain no waste.

Bordé extérieur et membrures principales

5. (1) Sous réserve des dispositions des paragraphes (2) et (3), en ce qui concerne tout navire de la cote arctique visé à l'un des articles du Tableau 2, dans la colonne I, le bordé extérieur et les membrures principales doivent, dans les sections précisées en tête des colonnes II à VII, pouvoir supporter la pression des glaces indiquée dans cette colonne en regard dudit article, sans que la limite d'élasticité des matériaux dont ils sont faits soit dépassée.

(2) Lorsque des déchets sont arrimés directement contre le bordé extérieur dans l'avant d'un navire autre qu'un navire de la cote arctique 8 ou 10,

a) les chiffres donnés à l'un des articles du tableau 2, dans les colonnes II et III, et

b) en ce qui concerne l'avant, les chiffres donnés à l'un des articles du tableau 2, dans la colonne VI,

ne s'appliquent pas et sont remplacés par les chiffres figurant dans les mêmes colonnes en regard de l'article suivant.

(3) Lorsqu'un navire autre qu'un navire de la cote arctique 1 est muni, sur toute la longueur de la section médiane, de ballasts latéraux conformes aux dispositions de l'article 6 de la présente annexe

a) les chiffres figurant à l'un des articles du tableau 2, dans la colonne IV, et

b) en ce qui concerne la section médiane, les chiffres figurant à l'un des articles du tableau 2, dans les colonnes V et VI,

ne s'appliquent pas et sont remplacés par les chiffres figurant dans les mêmes colonnes en regard de l'article précédent.

(4) Sous réserve des dispositions du paragraphe (5), en ce qui concerne un navire de la cote arctique visé à l'un des articles du tableau 3, dans la colonne I,

a) les porques supportant les membrures longitudinales principales, et

b) les serres supportant les membrures transversales principales,

doivent, dans les sections mentionnées en tête des colonnes II à IV, pouvoir supporter la pression des glaces indiquée en regard de cet article dans ladite colonne, sans que la limite d'élasticité des matériaux dont ils sont faits soit dépassée.

(5) Lorsque le dévers du bordé extérieur latéral d'un navire de la cote arctique est inférieur, sur cinq pour cent ou plus de la longueur de la section médiane du navire entre la limite inférieure de la section de transition inférieure et la limite inférieure de la section de transition supérieure, de 8 degrés par rapport à la verticale, les valeurs de la pression des glaces figurant dans la colonne III du tableau 3 ne s'appliquent pas et sont remplacées par celles qui figurent dans la colonne II en regard du même article.

6. Les ballasts latéraux visés au paragraphe 5(3) de la présente annexe et qui équipent un navire de la cote arctique visé à l'un des articles du tableau 4, dans la colonne I, doivent

a) avoir une largeur, mesurée à partir du bordé extérieur, au moins égale à celle qui est indiquée dans la colonne II en regard de cet article;

b) s'étendre verticalement depuis le bordé extérieur du petit fond du navire jusqu'au pont où les cloisons étanches principales du navire se terminent;

c) être construits de telle sorte que, si le bordé extérieur de la coque ou de l'arrondi du bouchain est déformé ou enfoncé par la glace, les membrures de renfort intérieures gauchiront avant de percer la paroi interne du ballast; et

d) ne pas contenir de déchets.

7. (1) Subject to subsection (2), for an Arctic Class ship set out in Column I of an item of Table 2, the thickness of the shell plating in each area specified in the heading to each of Columns II to VII shall not be less than the spacing of the main frames multiplied by the factor obtained from the formula

$$\text{factor} = \frac{2}{3}\sqrt{\frac{p}{f}}$$

where

(*a*) "p" is the pressure shown in each of Columns II to VII of that item,

(*b*) "f" is the yield stress of the shell plating material, and

(*c*) "p" and "f" are expressed in the same units.

(2) The thickness of the stem plate shall be not less than 1.3 times the thickness of the adjacent shell plating in the bow area determined in accordance with subsection (1).

8. (1) For an Arctic Class ship set out in Column I of an item of Table 2, the section modulus of the main transverse frames with the adjacent shell plating in each area specified in the heading to each of Columns II, IV and VII shall not be less than the value given by the formula

a) $$\frac{709\, p\, s\, (b - 1.31)}{f} \text{ inches}^3$$

where

(i) "p" is the pressure in pounds per square inch shown in each of Columns II, IV and VII of that item,

(ii) "s" is the main transverse frame spacing in feet,

(iii) "b" is the span of the main transverse frame in feet, and

(iv) "f" is the yield stress of the main transverse frame material in pounds per square inch; or

b) $$\frac{p\, s\, (b - 400)}{8f} \text{ cm}^3$$

where

(i) "p" is the pressure in kiloponds per square centimetre shown in each of Columns II, IV and VII of that item,

(ii) "s" is the main transverse frame spacing in millimetres,

(iii) "b" is the span of the main transverse frame in millimetres, and

(iv) "f" is the yield stress of the main transverse frame material in kiloponds per square centimetre.

(2) For an Arctic Class ship set out in Column I of an item of Table 2, the section modulus of the main longitudinal frames with the adjacent shell plating shall not be less than the value given by the formula

$$\frac{b^2\, s p k}{f} \text{ inches (cm}^3\text{)}$$

where

7. (1) Sous réserve des dispositions du paragraphe (2), en ce qui concerne un navire de la cote arctique visé à l'un des articles du tableau 2, dans la colonne I, l'épaisseur du bordé extérieur doit, dans chacune des sections mentionnées en tête des colonnes II à VII, être au moins égale à l'espacement des couples principaux multiplié par le coefficient obtenu au moyen de la formule

$$\text{coefficient} = \frac{2}{3}\sqrt{\frac{p}{f}}$$

dans laquelle

a) «p» représente la pression indiquée dans chacune des colonnes II à VII à cet article,

b) «f» représente la limite d'élasticité du matériau dont est construit le bordé extérieur, et

c) «p» et «f» sont exprimés par les mêmes unités.

(2) L'épaisseur de la tôle d'étrave doit être au moins égale à l'épaisseur calculée conformément au paragraphe (1) en ce qui concerne le bordé extérieur adjacent, multipliée par 1.3.

8. (1) En ce qui concerne un navire de la cote arctique visé à l'un des articles du tableau 2, dans la colonne I, le module de résistance que constituent les couples transversaux principaux avec le bordé extérieur adjacent doit être, dans les sections mentionnées en tête de chacune des colonnes II, IV et VII, au moins égal au chiffre obtenu par la formule

a) $$\frac{709\, p\, s\, (b - 1.31)}{f} \text{ pouces}^3$$

dans laquelle

(i) «p» représente la pression en livres par pouce carré, indiquée dans chacune des colonnes II, IV et VII à cet article,

(ii) «s» désigne l'écartement des couples transversaux principaux en pieds,

(iii) «b» représente la portée des couples transversaux principaux en pieds, et

(iv) «f» désigne la limite d'élasticité en livres par pouce carré du matériau des couples transversaux principaux; ou

b) $$\frac{p\, s\, (b - 400)}{8f} \text{ cm}^3$$

dans laquelle

(i) «p» représente la pression en kilogrammes-forces par centimètre carré, indiquée dans chacune des colonnes II, IV et VII, à cet article,

(ii) «s» désigne l'écartement des couples transversaux principaux, en millimètres,

(iii) «b» représente la portée des couples transversaux principaux, en millimètres, et

(iv) «f» représente la limite d'élasticité du matériau des couples transversaux principaux, en kilogrammes-forces par centimètre carré.

(2) En ce qui concerne un navire de la cote arctique visé à l'un des articles du tableau 2 dans la colonne I, le module de résistance que constituent les membrures longitudinales principales avec le bordé extérieur adjacent ne doit pas être inférieur au chiffre obtenu par la formule

$$\frac{b^2\, s p k}{f} \text{ pouces}^3 \text{ (cm}^3\text{)}$$

dans laquelle

(a) "b" is,
(i) in the case of a modulus expressed in $inch^3$ units, the span of the main longitudinal frame in feet, or
(ii) in the case of a modulus expressed in $centimetre^3$ units, spacing the main longitudinal frame spacing in millimetres,
(ii) in the case of a modulus expressed in $centimetre^3$ units, the span of the main longitudinal frame in millimetres,
in the bow area, mid-body area or stern area, whichever area is applicable;
(b) "s" is,
(i) in the case of a modulus expressed in $inch^3$ units, the main longitudinal frame spacing in feet, or
(ii) in the case of a modulus expressed in $centimetre^3$ units, the span of the main longitudinal frame in millimetres,
in the bow area, mid-body area or stern area, whichever area is applicable;
(c) "p" is, subject to subsection (3),
(i) in the case of a modulus expressed in $inch^3$ units, the pressure in pounds per square inch shown in Column II, IV or VII of the item, or
(ii) in the case of a modulus expressed in $centimetres^3$ units, the pressure in kiloponds per square centimetre shown in Column II, IV or VII, of the item,

whichever Column is applicable with respect to the area specified in the heading to the Column;
(d) "k" is,
(i) 85, in the case of framing in the bow area and a modulus expressed in $inch^3$ units,
(ii) $\frac{1}{20300}$, in the case of framing in the bow area and a modulus expressed in $centimetre^3$ units,
(iii) 93, in the case of framing in the mid-body area or stern area, and a modulus expressed in $inch^3$ units, and
(iv) $\frac{1}{18600}$, in the case of framing in the mid-body area or stern area, and a modulus expressed in $centimetre^3$ units;

(e) "f" is,
(i) in the case of a modulus expressed in $inch^3$ units, the yield stress of the main longitudinal frame material in pounds per square inch, or
(ii) in the case of a modulus expressed in $centimetre^3$ units, the yield stress of the main longitudinal frame material in kiloponds per square centimetre,

in the bow area, mid-body area or stern area, whichever area is applicable.

(3) Where longitudinal framing is used in the bow of a ship, the pressures shown in Columns II and III of an item of Table 2 shall be multiplied by the factor 1.2, except that in no case need the increased pressures so obtained exceed 1500 pounds per square inch (105.65 kiloponds per square centimetre).

a) «b» représente
(i) dans le cas d'un module exprimé en pouces cubes, la portée des membrures longitudinales principales, en pieds; ou
(ii) dans le cas d'un module exprimé en centimètres cubes, la portée des membrures longitudinales principales, en millimètres,
dans la section avant, la section médiane ou la section arrière, selon le cas;
b) «s» représente
(i) dans le cas d'un module exprimé en pouces cubes, l'écartement des membrures longitudinales principales en pieds; ou
(ii) dans le cas d'un module exprimé en centimètres cubes, l'écartement des membrures longitudinales principales en millimètres,
dans la section avant, la section médiane ou la section arrière, selon le cas;
c) «p» représente, sous réserve des dispositions du paragraphe (3),
(i) dans le cas d'un module exprimé en pouces cubes, la pression en livres par pouce carré, indiquée dans les colonnes II, IV ou VII à cet article, ou
(ii) dans le cas d'un module exprimé en centimètres cubes, la pression en kilogrammes-forces par centimètre carré, indiquée dans les colonnes II, IV ou VII à cet article,
selon celle de ces colonnes qui a trait à la section mentionnée en titre de la colonne;
d) «k» représente
(i) 85, dans le cas des membrures de la section avant et d'un module exprimé en pouces cubes,
(ii) $\frac{1}{20300}$, dans le cas des membrures de la section arrière et d'un module exprimé en centimètres cubes,
(iii) 93, dans le cas des membrures de la section médiane ou de la section arrière, et d'un module exprimé en pouces cubes, et
(iv) $\frac{1}{18600}$, dans le cas des membrures de la section médiane ou de la section arrière, et d'un module exprimé en centimètres cubes; et

e) «f» représente
(i) dans le cas d'un module exprimé en pouces cubes, la limite d'élasticité du matériau des membrures longitudinales principales, en livres par pouce carré, ou
(ii) dans le cas d'un module exprimé en centimètres cubes, la limite d'élasticité du matériau des membrures longitudinales principales en kilogrammes-forces par centimètre carré,
dans la section avant, la section médiane ou la section arrière, selon le cas.

(3) Lorsqu'une membrure longitudinale est ménagée dans l'avant d'un navire, les pressions indiquées à l'un des articles du Tableau 2, dans les colonnes II et III, doivent être multipliées par le coefficient 1.2 mais en aucun cas les valeurs de pressions majorées ainsi obtenues ne doivent excéder 1500 livres par pouce carré (105.65 kilogrammes-forces par centimètre carré).

Subdivision and Stability

9. (1) Every Arctic Class ship shall comply with the provisions of the *International Convention on Load Lines, 1966*.

(2) Every Arctic Class ship that is an icebreaker shall, in addition to subsection (1) when at its operating waterline, be able to withstand the flooding of any one compartment and remain afloat in a satisfactory condition of equilibrium.

(3) Every Arctic Class ship, other than an icebreaker, shall, in addition to subsection (1) when loaded to its worst operating condition, be able to withstand the flooding of any two adjacent fore and aft compartments and remain afloat in a satisfactory condition of equilibrium and the necessary calculations shall be based on the following assumptions:

(*a*) that the extent of the vertical side damage shall be from the baseline upwards to the main watertight bulkhead deck;

(*b*) that the extent of the transverse damage shall be

(i) to the first inboard main longitudinal watertight bulkhead, or

(ii) over the breadth of the ship if no main longitudinal watertight bulkheads are fitted; and

(*c*) that the extent of the bottom damage shall be over the breadth of the ship at

(i) the level of the inner bottom, or

(ii) the first watertight deck if no inner bottom is fitted.

10. Every Arctic Class ship shall be constructed or equipped so that, when the ship is riding up or sliding off the ice,

(*a*) the ship has positive stability; and

(*b*) the deck edge of any part of the ship does not submerge.

Rudder and Steering Gear

11. (1) Subject to subsection (7), the rudders, rudder posts, rudder stocks, pintles and steering gear of every Arctic Class ship shall comply with the *Hull Construction Regulations*.

(2) Subject to subsection (3), when calculations are being made for the strength of the rudders, rudder posts, rudder stocks, pintles and steering gear referred to in subsection (1), the speed of an Actic Class ship set out in Column I of an item of Table 5 shall be deemed to be the speed set out in Column II of that item.

(3) Where it can be shown that the maximum operating load on a rudder of a ship is greater than the load calculated by using the speed set out in Column II of an item of Table 5 for an Arctic Class ship set out in Column I of that item, the rudder, rudder post, rudder stock, pintles and steering gear shall be designed for the higher load.

(4) The main steering gear of an Arctic Class ship shall be fitted with a shock absorbing device and shall be capable of moving the rudder from 35 degrees on one side to 30 degrees on the other in $\sqrt{2L}$ seconds.

(5) Every Arctic Class ship shall, in addition to a main steering gear, be fitted with an auxiliary steering gear capable of being readily connected to the tiller and, in the case of a

Cloisonnement et stabilité

9. (1) Tout navire de la cote arctique doit satisfaire aux dispositions de la *Convention internationale sur les lignes de charge, 1966*.

(2) Tout brise-glace classé comme navire de la cote arctique calé jusqu'à sa ligne de flottaison doit, sans prejudice de sa conformité avec les dispositions du paragraphe (1), pouvoir demeurer à flot dans des conditions satisfaisantes d'équilibre malgré le remplissage de n'importe quel compartiment.

(3) Tout navire de la cote arctique autre qu'un brise-glace calé, dans les conditions d'exploitation doit, sans préjudice de sa conformité avec les dispositions du paragraphe (1), pouvoir, malgré le remplissage de deux compartiments adjacents quelconques à l'avant et à l'arrière, demeurer à flot dans des conditions satisfaisantes d'équilibre, les calculs nécessaires à cet effet étant fondés sur les hypothèses suivantes:

a) l'avarie causée au bordé de côté s'étend verticalement de la ligne d'eau zéro jusqu'au pont de cloisonnement étanche principal;

b) l'avarie s'étend dans le sens transversal

(i) jusqu'à la première cloison étanche longitudinale principale de l'intérieur, ou

(ii) sur la largeur du navire s'il n'est pas muni de cloisons étanches longitudinales principales; et

c) l'avarie au petit fond s'étend sur la largeur du navire

(i) au niveau du plafond de ballast, ou

(ii) au premier pont étanche s'il n'y a pas de double fond.

10. Tout navire de la cote arctique doit être construit ou équipé de façon que, lorsqu'il monte ou descend sur les glaces,

a) il a une stabilité vraie; et

b) aucune partie du can de pont n'est immergée.

Gouvernail et appareil à gouverner

11. (1) Sous réserve des dispositions du paragraphe (7), le safran, les étambots, les mèches de gouvernail, les aiguillots et l'appareil à gouverner doivent être conformes aux prescriptions du *Règlement sur la construction des coques*.

(2) Sous réserve des dispositions du paragraphe (3), dans le calcul de la résistance du safran, des étambots, des mèches de gouvernail, des aiguillots et de l'appareil à gouverner mentionnés au paragraphe (1), la vitesse d'un navire de la cote arctique visé à l'un des articles du Tableau 5 dans la colonne I est réputée être la vitesse indiquée dans la colonne II au même article.

(3) Lorsqu'il est possible de démontrer que la charge maximale d'exploitation sur le gouvernail d'un navire de la cote arctique visé à l'un des articles du Tableau 5 dans la colonne I est supérieure à la charge calculée d'après la vitesse donnée dans la colonne II au même article, le safran, les étambots, les mèches de gouvernail, les aiguillots et l'appareil à gouverner doivent être conçus pour résister à la charge supérieure.

(4) L'appareil à gouverner principal d'un navire de la cote arctique doit être muni d'un dispositif amortisseur de choc capable de paire passer le safran de la position 35° sur un bord à la position 30° sur l'autre bord en $\sqrt{2L}$ secondes.

(5) Tout navire de la cote arctique doit être équipé en plus d'un appareil à gouverner principal, d'un appareil à gouverner auxiliaire qui peut être facilement accouplé à la barre

ship with twin rudders operated by a single steering gear, shall be equipped so that each rudder can be readily disconnected and secured.

(6) Every Arctic Class ship shall be fitted with ice horns directly abaft each rudder in such a manner that

(a) the upper edge of the rudder is protected within two degrees port and starboard of mid-position when going astern; and

(b) ice is prevented from wedging between the top of the rudder and the ship's hull.

(7) The rudder side plating for every Arctic Class ship shall be reinforced for ice in direct proportion to the ice reinforcement required for the astern area plating.

et, dans le cas d'un navire à deux safrans commandés par un seul appareil à gouverner, d'un moyen de désaccoupler et d'immobiliser facilement chaque safran.

(6) Tout navire de la cote arctique sera muni d'oreilles anti-glace installées directement en arrière de chaque safran de façon à

a) protéger le bord supérieur du safran à deux degrés d'angle près à babord et à tribord de la position médiane pendant la marche arrière; et

b) à empêcher la glace de se coincer entre le haut du safran et la coque du navire.

(7) Les tôles de protection du safran de tout navire de la cote arctique doivent être renforcées en proportion directe du renforcement qu'exige la navigation dans les glaces en fait de renforcement de la tôlerie de la section arrière.

TABLE I

		Values expressed in feet and centimetres						Values expressed as a percentage of the length (L) of the ship.		
	Column I	Column II	Column III	Column IV	Column V	Column VI	Column VII	Column VIII	Column IX	Column X
Item	Arctic Class	'D' ft. cm.	'AW' ft. cm.	'BW' ft. cm.	'UT' ft. cm.	'LT' ft. cm.	'C' ft. cm.	'E'	'F'	'S'
1	1A	4 (122)	2.5 (76)	3.5 (107)	1 (30)	2 (61)	2.5 (76)	2.5	20	15
2	2	5 (152)	3 (91)	5 (152)	1.5 (46)	2 (61)	3 (91)	2.5	20	15
3	3	6 (183)	4.5 (137)	7.5 (229)	1.5 (46)	2 (61)	4.5 (137)	2.5	20	15
4	4	8 (244)	6 (183)	12 (366)	2 (61)	3 (91)	6 (183)	2.5	20	15
5	6	12 (366)	9 (274)	15 (457)	3 (91)	4.5 (137)	9 (274)	2.5	25	20
6	7	16 (488)	12 (366)	20 (610)	4 (122)	6 (183)	12 (366)	2.5	30	25
7	8	20 (610)	15 (457)	25 (762)	5 (152)	7.5 (229)	15 (457)	2.5	30	25
8	10	24 (732)	18 (549)	30 (914)	6 (183)	9 (274)	18 (549)	2.5	30	25

TABLEAU I

		Dimensions exprimées en pieds et en centimètres						Dimensions exprimées en pourcentage de la longueur (L) du navire		
	Colonne I	Colonne II	Colonne III	Colonne IV	Colonne V	Colonne VI	Colonne VII	Colonne VIII	Colonne IX	Colonne X
Article	Cote arctique	'D' pi cm	'AW' pi cm	'BW' pi cm	'UT' pi cm	'LT' pi cm	'C' pi cm	'E'	'F'	'S'
1	1A	4 (122)	2.5 (76)	3.5 (107)	1 (30)	2 (61)	2.5 (76)	2.5	20	15
2	2	5 (152)	3 (91)	5 (152)	1.5 (46)	2 (61)	3 (91)	2.5	20	15
3	3	6 (183)	4.5 (137)	7.5 (229)	1.5 (46)	2 (61)	4.5 (137)	2.5	20	15
4	4	8 (244)	6 (183)	12 (366)	2 (61)	3 (91)	6 (183)	2.5	20	15
5	6	12 (366)	9 (274)	15 (457)	3 (91)	4.5 (137)	9 (274)	2.5	25	20
6	7	16 (488)	12 (366)	20 (610)	4 (122)	6 (183)	12 (366)	2.5	30	25
7	8	20 (610)	15 (457)	25 (762)	5 (152)	7.5 (229)	15 (457)	2.5	30	25
8	10	24 (732)	18 (549)	30 (914)	6 (183)	9 (274)	18 (549)	2.5	30	25

TABLE 2

Ice Pressures in pounds per square inch (kiloponds per square centimetre)

Item	Column I	Column II	Column III	Column IV	Column V	Column VI	Column VII
	Arctic Class	Bow Area	Lower Bow Area	Mid-body Area	Lower Transition Area	Upper Transition Area	Stern Area
1	1	250* (17.58)	**	100* (7.03)	**	**	100* (7.03)
2	1A	400 (28.12)	210 (14.76)	260 (18.28)	180 (12.65)	130 (9.14)	325 (22.85)
3	2	600 (42.18)	320 (22.50)	400 (28.12)	260 (18.28)	200 (14.06)	500 (35.15)
4	3	800 (56.24)	420 (29.53)	530 (37.26)	370 (26.01)	260 (18.28)	660 (46.40)
5	4	1000 (70.30)	530 (37.26)	660 (46.40)	460 (32.34)	330 (23.20)	820 (57.65)
6	6	1200 (84.36)	640 (44.99)	750 (52.73)	520 (36.56)	370 (26.01)	940 (66.08)
7	7	1400 (98.42)	740 (52.02)	850 (59.76)	600 (42.18)	420 (29.53)	1050 (73.82)
8	8	1500 (105.65)	800 (56.24)	950 (66.79)	660 (46.40)	470 (33.04)	1200 (84.36)
9	10	1500 (105.65)	800 (56.24)	950 (66.79)	660 (46.40)	470 (33.04)	1200 (84.36)

*In an Arctic Class 1 ship, only that part of
(a) the bow area and stern area lying between the horizontal projections of the upper and lower edges of the mid-body area need be considered; and
(b) the mid-body area forward of amidships need be considered.
**In an Arctic Class 1 ship, ice pressure need not be considered as a factor in the design of the hull in the lower bow area, lower transition area and upper transition area, and the strength standards usually applied to ocean-going ships shall apply in these areas.

TABLEAU 2

Pression des glaces en livres par pouce carré (kilogrammes-forces par centimètre carré)

Article	Colonne I	Colonne II	Colonne III	Colonne IV	Colonne V	Colonne VI	Colonne VII
	Cote arctique	Section avant	Section avant inférieure	Section médiane	Section de transition inférieure	Section de transition supérieure	Section arrière
1	1	250* (17.58)	**	100* (7.03)	**	**	100* (7.03)
2	1A	440 (28.12)	210 (14.76)	260 (18.28)	180 (12.65)	130 (9.14)	325 (22.85)
3	2	600 (42.18)	320 (22.50)	400 (28.12)	260 (18.28)	200 (14.06)	500 (35.15)
4	3	800 (56.24)	420 (29.53)	530 (37.26)	370 (26.01)	260 (18.28)	660 (46.40)
5	4	1000 (70.30)	530 (37.26)	660 (46.40)	460 (32.34)	330 (23.20)	820 (57.65)
6	6	1200 (84.36)	640 (44.99)	750 (52.73)	520 (36.56)	370 (26.01)	940 (66.08)
7	7	1400 (98.42)	740 (52.02)	850 (59.76)	600 (42.18)	420 (29.53)	1050 (73.82)
8	8	1500 (105.65)	800 (56.24)	950 (66.79)	660 (46.40)	470 (33.04)	1200 (84.36)
9	10	1500 (105.65)	800 (56.24)	950 (66.79)	660 (46.40)	470 (33.04)	1200 (84.36)

*Pour les navires de la cote arctique 1, il suffit de tenir compte
a) de la partie de la section avant et de la section arrière comprise entre les projections horizontales des limites inférieure et supérieure de la section médiane; et
b) de la partie de la section médiane située en avant du milieu du navire.
**Pour les navires de la cote arctique 1, il n'est pas nécessaire de tenir compte de la pression des glaces dans la conception de la coque, notamment de la section avant inférieure ainsi que des sections de transition inférieure et supérieure; il suffit d'observer les normes de résistance qui s'appliquent habituellement aux long-courriers.

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TABLE 3

	Minimum Ice Loading, expressed in Tons per Foot Run (Tonnes per Metre Run), for Stringers or Web Frames in the Areas Specified in the column headings below			
	Column I	Column II	Column III	Column IV
Item	Arctic Class	Bow Area	Mid-body Area	Stern Area
1	1	22 (73.3)	*	*
2	1A	25 (83.3)	20 (66.6)	22 (73.3)
3	2	30 (99.9)	25 (83.3)	27 (89.9)
4	3	40 (133.2)	30 (99.9)	35 (116.6)
5	4	50 (166.5)	35 (116.6)	40 (133.2)
6	6	70 (233.1)	45 (149.9)	55 (182.2)
7	7	80 (266.4)	50 (166.5)	60 (199.8)
8	8	100 (333.3)	60 (199.8)	75 (249.8)
9	10	165 (549.5)	70 (233.1)	80 (266.4)

NOTE: The loading values shown in this Table are based upon a stringer or web frame spacing of 4 feet. For any other spacing, these loading values shall be increased or decreased, respectively, in direct proportion to the amount that the actual spacing is greater than or less than 4 feet.

*In an Arctic Class 1 ship, ice loads need not be considered as a factor in the design of the hull in the mid-body area and stern area, and the strength standards usually applied to ocean-going ships shall apply in these areas.

TABLEAU 3

	Résistance minimale à la glace des serres ou des porques pour les sections spécifiées en tête des colonnes ci-dessous, exprimée en tonnes par pied de longueur (tonnes par mètre de longueur)			
	Colonne I	Colonne II	Colonne III	Colonne IV
Article	Cote arctique	Section avant	Section médiane	Section arrière
1	1	22 (73.3)	*	*
2	1A	25 (83.3)	20 (66.6)	22 (73.3)
3	2	30 (99.9)	25 (83.3)	27 (89.9)
4	3	40 (133.2)	30 (99.9)	35 (116.6)
5	4	50 (166.5)	35 (116.6)	40 (133.2)
6	6	70 (233.1)	45 (149.9)	55 (182.2)
7	7	80 (266.4)	50 (166.5)	60 (199.8)
8	8	100 (333.3)	60 (199.8)	75 (249.8)
9	10	165 (549.5)	70 (233.1)	80 (266.4)

REMARQUE: Les résistances minimales indiquées au présent tableau sont valables pour un écartement des serres ou des porques de 4 pieds. Pour toute autre distance d'écartement, il y aura lieu d'augmenter ou de diminuer respectivement ces chiffres directement en proportion de la différence entre l'écartement réel et un écartement de 4 pieds.

*Dans le cas d'un navire de la cote arctique 1, il n'est pas nécessaire de tenir compte de la pression des glaces pour l'étude de la section médiane et de la section arrière de la coque, et les normes de résistance à utiliser pour ces sections sont celles qui s'appliquent habituellement aux long-courriers.

TABLE 4

	Column I	Column II
Item	Arctic Class	Minimum Side Tank Widths
1	1	not applicable
2	1A	3.0 feet (0.91 metres)
3	2	3.0 feet (0.91 metres)
4	3	3.5 feet (1.07 metres)
5	4	4.0 feet (1.22 metres)
6	6	5.0 feet (1.52 metres)
7	7	6.0 feet (1.83 metres)
8	8	6.0 feet (1.83 metres)
9	10	6.0 feet (1.83 metres)

TABLEAU 4

	Colonne I	Colonne II
Article	Cote arctique	Largeur minimale des ballasts latéraux
1	1	Sans objet
2	1A	3.0 pieds (0.91 mètre)
3	2	3.0 pieds (0.91 mètre)
4	3	3.5 pieds (1.07 mètre)
5	4	4.0 pieds (1.22 mètre)
6	6	5.0 pieds (1.52 mètre)
7	7	6.0 pieds (1.83 mètre)
8	8	6.0 pieds (1.83 mètre)
9	10	6.0 pieds (1.83 mètre)

TABLE 5

Item	Column I Arctic Class	Column II Minimum Speed in Knots
1	1	16
2	1A	18
3	2	20
4	3	22
5	4	22
6	6	24
7	7	26
8	8	26
9	10	26

TABLEAU 5

Article	Colonne I Cote arctique	Colonne II Vitesse minimale en nœuds
1	1	16
2	1A	18
3	2	20
4	3	22
5	4	22
6	6	24
7	7	26
8	8	26
9	10	26

SCHEDULE G

MACHINERY REQUIREMENTS FOR ARCTIC CLASS SHIPS

Power Requirements

1. (1) Subject to subsections (2), (3) and (7), the minimum continuous shaft horsepower available from the propulsion machinery of every Arctic Class ship shall not be less than the numerical value obtained from

(*a*) $P_r \times \frac{D_r}{D}$ if $\frac{D_r}{D} \geqslant 1$, or

(*b*) P_r if $\frac{D_r}{D} < 1$,

where

(*c*) "P_r" = $(22 - 0.1W^{1/3})\ BA^2$, for calculations using inch/pound units, or $(787.7 - 3.561W^{1/3})\ BA^2$, for calculations using kilogram/metre units,

(*d*) "B" = the maximum breadth of the ship at the operating waterline in feet (metres),

(*e*) "W" = displacement of the ship in tons (tonnes) at the operating waterline,

(*f*) "D_r" = $4.5\sqrt{\frac{P_R}{1000Z}}$,

(*g*) "D" = the diameter of the propellers in feet (metres), except that where the propellers are of different diameters,

$$D = \sqrt{\frac{D_1^2 + D_2^2 + D_3^2 \ \ldots}{Z}},$$

(*h*) "Z" = the number of propellers, and

(*i*) "A" = for an Arctic Class ship set out in Column I of an item of the Table to this section, the value shown in Column II of that item.

ANNEXE G

EXIGENCES RELATIVES AUX MACHINES DES NAVIRES DE LA COTE ARCTIQUE

Puissance requise

1. (1) Sous réserve des dispositions des paragraphes (2), (3) et (7), la puissance minimale sur l'arbre en régime permanent de la machine de propulsion de tout navire de la cote arctique ne doit pas être inférieure aux valeurs numériques tirées de:

a) $P_r \times \frac{D_r}{D}$ si $\frac{D_r}{D} \geqslant 1$, ou

b) P_r si $\frac{D_r}{D} < 1$,

dans laquelle

c) «P_r» = $(22 - 0.1W^{1/3})\ BA^2$, si l'on utilise le pouce et la livre comme unités, ou $(787.7 - 3.561W^{1/3})\ BA^2$, si l'on utilise le kilogramme et le mètre comme unités,

d) «B» = représente la largeur en pieds (mètres) au fort du navire au niveau de la ligne de charge maximale,

e) «W» = représente le déplacement du navire à son tirant d'eau maximal permis en tonnes (tonnes métriques),

f) «D_R» = $4.5\sqrt{\frac{P_R}{1000Z}}$,

g) «D» = représente le diamètre en pieds (mètres) des hélices. Toutefois si les hélices sont de diamètres différents,

$$D = \sqrt{\frac{D_1^2 + D_2^2 + D_3^2}{Z}} \ \ldots,$$

h) «Z» = représente le nombre d'hélices, et

i) «A» = représente, dans le cas d'un navire de la cote arctique visé à l'un des articles du tableau ci-après, dans la colonne I, la valeur indiquée dans la colonne II, à cet article.

TABLE

Item	Column I Arctic Class	Column II Value of A feet	 metres
1	1	1	0.305
2	1A	1.5	0.458
3	2	2	0.610
4	3	3	0.915
5	4	4	1.220
6	6	6	1.830
7	7	7	2.135
8	8	8	2.440
9	10	10	3.050

(2) The minimum continuous shaft horsepower available for the propulsion of every Arctic Class ship shall not be less than that required to propel the ship in still water at a speed of 12 knots.

(3) A pollution prevention officer may accept a ship as an Arctic Class ship, where the shaft horsepower is less than that required by subsection (1) for a ship of that Arctic Class, if the owner of that ship can show that the ship is able to maintain continuous progress in those zones and at those times of year in which a ship of that Arctic Class is permitted to operate.

(4) The shaft horsepower that the propelling machinery of every Arctic Class ship is able to develop when going astern shall not be less than 70% of the horsepower required for that ship in subsection (1) and the machinery shall be able to maintain that horsepower for a period of not less than three hours.

(5) Every ship of Arctic Class 10, 8 or 7 shall be

(*a*) powered by not less than two prime movers; and

(*b*) provided with not less than two propellers, each located at the stern.

(6) Every Arctic Class ship that is propelled by steam driven machinery shall be provided with not less than two boilers that have an equal maximum evaporation rate.

(7) Every Arctic Class ship that is propelled by diesel machinery other than

(*a*) diesel electric machinery, or

(*b*) diesel machinery that drives a controllable pitch propeller,

shall be provided with machinery capable of developing 1.1 times the shaft horsepower derived from the formula in subsection (1).

Machinery Protection

2. (1) The propulsion machinery, gearing, shafting and propellers of every ship of Arctic Class 10, 8, 7, 6, 4 or 3, shall be protected from shock loads due to the propeller striking ice and such method of protection shall

TABLEAU

Article	Colonne I Cote arctique	Colonne II Valeur de A en pieds	 en mètres
1	1	1	0.305
2	1A	1.5	0.458
3	2	2	0.610
4	3	3	0.915
5	4	4	1.220
6	6	6	1.830
7	7	7	2.135
8	8	8	2.440
9	10	10	3.050

(2) La puissance minimale sur l'arbre en régime permanent de la machine de propulsion de tout navire de la cote arctique ne doit pas être inférieure à celle qui est nécessaire pour propulser le navire en eau calme à la vitesse de 12 nœuds.

(3) Un fonctionnaire chargé de la prévention de la pollution peut accepter un navire en cote arctique lorsque la puissance sur l'arbre est inférieure à celle que prescrit le paragraphe (1) pour un navire de la classe arctique, si le propriétaire du navire peut démontrer que son navire est en mesure d'assurer un service continu dans les zones et pendant le temps de l'année où un navire de la cote arctique est autorisé à naviguer.

(4) La puissance sur l'arbre que la machine de propulsion de tout navire de la classe arctique est capable de produire en marche arrière ne doit pas être inférieure à 70% de la puissance prescrite pour ce navire par le paragraphe (1), et la machine de propulsion doit pouvoir maintenir cette puissance durant au moins trois heures.

(5) Tout navire de la cote arctique 10, 8 ou 7 doit être

a) mû par au moins deux moteurs primaires; et

b) équipé d'au moins deux hélices situées à l'arrière.

(6) Tout navire de la cote arctique mû par une machine à vapeur doit être équipé d'au moins deux chaudières ayant le même taux maximal de vaporisation.

(7) Tout navire de la cote arctique mû par un moteur diesel, sauf

a) un moteur diesel-électrique, ou

b) un moteur diesel entraînant une hélice à pas variable,

doit pouvoir produire une puissance sur l'arbre égale à 1.1 fois celle qui résulte de l'application de la formule énoncée au paragraphe (1).

Protection des machines

2. (1) Les machines de propulsion, les engrenages, les arbres et les hélices de tout navire des cotes arctiques 10, 8, 7, 6, 4 ou 3 doivent être protégés contre les chocs qui se produisent lorsque les hélices heurtent les glaces et le moyen de protection prévu à cet effet doit

(a) be by means of a shear coupling or a method that is equally effective, fitted at that part of the propulsion system where the highest impact torque will occur;
(b) prevent the torque on any part of the propulsion system from exceeding twice the designed torque; and
(c) be capable of further operation to permit the ship to complete the voyage.

(2) Means shall be provided to prevent the prime movers of every Arctic Class ship from overspeeding.

(3) Where an electric motor is used for the propulsion of any Arctic Class ship, provision shall be made to automatically protect the motor from
(a) excess torque;
(b) overloading; and
(c) overheating.

Determination of Ice Torque

3. (1) The calculations made to determine the dimensions of a propeller and screw shaft of every Arctic Class ship shall include an ice torque factor.

(2) The ice torque factor described in subsection (1) shall be derived from the following formula

$M = mD^2$ tons feet units (tonnes metres units)

where
(a) "D" = the propeller diameter in feet (metres)
(b) "m" = for an Arctic Class ship set out in Column I of an item of the Table to this section, the value shown in Column II of that item.

TABLE

	Column I	Column II	
		Value of "m"	
Item	Arctic Class	inch/pound units	kilogram/metre units
1	1	0.365	1.22
2	1A	0.480	1.60
3	2	0.540	1.80
4	3	0.645	2.15
5	4	0.735	2.45
6	6	0.875	2.91
7	7	0.920	3.07
8	8	0.985	3.28
9	10	1.01	3.36

Testing of Materials

4. Materials used for propellers and shafting of every Arctic Class ship shall be tested in accordance with
(a) the *Steamship Machinery Construction Regulations*; or

a) être réalisé au moyen d'un accouplement à rupture par cisaillement ou un autre dispositif aussi efficace installé au point de l'appareil de propulsion où le couple dû aux chocs est le plus élevé;
b) empêcher le couple agissant sur toute partie de l'appareil de propulsion d'excéder le double du couple prévu; et
c) pouvoir continuer à fonctionner pour permettre au navire de terminer le voyage.

(2) Des moyens doivent être prévus pour empêcher les moteurs primaires de tout navire de la cote arctique de s'emballer.

(3) Lorsque la propulsion d'un navire de la cote arctique est assurée au moyen d'un moteur électrique, des dispositions doivent être prises pour protéger automatiquement celui-ci contre
a) l'excès de couple;
b) la surcharge; et
c) l'échauffement.

Détermination du couple dû aux glaces

3. (1) Les calculs permettant de déterminer les dimensions des hélices et des arbres d'un navire de la cote arctique doivent comporter un coefficient du couple dû aux glaces.

(2) Le coefficient du couple dû aux glaces dont il est fait mention au paragraphe (1) doit être établi d'après la formule ci-après:

$M = mD^2$ pieds-tonnes (mètres—tonnes métriques)

dans laquelle
a) «D» constitue le diamètre de l'hélice en pieds (mètres), et
b) «m», dans le cas d'un navire de la cote arctique visée à l'un des articles du tableau ci-après, dans la colonne I, prend la valeur numérique indiquée dans la colonne II, au même article.

TABLEAU

	Colonne I	Colonne II	
		Valeur de «m»	
Article	Cote arctique	Système pouces et livres	Système kilogrammes et mètres
1	1	0.365	1.22
2	1A	0.480	1.60
3	2	0.540	1.80
4	3	0.645	2.15
5	4	0.735	2.45
6	6	0.875	2.91
7	7	0.920	3.07
8	8	0.985	3.28
9	10	1.01	3.36

Épreuves des matériaux

4. Les matériaux dont sont faits les hélices et les arbres de tout navire de la cote arctique doivent être éprouvés conformément
a) au *Règlement sur la construction des machines de navires à vapeur;* ou

(*b*) in the case of a ship that is certificated by an exclusive surveyor of one of the classification societies described in paragraph 13(1)(*b*), the rules of that society.

Propellers

5. (1) Propellers of every Arctic Class ship shall be made of a material that has

(*a*) an elongation of not less than 19 per cent; and

(*b*) if made of carbon or low alloy steel, a Charpy V-notch test value of not less than 15 foot pounds (2.1 kilogram metres) at 15° Fahrenheit (−10° Centigrade).

(2) The width and thickness of propeller blade sections shall not be less than that determined by the following formulae:

(*a*) for solid propellers at 25 per cent of the radius measured from the centre of the boss

$$WT^2 = \frac{27000}{S(0.65 + 0.7P)}\left(\frac{176H}{RN} + 59.134M\right) \text{ in.}^3\text{, or}$$

$$WT^2 = \frac{270}{S(0.65 + 0.7P)}\left(\frac{200H}{RN} + 200M\right) \text{ cm.}^3\text{;}$$

(*b*) for controllable pitch propellers at 35 per cent of the radius measured from the centre of the boss

$$WT^2 = \frac{21500}{S(0.65 + 0.7P)}\left(\frac{176H}{RN} + 61.822M\right) \text{ in.}^3\text{, or}$$

$$WT^2 = \frac{215}{S(0.65 + 0.7P)}\left(\frac{200H}{RN} + 230M\right) \text{ cm.}^3\text{; and}$$

(*c*) for all propellers at 60 per cent of the radius measured from the centre of the boss

$$WT^2 = \frac{9500}{S(0.65 + 0.7P)}\left(\frac{176H}{RN} + 75.261M\right) \text{ in.}^3\text{, or}$$

$$WT^2 = \frac{95}{S(0.65 + 0.7P)}\left(\frac{200H}{RN} + 280M\right) \text{ cm.}^3\text{;}$$

where

(*d*) "W" = expanded width of a cylindrical section of the propeller blade at the appropriate radius in inches (centimetres),

(*e*) "T" = maximum thickness of the propeller blade at the appropriate radius in inches (centimetres),

(*f*) "P" = in the case of a fixed pitch propeller, the propeller pitch in feet (metres) at the appropriate radius divided by the propeller diameter, or in the case of a controllable pitch propeller, 0.7 times the nominal pitch in feet (metres) divided by the propeller diameter,

(*g*) "H" = the maximum shaft horsepower available for that propeller,

b) dans le cas d'un navire auquel est attribué un certificat par un visiteur exclusif de l'une des sociétés de classification mentionnées à l'alinéa 13(1)*b*) conformément aux règles de la société.

Hélices

5. (1) Les hélices de tout navire de la cote arctique doivent être faites d'un matériau ayant

a) un allongement d'au moins 19 pour cent; et

b) une résilience de 15 livres-pieds (2.1 kilogrammètres) à 15 degrés Fahrenheit (−10° Celsius), déterminée au pendule de Charpy (barreau entaillé), dans le cas où le matériau est de l'acier au carbonne ou à faible teneur en métaux d'alliage.

(2) La largeur et l'épaisseur des ailes d'hélices ne doivent pas être inférieures à celles qui sont déterminées au moyen des formules suivantes:

a) dans le cas des hélices massives, pour une distance mesurée depuis le centre du moyeu égale à 25 pour cent du rayon

$$LE^2 = \frac{27000}{S(0.65 + 0.7P)}\left(\frac{176H}{RN} + 59.134M\right) \text{ po}^3\text{, ou}$$

$$LE^2 = \frac{270}{S(0.65 + 0.7P)}\left(\frac{200H}{RN} + 220M\right) \text{ centimètres}^3\text{;}$$

b) dans le cas des hélices à pas variable, pour une distance mesurée depuis le centre du moyeu égale à 35 pour cent du rayon

$$LE^2 = \frac{21500}{S(0.65 + 0.7P)}\left(\frac{176H}{RN} + 61.822M\right) \text{ po}^3\text{, ou}$$

$$LE^2 = \frac{215}{S(0.65 + 0.7P)}\left(\frac{200H}{RN} + 230M\right) \text{ centimètres}^3\text{; et}$$

c) dans le cas de toutes les hélices, pour une distance mesurée depuis le centre du moyeu égale à 60 pour cent du rayon

$$LE^2 = \frac{9500}{S(0.65 + 0.7P)}\left(\frac{176H}{RN} + 75.261M\right) \text{ po}^3\text{, ou}$$

$$LE^2 = \frac{95}{S(0.65 + 0.7P)}\left(\frac{200H}{RN} + 280M\right) \text{ centimètres}^3\text{;}$$

dans lesquelles

d) «L» est en pouces (centimètres) la largeur déployée d'une coupe circulaire d'une aile d'hélice au rayon approprié,

e) «E» est l'épaisseur maximale en pouces (centimètres) de l'aile de l'hélice au rayon approprié,

f) «P» est, dans le cas d'une hélice à pas fixe, le pas en pieds (mètres) au rayon approprié divisé par le diamètre de l'hélice, ou, dans le cas d'une hélice à pas variable, le pas nominal en pieds (mètres), multiplié par 0.7 et divisé par le diamètre de l'hélice,

g) «H» est la puissance maximale sur l'arbre qui peut être transmise à l'hélice,

(h) "S" the ultimate tensile stress of the material of the propeller blade in pounds per square inch (kilograms per square millimetre),
(i) "M" the ice torque as determined in accordance with section 3 of this Schedule,
(j) "R"= propeller revolutions per minute at the maximum shaft horsepower available for that propeller; and
(k) "N"=number of blades.

(3) The propeller blade thickness at 95 per cent of the radius measured from the centre of the boss shall not be less than that determined from the following formulae for a ship of the appropriate Arctic Class:

(a) for an Arctic Class 10, 8, 7, 6, 4, 3 or 2 ship

$$t = (0.787 + 0.024D) \sqrt{70700/S} \text{ inches, or}$$

$$t = (20 + 2D) \sqrt{50/S} \text{ millimetres; and}$$

(b) for an Arctic Class 1A or 1 ship

$$t = (0.591 + 0.024D) \sqrt{70700/S} \text{ inches, or}$$

$$t = (15 + 2D) \sqrt{50/S} \text{ millimetres;}$$

where

(c) "t"= thickness of blade in inches (millimetres),
(d) "D"= diameter of propeller in feet (metres), and
(e) "S"= ultimate tensile stress of the material of the propeller blade in pounds per square inch (kilograms per square millimetre).

(4) The strength of the mechanism in the boss of a controllable pitch propeller shall be one and one half times the strength of one of the blades when a load is applied at nine-tenths of the radius from the centre of the boss in the weakest direction of the blade.

Shafting

6. (1) Subject to subsection (2) and section 9 of this Schedule, the diameter of a screw shaft of every Arctic Class ship shall not be less than that derived from the following formulae:

(a) if the diameter of the propeller boss is one-quarter of the diameter of the propeller or less,

Screw shaft diameter

$$= 1.08 \sqrt[3]{\frac{Su\ WT^2}{Sy}} \text{ inches (centimetres); or}$$

(b) if the diameter of the propeller boss is greater than one-quarter of the diameter of the propeller,

Screw shaft diameter

$$= 1.15 \sqrt[3]{\frac{Su\ WT^2}{Sy}} \text{ inches (centimetres);}$$

where

(c) "Su"= the ultimate tensile stress of the material of the propeller blade in pounds per square inch (kilograms per square millimetre),
(d) "Sy"= the yield stress of the material of the screw shaft in pounds per square inch (kilograms per square millimetre), and
(e) "WT^2"= in the case of the formula in paragraph (a) the value derived from the formulae in paragraph 5(2)(a) of this Schedule and in the case of the formula in paragraph (b) the value derived from the formulae in paragraph 5(2)(b) of this Schedule.

h) «S» est la résistance limite à la traction du matériau dont est faite l'aile de l'hélice, en livres par pouce carré (kilogrammes par millimètre carré),
i) «M» est le couple de torsion dû aux glaces déterminé conformément à l'article 3 de la présente annexe,
j) «R» est la vitesse de rotation à la minute de l'hélice à puissance maximale sur arbre; et
k) «N» est le nombre d'ailes.

(3) L'épaisseur des ailes d'hélices à une distance du centre du moyeu égale à 95 pour cent du rayon ne doit pas être inférieure à celle qui est déterminée au moyen des formules suivantes pour un navire de la cote arctique correspondante:

a) dans le cas d'un navire de la cote arctique 10, 8, 7, 6, 4, 3 ou 2

$$e = (0.787 + 0.024D) \sqrt{70700/S} \text{ pouces, ou}$$

$$e = (20 + 2D) \sqrt{50/S} \text{ millimètres; et}$$

b) dans le cas d'un navire de la cote arctique 1A ou 1

$$e = (0.591 + 0.024D) \sqrt{70700/S} \text{ pouces, ou}$$

$$e = (15 + 2D) \sqrt{50/S} \text{ millimètres;}$$

dans lesquelles

c) «e» est l'épaisseur de l'aile en pouces (millimètres),
d) «D» est le diamètre de l'hélice en pieds (mètres), et
e) «S» est la résistance limite à la traction, en livres par pouce carré (kilogrammes par millimètre carré), du matériau dont sont faites les ailes d'hélice.

(4) La résistance du mécanisme dans le moyeu d'une hélice à pas variable doit être égale à une fois et demie celle de l'une des ailes lorsqu'une charge est appliquée à une distance du centre du moyen égale aux neuf dixièmes du rayon dans la direction la plus faible de l'aile.

Arbres

6. (1) Sous réserve des dispositions du paragraphe (2) et de l'article 9 de la présente annexe, le diamètre de l'arbre d'hélice de tout navire de la cote arctique ne doit pas être inférieur à celui qui résulte de l'application des formules suivantes:

a) si le diamètre du moyeu de l'hélice est égal au quart de celui de l'hélice, ou moindre, le diamètre de l'arbre porte-hélice sera

$$= 1.08 \sqrt[3]{\frac{Su\ LE^2}{Sy}} \text{ pouces (centimètres); ou}$$

b) si le diamètre du moyeu de l'hélice est supérieur au quart de celui de l'hélice, le diamètre de l'arbre porte-hélice sera

$$= 1.15 \sqrt[3]{\frac{Su\ LE^2}{Sy}} \text{ pouces (centimètres);}$$

dans lesquelles

c) «Su» représente la résistance limite à la traction en livres par pouce carré (kilogrammes par millimètre carré), du matériau dont sont faites les ailes des hélices,
d) «Sy» représente la limite d'élasticité, en livres par pouce carré (kilogrammes par millimètre carré), du matériau dont est fait l'arbre d'hélice, et
e) «LE^2», dans le cas de la formule de l'alinéa a), représente la valeur tirée des formules de l'alinéa 5(2)a) de la présente annexe et, dans le cas de la formule de l'alinéa b), la valeur tirée de la formule de l'alinéa 5(2)b) de la présente annexe.

(2) Where the diameter of a screw shaft when calculated by the appropriate formulae in subsection (1) is less than that of a screw shaft required by the appropriate formulae in the *Steamship Machinery Construction Regulations*, the diameter of the screw shaft shall not be less than that required by those Regulations.

(3) When calculations are made to determine the diameter of the intermediate shaft in order to determine the diameter of the screw shaft for the purposes of subsection (2), the diameter of the intermediate shaft need not be increased as required in section 7 of this Schedule.

(4) Where carbon or low alloy steel is used for the construction of a screw shaft, the material shall

(*a*) be subjected to a Charpy V-notch test at 15° Fahrenheit (−10° Centigrade); and

(*b*) have an average energy valve of not less than 15 foot pounds (2.1 kilogram metres).

7. (1) Subject to subsection (2) and section 9 of this Schedule, the diameter of the intermediate and thrust shafts for an Arctic Class ship set out in Column I of an item of the Table to this section, shall be determined by the appropriate formula in the *Steamship Machinery Construction Regulations*, and the diameter determined by that formula shall be increased by the amount shown in Column II of that item.

TABLE

Item	Column I Arctic Class	Column II Percentage of Increase in Diameter
1	1	No Increase
2	1A	4
3	2	8
4	3	12
5	4	15
6	6 and 7	20
7	8 and 10	20

(2) Notwithstanding the requirements of subsection (1), the diameter of the intermediate and thrust shafts need not exceed 0.85 times the diameter of the screw shaft determined by section 6 of this Schedule.

Gearing

8. (1) Subject to section 9 of this Schedule, where gearing is fitted between the engine and the propeller shafting of an Arctic Class ship set out in Column I of an item of the Table to this section, the gearing shall be designed and constructed to transmit, in addition to the maximum torque that the engine is able to develop, the percentage increase in torque that is set out in Column II of that item.

(2) Lorsque le diamètre de l'arbre d'hélice calculé au moyen des formules correspondantes du paragraphe (1) est inférieur à celui que prescrit par les formules appropriées le *Règlement sur la construction des machines de navires à vapeur*, le diamètre de l'arbre porte-hélice ne doit pas être inférieur à celui que prescrit ledit règlement.

(3) Lorsque des calculs sont faits pour déterminer le diamètre de l'arbre intermédiaire afin de pouvoir déterminer celui de l'arbre d'hélice aux fins des dispositions de l'article (2), il n'y a pas lieu d'augmenter le diamètre de l'arbre intermédiaire comme le prescrivent les dispositions de l'article 7 de la présente annexe.

(4) Lorsqu'un acier au carbone ou à faible teneur en métaux d'alliage est utilisé pour la construction d'un arbre d'hélice, le matériau devra

a) être éprouvé à 15° Fahrenheit (−10° Celsius) au pendule de Charpy (barreau entaillé); et

b) présenter une valeur énergétique moyenne d'au moins 15 livres-pieds (2.1 kilogrammètres).

7. (1) Sous réserve des dispositions du paragraphe (2) et de l'article 9 de la présente annexe, le diamètre de l'arbre de butée d'un navire de la cote arctique visé à l'un des articles du tableau ci-après, dans la colonne I, doit être déterminé au moyen de la formule appropriée du *Règlement sur la construction des machines des navires à vapeur*, et le diamètre ainsi déterminé doit être augmenté à raison du pourcentage indiqué dans la colonne II, en regard de cet article.

TABLEAU

Article	Colonne I Cote arctique	Colonne II Pourcentage d'augmentation du diamètre
1	1	Pas d'augmentation
2	1A	4
3	2	8
4	3	12
5	4	15
6	6 et 7	20
7	8 et 10	20

(2) Nonobstant les prescriptions du paragraphe (1), il ne sera pas nécessaire que le diamètre de l'arbre intermédiaire et celui de l'arbre de butée excède 0.85 fois le diamètre de l'arbre d'hélice défini à l'article 6 de la présente annexe.

Engrenages

8. (1) Sous réserve des dispositions de l'article 9 de la présente annexe, lorsqu'un engrenage relie le moteur à l'arbre d'hélice d'un navire de la cote arctique visé à l'un des articles du tableau ci-après, dans la colonne I, l'engrenage doit être conçu et construit pour transmettre, outre le couple maximal que le moteur peut produire, l'augmentation en pourcentage du couple moteur qui est indiqué dans la colonne II, au même article.

TABLE

	Column I	Column II
Item	Arctic Class	Percentage of Increase in Torque
1	1	15
2	1A	15
3	2	30
4	3	50
5	4	60
6	6 and 7	70
7	8 and 10	100

TABLEAU

	Colonne I	Colonne II
Article	Cote arctique	Pourcentage d'augmentation du couple
1	1	15
2	1A	15
3	2	30
4	3	50
5	4	60
6	6 et 7	70
7	8 et 10	100

Deep Submerged Propellers

9. Notwithstanding the requirements of sections 5 to 8 of this Schedule, where, in the case of an Arctic Class ship set out in Column I of an item of the Table to this section, the propeller tips at their highest point are not less than the distance set out in Column II of that item below the lightest operating waterline of the ship, the construction of the propellers, shafts and gears need not be stronger than that required for an Arctic Class 3 ship.

Hélices profondes

9. Nonobstant les prescriptions des articles 5 à 8 de la présente annexe, lorsque, dans le cas d'un navire de la cote arctique visé à l'un des articles du tableau ci-après dans la colonne I, la distance entre le point le plus élevé que les bords d'ailes des hélices atteignent et la ligne de charge maximale du navire n'est pas inférieure à celle qui est indiquée dans la colonne II du tableau au même article, il n'est pas nécessaire que les hélices, les arbres et les engrenages soient plus résistants que ce qui est prescrit pour un navire de la cote arctique.

TABLE

	Column I	Column II
Item	Arctic Class	Minimum Distance in feet (metres)
1	4	10 (3.05)
2	6	15 (4.57)
3	7	17.5 (5.34)
4	8	20 (6.10)
5	10	25 (7.63)

TABLEAU

	Colonne I	Colonne II
Article	Cote arctique	Distance minimale en pieds (mètres)
1	4	10 (3.05)
2	6	15 (4.57)
3	7	17.5 (5.34)
4	8	20 (6.10)
5	10	25 (7.63)

Cooling Water Arrangements

10. (1) Every Arctic Class ship shall be provided with at least one sea bay or tank from which cooling water for machinery that is essential for the propulsion of the ship may be drawn.

(2) The sea bays or tanks described in subsection (1) shall be

(*a*) located as close to the keel as practicable; and

(*b*) be supplied with water from more than one sea inlet box.

(3) The sea inlet boxes described in paragraph (2)(*b*) shall

(*a*) be fitted on each side of the ship;

(*b*) each have an area open to the sea of at least six times the total area of the pump suctions served by the sea bay; and

(*c*) be connected to the sea by pipes, valves and a strainer

Circuits d'eau de refroidissement

10. (1) Tout navire de la cote arctique doit être doté d'au moins une caisse ou un réservoir d'eau de mer d'où peut être aspirée l'eau de refroidissement des machines qui sont indispensables à la propulsion du navire.

(2) Les caisses ou réservoirs d'eau de mer mentionnés au paragraphe (1) doivent être

a) placés aussi près que possible de la quille; et

b) alimentés par plus d'une prise d'eau.

(3) Les prises d'eau mentionnées à l'alinéa (2)*b*) doivent

a) être installées sur chaque bord du navire;

b) avoir chacune une section égale à six fois au moins la section totale des tuyaux d'aspiration raccordés à la caisse d'eau de mer; et

c) être raccordées à la caisse d'eau de mer par des tuyaux, des robinets et une crépine de façon que la crépine puisse être isolée de la mer et de la caisse d'eau de mer. La so that the strainer may be shut off from the sea and from the sea bay and the cross sectional area of such pipes, valves and strainer shall be not less than the total area of the pump suctions served by the sea bay.

11. (1) Every sea water pump in an Arctic Class ship that provides sea water to machinery essential for the propulsion of the ship shall be able to draw sea water directly from the sea bay or tank described in subsection 10(1) of this Schedule.

(2) The design flow velocity of sea water through the suction pipe to any pump described in subsection (1) shall not be more than 400 feet per minute.

(3) Cross connections shall be provided from the overboard discharge pipes from the machinery referred to in subsection (1) and such cross connections shall be

(*a*) connected to the pipe between the valve on the sea inlet box and the strainer;

(*b*) of the same bore as the overboard discharge pipe; and

(*c*) provided with a suitable system of valves so that the water may be re-circulated.

Air Starting Systems

12. (1) Every Arctic Class ship that is propelled with engines that are started by compressed air shall be provided with not less than two air receivers and the total capacity of the air receivers shall be sufficient to provide, without replenishment, air for

(*a*) twelve starts in the case of a ship with reversible engines; or

(*b*) six starts in the case of a ship with non-reversible engines.

(2) The compressed air required in subsection (1) shall be provided by more than one independently driven air compressor and the air compressors shall have sufficient capacity to charge the air receivers from empty to maximum pressure in not more than 30 minutes.

(3) The capacity of the smallest air compressor required by subsection (2) shall not be less than two-thirds of the capacity of the largest air compressor.

section transversale de ces tuyaux, de ces robinets et de la crépine ne doit pas être de moindre dimension que la section totale des pompes d'aspiration raccordées à la caisse d'eau de mer.

11. (1) Chaque pompe qui alimente en eau de mer les machines indispensables à la propulsion du navire doit pouvoir aspirer l'eau directement de la caisse ou du réservoir mentionné au paragraphe 10(1) de la présente annexe.

(2) La vitesse d'écoulement prévue de l'eau de mer dans le tuyau d'aspiration de toute pompe mentionnée au paragraphe (1) ne doit pas dépasser 400 pieds à la minute.

(3) Des raccordements traversiers doivent être établis entre les tuyaux de déversement à la mer des machines mentionnées au paragraphe (1), et ces raccordements traversiers doivent être

a) raccordés au tuyau entre le robinet de la prise d'eau à la mer et la crépine;

b) du même calibre que le tuyau de déversement à la mer; et

c) dotés d'un ensemble convenable de robinets qui permettront de faire recirculer l'eau.

Dispositifs de démarrage à l'air comprimé

12. (1) Tout navire de la cote arctique, propulsé par des moteurs dont le démarrage se fait à l'air comprimé, doit être muni d'au moins deux récipients d'air comprimé d'une capacité globale suffisante pour fournir, sans recharge, l'air nécessaire

a) à douze démarrages dans le cas d'un navire à moteurs à renversement de marche; ou

b) à six démarrages dans le cas d'un navire à moteurs dont la marche ne peut être renversée.

(2) L'air comprimé prescrit au paragraphe (1) doit être fourni par plusieurs compresseurs d'air indépendants et assez puissants pour mettre les récipients vides d'air comprimé sous pression maximale en 30 minutes au plus.

(3) La capacité du plus petit des compresseurs d'air que prescrit le paragraphe (2) ne doit pas être inférieure aux deux tiers de la capacité du plus grand des compresseurs.

SCHEDULE H

TABLE

Column I Category	Column II Zone 1	Column III Zone 2	Column IV Zone 3	Column V Zone 4	Column VI Zone 5	Column VII Zone 6	Column VIII Zone 7	Column IX Zone 8	Column X Zone 9	Column XI Zone 10	Column XII Zone 11	Column XIII Zone 12	Column XIV Zone 13	Column XV Zone 14	Column XVI Zone 15	Column XVII Zone 16
Arctic Class 10 1.	All Year	All Year	All Year	All Year	All Year	All Year	All Year	All Year	All Year	All Year	All Year	All Year	All Year	All Year	All Year	All Year
Arctic Class 8 2.	Jul. 1 to Oct. 15	All Year	All Year	All Year	All Year	All Year	All Year	All Year	All Year	All Year	All Year	All Year	All Year	All Year	All Year	All Year
Arctic Class 7 3.	Aug. 1 to Sept. 30	Aug. 1 to Nov. 30	Jul 1 to Dec. 31	Jul. 1 to Dec. 15	Jul. 1 to Dec. 15	All Year	All Year	All Year	All Year	All Year	All Year	All Year	All Year	All Year	All Year	All Year
Arctic Class 6 4.	Aug. 15 to Sept. 15	Aug. 1 to Oct. 31	Jul. 15 to Nov. 30	Jul. 15 to Nov. 30	Aug. 1 to Oct. 15	Jul 15 to Feb. 28	Jul. 1 to Mar. 31	Jul. 1 to Mar. 31	All Year	All Year	Jul. 1 to Mar. 31	All Year	All Year	All Year	All Year	All Year
Arctic Class 4 5.	Aug. 15 to Sept. 15	Aug. 15 to Oct. 15	Jul. 15 to Oct. 31	Jul. 15 to Nov. 15	Aug. 15 to Sept. 30	Jul. 20 to Dec. 31	Jul. 15 to Jan. 15	Jul. 15 to Jan. 15	Jul. 10 to Mar. 31	Jul. 10 to Feb. 28	Jul. 5 to Jan. 15	June 1 to Jan. 31	June 1 to Feb. 15	June 15 to Feb. 15	June 15 to Mar. 15	June 1 to Feb. 15
Arctic Class 3 6.	Aug. 20 to Sept. 15	Aug. 20 to Sept. 30	Jul. 25 to Oct. 15	Jul. 20 to Nov. 5	Aug. 20 to Sept. 25	Aug. 1 to Nov. 20	Jul. 20 to Dec. 15	Jul. 20 to Dec. 31	Jul. 20 to Jan. 20	Jul. 15 to Jan. 25	Jul. 5 to Dec. 15	June 10 to Dec. 31	June 10 to Dec. 31	June 20 to Jan. 10	June 20 to Jan. 31	June 5 to Jan. 10
Arctic Class 2 7.	No Entry	No Entry	Aug. 15 to Sept. 30	Aug. 1 to Oct. 31	No Entry	Aug. 15 to Nov. 20	Aug. 1 to Nov. 20	Aug. 1 to Nov. 30	Aug. 1 to Dec. 20	Jul. 25 to Dec. 20	Jul. 10 to Nov. 20	June 15 to Dec. 5	June 25 to Nov. 15	June 25 to Dec. 10	June 25 to Dec. 20	June 10 to Dec. 10
Arctic Class 1A 8.	No Entry	No Entry	Aug. 20 to Sept. 15	Aug. 20 to Sept. 30	No Entry	Aug. 25 to Oct. 31	Aug. 10 to Nov. 5	Aug. 10 to Nov. 20	Aug. 10 to Dec. 10	Aug. 1 to Dec. 10	Jul. 15 to Nov. 10	Jul. 1 to Nov. 10	Jul. 15 to Oct. 31	Jul. 1 to Nov. 30	Jul. 1 to Dec. 10	June 20 to Nov. 10
Arctic Class 1 9.	No Entry	No Entry	No Entry	No Entry	No Entry	Aug. 25 to Sep. 30	Aug. 10 to Oct. 15	Aug. 10 to Oct. 31	Aug. 10 to Oct. 31	Aug. 1 to Oct. 31	Jul. 15 to Oct. 20	Jul. 1 to Oct. 31	Jul. 15 to Oct. 15	Jul. 1 to Nov. 30	Jul. 1 to Nov. 30	June 20 to Nov. 15
Type A 10.	No Entry	No Entry	Aug. 20 to Sept. 10	Aug. 20 to Sept. 20	No Entry	Aug. 15 to Oct. 15	Aug. 1 to Oct. 25	Aug. 1 to Nov. 10	Aug. 1 to Nov. 20	Jul. 25 to Nov. 20	Jul. 10 to Oct. 31	June 15 to Nov. 10	June 25 to Oct. 22	June 25 to Nov. 30	June 25 to Dec. 5	June 20 to Nov. 20
Type B 11.	No Entry	No Entry	Aug. 20 to Sept. 5	Aug. 20 to Sept. 15	No Entry	Aug. 25 to Sep. 30	Aug. 10 to Oct. 15	Aug. 10 to Oct. 31	Aug. 10 to Oct. 31	Aug. 1 to Oct. 31	Jul. 15 to Oct. 20	Jul. 1 to Oct. 25	Jul. 15 to Oct. 15	Jul. 1 to Nov. 30	Jul. 1 to Nov. 30	June 20 to Nov. 10
Type C 12.	No Entry	No Entry	No Entry	No Entry	No Entry	Aug. 25 to Sep. 25	Aug. 10 to Oct. 10	Aug. 10 to Oct. 25	Aug. 10 to Oct. 25	Aug. 1 to Oct. 25	Jul. 15 to Oct. 15	Jul. 1 to Oct. 25	Jul. 15 to Oct. 10	Jul. 1 to Nov. 25	Jul. 1 to Nov. 25	June 25 to Nov. 10
Type D 13.	No Entry	No Entry	No Entry	No Entry	No Entry	No Entry	Aug. 10 to Oct. 5	Aug. 15 to Oct. 20	Aug. 15 to Oct. 20	Aug. 5 to Oct. 20	Jul. 15 to Oct. 10	Jul. 1 to Oct. 20	Jul. 30 to Sep. 30	Jul. 10 to Nov. 10	Jul. 5 to Nov. 10	Jul. 1 to Oct. 31
Type E 14.	No Entry	No Entry	No Entry	No Entry	No Entry	No Entry	Aug. 10 to Sep. 30	Aug. 20 to Oct. 20	Aug. 20 to Oct. 15	Aug. 10 to Oct. 20	Jul. 15 to Sep. 30	Jul. 1 to Oct. 20	Aug. 15 to Sep. 20	Jul. 20 to Oct. 31	Jul. 20 to Nov. 5	Jul. 1 to Oct. 31

ANNEXE H

TABLEAU

Colonne I Catégorie	Colonne II Zone 1	Colonne III Zone 2	Colonne IV Zone 3	Colonne V Zone 4	Colonne VI Zone 5	Colonne VII Zone 6	Colonne VIII Zone 7	Colonne IX Zone 8	Colonne X Zone 9	Colonne XI Zone 10	Colonne XII Zone 11	Colonne XIII Zone 12	Colonne XIV Zone 13	Colonne XV Zone 14	Colonne XVI Zone 15	Colonne XVII Zone 16
Cote arctique 10 1.	Toute l'année	Toute l'année	Toute l'année	Toute l'année	Toute l'année	Toute l'année	Toute l'année	Toute l'année	Toute l'année	Toute l'année	Toute l'année	Toute l'année	Toute l'année	Toute l'année	Toute l'année	Toute l'année
Cote arctique 8 2.	du 1er juil. au 15 oct.	Toute l'année	Toute l'année	Toute l'année	Toute l'année	Toute l'année	Toute l'année	Toute l'année	Toute l'année	Toute l'année	Toute l'année	Toute l'année	Toute l'année	Toute l'année	Toute l'année	Toute l'année
Cote arctique 7 3.	du 1er août au 30 sept.	du 1er août au 30 nov.	du 1er juil. au 31 déc.	du 1er juil. au 15 déc.	du 1er juil. au 15 déc.	Toute l'année	Toute l'année	Toute l'année	Toute l'année	Toute l'année	Toute l'année	Toute l'année	Toute l'année	Toute l'année	Toute l'année	Toute l'année
Cote arctique 6 4.	du 15 août au 15 sept.	du 1er août au 31 oct.	du 15 juil. au 30 nov.	du 15 juil. au 30 nov.	du 1er août au 15 oct.	du 15 juil. au 28 fév.	du 1er juil. au 31 mars	du 1er juil. au 31 mars	Toute l'année	Toute l'année	du 1er juil. au 31 mars	Toute l'année	Toute l'année	Toute l'année	Toute l'année	Toute l'année
Cote arctique 4 5.	du 15 août au 15 sept.	du 15 août au 15 oct.	du 15 juil. au 31 oct.	du 15 juil. au 15 nov.	du 15 août au 30 sept.	du 20 juil. au 31 déc.	du 15 juil. au 15 janv.	du 15 juil. au 15 janv.	du 10 juil. au 31 mars	du 10 juil. au 28 fév.	du 5 juil. au 15 janv.	du 1er juil. au 31 janv.	du 1er juin au 15 fév.	du 15 juin au 15 fév.	du 15 juin au 15 mars	du 1er juin au 15 fév.
Cote arctique 3 6.	du 20 août au 15 sept.	du 20 août au 30 sept.	du 25 juil. au 15 oct.	du 20 juil. au 5 nov.	du 20 août au 25 sept.	du 1er août au 30 nov.	du 20 juil. au 15 déc.	du 20 juil. au 31 déc.	du 20 juil. au 20 janv.	du 15 juil. au 15 janv.	du 5 juil. au 15 déc.	du 10 juin au 31 déc.	du 10 juin au 31 déc.	du 20 juin au 10 janv.	du 20 juin au 31 janv.	du 5 juin au 10 juin
Cote arctique 2 7.	Entrée interdite	Entrée interdite	du 15 août au 30 sept.	du 1er août au 31 oct.	Entrée interdite	du 15 août au 20 nov.	du 1er août au 20 nov.	du 1er août au 30 nov.	du 1er août au 20 déc.	du 25 juil. au 20 déc.	du 10 juil. au 20 nov.	du 15 juin au 5 déc.	du 25 juin au 15 nov.	du 25 juin au 10 déc.	du 25 juin au 20 déc.	du 10 juin au 10 déc.
Cote arctique 1A 8.	Entrée interdite	Entrée interdite	du 20 août au 15 sept.	du 20 août au 30 sept.	Entrée interdite	du 25 août au 31 oct.	du 10 août au 5 nov.	du 10 août au 20 nov.	du 10 août au 10 déc.	du 1er août au 10 déc.	du 15 juil au. 10 nov.	du 1er juil. au 10 nov.	du 15 juil. au 31 oct.	du 1er juil. au 30 nov.	du 1er juil. au 10 déc.	du 20 juin au 30 nov.
Cote arctique 1 9.	Entrée interdite	Entrée interdite	Entrée interdite	Entrée interdite	Entrée interdite	du 25 août au 30 sept.	du 10 août au 15 oct.	du 10 août au 31 oct.	du 10 août au 31 oct.	du 1er août au 31 oct.	du 15 juil. au 20 oct.	du 1er juil. au 15 oct.	du 15 juil. au 15 oct.	du 1er juil. au 30 nov.	du 1er juil. au 30 nov.	du 20 juin au 15 nov.
Type A 10.	Entrée interdite	Entrée interdite	du 20 août au 10 sept.	du 20 août au 20 sept.	Entrée interdite	du 15 août au 15 oct.	du 1er août au 25 oct.	du 1er août au 10 nov.	du 1er août au 20 nov.	du 25 juil. au 20 nov.	du 10 juil. au 31 oct.	du 15 juin au 31 oct.	du 25 juin au 22 oct.	du 25 juin au 30 nov.	du 25 juin au 5 déc.	du 20 juin au 20 nov.
Type B 11.	Entrée interdite	Entrée interdite	du 20 août au 5 sept.	du 20 août au 15 sept.	Entrée interdite	du 25 août au 30 sept.	du 10 août au 15 oct.	du 10 août au 31 oct.	du 10 août au 31 oct.	du 1er août au 31 oct.	du 15 juil. au 20 oct.	du 1er juil. au 20 oct.	du 15 juil. au 15 oct.	du 1er juil. au 30 nov.	du 1er juil. au 30 nov.	du 20 juin au 10 nov.
Type C 12.	Entrée interdite	Entrée interdite	Entrée interdite	Entrée interdite	Entrée interdite	du 25 août au 25 sept.	du 10 août au 10 oct.	du 10 août au 25 oct.	du 10 août au 25 oct.	du 1er août au 25 oct.	du 15 juil. au 15 oct.	du 1er juil. au 25 oct.	du 15 juil. au 10 oct.	du 1er juil. au 25 nov.	du 1er juil. au 25 nov.	du 25 juin au 10 nov.
Type D 13.	Entrée interdite	Entrée interdite	Entrée interdite	Entrée interdite	Entrée interdite	Entrée interdite	du 10 août au 5 oct.	du 15 août au 20 oct.	du 15 août au 20 oct.	du 5 août au 20 oct.	du 15 juil. au 10 oct.	du 1er juil. au 10 oct.	du 30 juil. au 30 sept.	du 10 juil. au 10 nov.	du 5 juil. au 10 nov.	du 1er juil. au 31 oct.
Type E 14.	Entrée interdite	Entrée interdite	Entrée interdite	Entrée interdite	Entrée interdite	Entrée interdite	du 10 août au 30 sept.	du 20 août au 20 oct.	du 20 août au 15 oct.	du 10 août au 20 oct.	du 15 juil. au 30 sept.	du 2 juil. au 10 oct.	du 15 août au 20 sept.	du 20 juil. au 31 oct.	du 20 juil. au 5 nov.	du 1er juil. au 31 oct.

SCHEDULE J

BUNKERING STATION FLANGE

ANNEXE J

COLLET DE POSTE DE MAZOUTAGE