Kiggavik Project

Environmental Impact Statement

Tier 3 Technical Appendix 2J

Marine Transportation

December 2011

TABLE OF CONTENTS

SECTION **PAGE**

LIST OF FIGURES

LIST OF ATTACHMENTS

1 INTRODUCTION

The objective of this report is to provide information on marine transportation associated with the Kiggavik Project. This information will be used to assess the effects of the mines proposed by AREVA. The Project is located about 75 kilometres (km) west of the community of Baker Lake, Nunavut, which is west of Chesterfield Inlet and Hudson Bay (Figure 1.1-1). The Kiggavik Project includes three open pit mines and one underground mine. The Main Zone, Centre Zone and East Zone Pits are near each other and the Andrew Lake Pit and End Grid Underground Mine are located about 15 km to the southwest.

Collection of marine transportation information for the Kiggavik Project site was initiated in 2007.

This report is organized as follows:

- Section 2 summarizes AREVA experience in marine shipping in Canada;
- Section 3 summarizes the regulatory regime and international conventions;
- Section 4 describes the spatial and temporal boundaries of the proposed marine transportation activities;
- Section 5 describes the marine shipping plan;
- Section 6 described navigation features specific to the Chesterfield Narrows area;
- Section 7 presents the proposed Baker Lake and storage facilities;
- Section 8 presents the proposed fuel and explosives facilities;
- Section 9 presents loading and offloading procedures;
- Section 10 reviews the content of key management plans;
- Section 11 discusses other environmental considerations.

Projection: NAD 1983 UTM Zone 14N
Creator: CDC
Date: 05/24/2011 Scale: 1:16,000,000
File:
Data Sources: *Natural Resources Canada, Geobase®, Nation Topographic Database, Geological Survey of Canada, AREVA Resources Canada Inc.*

FIGURE 1.1-1
GENERAL LOCATION OF PROPOSED KIGGAVIK PROJECT IN CANADA
MARINE TRANSPORTATION

Kiggavik Project
AREVA

AREVA Resources Canada Inc - P.O. Box 9204 - 817 - 45th Street West - Saskatoon, SK - S7K 3X5

2 AREVA EXPERIENCE IN MARINE SHIPPING IN CANADA

AREVA has shipped approximately 1,000 marine shipping containers totaling 11,710 tonnes of Uranium concentrate since 2001. These containers were shipped from the Cluff Lake and McClean Lake operations, plus AREVA's share of production from McArthur / Key Lake in northern Saskatchewan to Montreal where they were loaded on container ships for final delivery in Europe. Areva has developed methods of securing 35 drums of Uranium concentrate in each 20 foot marine shipping container.

Areva has an excellent safety record in marine shipping of Uranium concentrate. One incident occurred in the Port of Montreal in December 2007 where a snow plow operator damaged a marine container which was stored on the dock. The snow plow punctured the side of a 20 foot container loaded with 35 drums of Yellow Cake. One drum in the container was slightly dented as well as receiving a small (5mm) puncture. The Emergency Response Assistance Plan (ERAP) was activated. A small amount of yellow cake had leaked from the 5mm hole in the drum however it was contained inside the shipping container. The damaged drum was removed and the contents were repackaged. The remaining drums of yellow cake were removed from the damaged sea container and were loaded into another container.

3 REGULATORY REGIME AND CONVENTIONS

The Marine component will operate under the Canada Shipping Act, The Arctic Waters Pollution Prevention Act, Canada Oceans Act, 1997, MARPOL 73/78 Annex I (Mineral oils), Annex II (Noxious Liquid Substances carried in bulk), Annex III (Harmful substances carried in packaged forms), Annex IV (Sewage), Annex V (Garbage) and Annex VI (Air Pollution), Solas 74 and amendments. Transport Canada Regulations for the Marine Transportation of dangerous Goods.

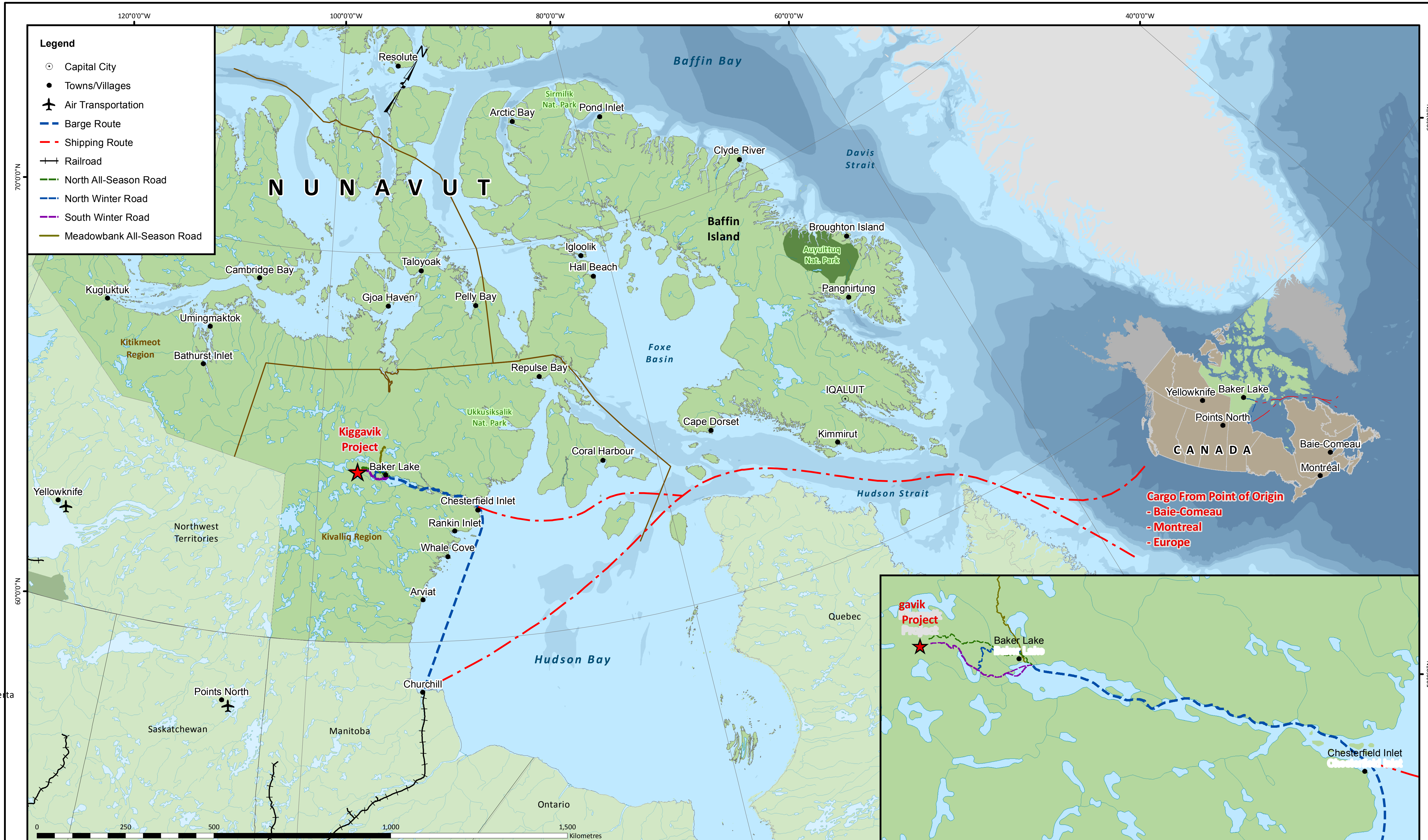
The existing fuel barges operated by Marine Shipping Contractors on the east coast do not meet the new double hull regulations that will be coming into effect. Barges, meeting the new regulations as well as commercial requirements, will have to be designed and built to meet the needs of the Kiggavik project. Canadian registered double hull tankers needed to carry fuel from southern Canadian or foreign ports to Chesterfield Inlet or Churchill, do exist, however the availability of sufficient capacity to meet the needs of the Kiggavik project may be an issue. Foreign registered tankers meeting the new regulations and commercial requirements to ship fuel from foreign ports to Chesterfield Inlet or Churchill are available. The existing fleet of dry cargo vessels meets or exceeds existing regulations. Meeting the new environmental regulations which will be coming into effect during the life of this project will require a significant investment in new equipment or modifications to existing equipment by Marine Shipping Contractors. Meeting the new exhaust emission standards may prove to be very difficult for older vessels. Vessels with engines which cannot meet the new exhaust emission standards will have to be re-engined or replaced.

Canada is a signatory to IMO/MARPOL and SOLAS and as such the Canadian rules are a reflection of these International Conventions and protocols. The Canadian Regulations offer exemptions from some of the International Rules and this also applies to implementation schedules for certain provisions affecting Canadian registered vessels operating in Canadian waters only. Vessels used in the Kiggavik Project will be required to meet all of the International and Canadian Marine Regulations.

4 SPATIAL AND TEMPORAL BOUNDARIES

The Spatial boundaries of the Local Study Area (LSA) are defined as the waterway starting at the entrance to Chesterfield Inlet from the Hudson Bay through Chesterfield Narrows to the dock site on the north shore of Baker Lake. The Spatial boundaries of the Regional Study Area (RSA) are defined as the eastern entrance of Hudson Strait, Hudson Bay and the Port of Churchill (see Transportation Routes, Figure 4.1-1).

According to evidence based on Traditional Knowledge (TK), water levels on rivers feeding into Baker Lake have reduced quite noticeably since 1990. Water levels in Baker Lake are noticeably lower; this is evident along the south shore of the lake. Navigation course lines running East and West down the center of the lake and along the north shore have substantial water depth in the order of 50 m. and therefore will not be affected by a reduction of water depth. Water depths with abrupt drop offs near the North shore in the vicinity of Areva's potential dock-sites are also substantial and will not be adversely affected by reduced water depth. Studies on global warming predict an increase in on ocean water levels. The water way from Hudson Bay and Chesterfield inlet is tidal and therefore should remain unchanged in the short term and may increase in depth in the long term. The most significant change which appears to have occurred since 1990 is the early break up of the winter ice and the later onset of freeze up in the fall. The ice free season is increasing in length and global warming will promote the continuation of this trend which has a positive affect on Marine shipping. Residents of Baker Lake and ship operators report stronger and less predictable wind conditions on Baker Lake. Winds from the southerly direction can hamper loading and unloading operations at dock-sites on the north shore of Baker Lake. The negative affect brought on by the high winds is offset by the positive affect of the increase in season length.



Projection: NAD 1983 UTM Zone 14N
Creator: CDC
Date: 04/20/2011 Scale: 1:10,000,000
File:
Data Sources: *Natural Resources Canada, Geobase®, Nation Topographic Database, AREVA Resources Canada Inc.*

FIGURE 4.1-1
TRANSPORTATION ROUTES

MARINE TRANSPORTATION

Kiggavik Project

AREVA

AREVA Resources Canada Inc - P.O. Box 9204 - 817 - 45th Street West - Saskatoon, SK - S7K 3X5

5 MARINE SHIPPING PLAN

5.1 SUMMARY

The shipping requirements to support the Kiggavik mine are substantial. The materials and equipment needed for the construction of the mine are not available in the RSA. The consumables needed for the day to day operation of the mine are also not available in the RSA. There are no alternative shipping methods available to support the construction and operation of the mine. The existing fleet of vessels which has traditionally provided shipping services to the Kivalliq region will have to be expanded to meet the increased volume requirements. The new vessels will be more efficient and will meet stringent new environmental regulations limiting exhaust emissions, sewage treatment and garbage management. The barges and tankers carrying fuel will be of double hull construction designed to prevent oil spills as a result of groundings or other mishaps. The new tug- barge design will be state of the art providing safe and reliable marine transportation to Baker Lake. A new modern marine dock with improved cargo handling equipment will reduce accidents, reduce damage to cargo, increase though-put of cargo and reduce the overall cost of shipping to Baker Lake.

All vessels that will operate in the restricted waters of the Chesterfield Narrows will be designed with double redundancy on critical equipment such as propulsion, steering, essential navigation and electrical power supply. The Marine Shipping Plan (MSP) will include a traffic management scheme which will coordinate and regulate the movement of all marine operators working in the LSA in accordance with Transport Canada Requirements and guidelines. The marine traffic management Scheme will be developed in consultation with Transport Canada, Baker Lake Community Interests, Baker Lake Commercial Interests and Marine Shipping Companies. The Areva MSP is based on good marine practice and has been developed following consultation with reputable marine shipping companies who have a longstanding reputation for providing safe and reliable service in the LSA and RSA.

The MSP has applied Traditional Knowledge (TK) to establish a safety buffer when setting targets for ice free operation. TK has provided incisive information on climatic conditions which have an adverse affect on shipping such observed changes in wind forces and predominant wind directions on Baker Lake. TK also confirms that bouts of high wind conditions appear to be lasting longer. This information based on TK was used to include a significant number of non navigational days which were factored in to the shipping plan. TK of the changes in ice break up patterns and timing was useful as well as comments on the later arrival of freeze up.

The annual cargo requirement to support the Kiggavik Mine Project is estimated to include 57,000 tonnes of diesel fuel and 80,000 tonnes of dry cargo. Most of the dry cargo will be shipped in approximately 4,000 ISO shipping containers (TEUs).

There are a number of primary proposed segments of marine transport to be considered:

- o Marine shipment of fuel and dry cargo via ocean going vessels through Hudson Strait to Chesterfield Inlet. The cargo would then be lightered into barges or smaller self propelled vessels in Chesterfield Inlet and delivered to the final destination in Baker Lake.

- o Marine shipment via ocean going tug/barges from southern ports direct to Baker Lake.

- o Marine shipment via ocean-going vessels through Hudson Strait and Hudson Bay to Churchill. The cargo would be transshipped from Churchill to Baker Lake via tug and barge. A rail link connecting to major southern railways is also available for shipping fuel and dry cargo to Churchill.

The Hamlet of Baker Lake and the Agnico-Eagle mine currently receive supplies during the annual sealift which takes place in the open water season from August to October. Dry cargo and fuel are loaded on ships or barges in southern ports and are then transported to Chesterfield Inlet. A section of the passage between Chesterfield Inlet and Baker Lake known as Chesterfield Narrows (the Narrows) is relatively shallow and is subject to strong currents which limit the size and timing of vessels passing this area. Most ocean going vessels are too deep drafted to pass the Narrows, therefore cargo is lightered onto barges or small shallow draft vessels east of the Narrows for transportation to Baker Lake.

Agnico Eagle has constructed a 40,000 cubic meter tank farm in Baker Lake and is in the process of expanding the tank farm capacity to 60,000 cubic meters. The proposed Kiggavik Project dockside will also include a tank farm of 60,000 cubic meters and a lay down area to handle approximately 4,000 TEUs. The cumulative cargo requirements for the Hamlet of Baker Lake, Agnico Eagle mine and the proposed Kiggavik mine would approximately double the volume of cargo currently being shipped into Baker Lake. Efficient cargo handling facilities will be required at Baker Lake in order to accommodate the increased volume of cargo. Modern marine equipment with the correct capacity will be required to meet new regulations

A number of natural factors affect the amount of cargo that can be transported by sea lift to Baker Lake. The length of the open water shipping season is conservatively assumed to be 60 days. Navigation at the Chesterfield Narrows is assumed to be at high tide slack water only with two barge loads passing the Narrows on each tide. Navigation through Chesterfield Narrows is assumed to be during daylight hours only. This translates to 90 high tides, at the Chesterfield Narrows that correspond with daylight navigation for a 60 day shipping season. Marine operators have reported losing an average of seven days per season due to weather issues including high winds and other factors that limit visibility. For conservatism purposes, a total of fourteen high tides are assumed to be lost leaving a total of 78 high tides available to transit the Narrows.

The entire Kiggavik annual cargo requirement can be transported through the Chesterfield inlet on 28 tides using 5,000 tonne barges. The Agnico Eagle transportation requirements are assumed to be approximately equal to the Kiggavik project therefore they will also require 28 tides. The annual transportation requirement for fuel and dry cargo for the hamlet of Baker Lake is assumed to be conservatively high at approximately 20,000 tonnes therefore this would require an additional 4 tides.

The total cumulative requirement for the annual sealift into Baker Lake is assumed to be 300,000 tonnes. The total cargo requirement can be transported through the Chesterfield Inlet on 60 tides using 5,000 tonne barges. There are 78 available tides based on a 60 day open water season therefore the waterway has the capacity to handle the anticipated cumulative traffic including a 30% contingency to account for unknowns such as late deliveries, mechanical breakdowns and conflicts in scheduling. The Kiggavik Marine Shipping Plan will also evaluate the use of 7,500 tonne barges which will add another dimension to the cargo capacity of the waterway.

AREVA will contract with Marine Shipping companies to provide modern efficient vessels for the Baker Lake Sealift. The hamlet of Baker Lake will benefit from the availability of the same equipment to move their cargo at rates which will reflect economies of scale. There will be an abundance of opportunities to take advantage of under utilized backhaul capacity.

5.2 SEASON

The Shipping Plan is scheduled around open water operations only. No ice breaking activity is planned.

The average thickness attained by level shore fast ice at Baker Lake is 221 cm (87 ins) with a record maximum thickness of 248 cm (98 ins) measured in 1969. Breakup usually begins about mid June with the lake becoming clear of ice by the last week of July. Freeze up usually begins about mid October with a complete ice cover forming before the end of the month. Two to three weeks variation in breakup and freeze up can occur.

The Marine Shipping Plan (MSP) has been based on a conservative operating season estimate of 60 days, commencing in August 1 and completing on October 1. Traditional Knowledge and the experience of shipping companies working in the area indicates that the operating season may be more accurately predicted as being from mid July to mid October. The plan calls for operations in the open water season only, however all vessels will have an Ice Class meeting AWPP regulations for operating mid July to the end of October in Zone 14, 15 and 16 which includes the Hudson strait, Hudson Bay and Chesterfield inlet/Baker Lake. All vessels used for carrying fuel will be of double hull construction.

For conservative planning purposes the first loaded vessel will arrive at the entrance to Chesterfield Inlet on August 1. The lightering of dry cargo or fuel will commence on arrival and will continue until the cargo has been delivered or October 1. If the season commences earlier, then the first vessel will arrive in Chesterfield Inlet to take advantage of the open water. The purpose of precautionary planning is to provide a contingency for unknown occurrences so that the Kiggavik sealift will be completed well before freeze up.

Attachment A includes a seasonal summary for the Canadian Arctic Summer 2009 and summaries for the years 2005, 2006, 2007 and 2008. The conclusion drawn from these summaries is that an extended operating season mid July to mid October is likely to be the norm in future years.

5.3 ROUTES

The following marine shipping routes have been considered for delivering Dry cargo from southern ports to Baker Lake:

- Wherever possible dry cargo will be transported in 20 foot marine shipping containers (TEU's). Dry cargo may be carried on general cargo vessels fitted with unloading cranes direct to an anchorage at Helicopter Island which is located east of the Chesterfield Narrows. See Marine Chart 5624. Cargo will be lightered from the cargo ships onto barges and will be delivered to the Baker Lake dock site.

- Dry cargo may be loaded on ocean-going barges in southern ports and delivered direct to Baker Lake.

- Dry cargo may be loaded on large container ships in southern ports and delivered direct to the port of Churchill. The containers will be loaded on barges in Churchill and delivered direct to the Baker Lake dock site. (Note. No infrastructure currently exists for container handling and storage at Churchill)

- Dry cargo may be delivered to Churchill by rail then loaded on barges for delivery direct to Baker Lake. (Note. This is a very costly option)

The following marine shipping routes have been considered for delivering fuel from southern ports to Baker Lake:

- Fuel may be carried in ocean-going double hull tankers to an anchorage near Ellis Island which is located at the eastern end of Chesterfield Inlet. See Marine Chart 5621. Fuel will be transferred to double bottom barges for delivery direct to Baker Lake.

- Fuel may be carried in ocean-going double hull tankers direct to the Churchill tank farm. Fuel will be loaded from the tank farm into double hull barges for delivery direct to Baker Lake.

- Areva has considered shipping routes with load ports in Rotterdam, Houston, Halifax and Montreal. Only fuel meeting stringent Arctic Diesel fuel specifications will be loaded.

Attachment A includes the Marine charts which show the course routes.

5.4 VESSELS

Various sizes of dry cargo ships, tugs, barges and tankers have been studied and proposed for the Kiggavik project. In the case of fuel barges and tugs these will have to be designed and built. Dry Cargo ships, Tankers, Tugs and barges will be designed, built and operated in accordance with Classification requirements of a Classification Society belonging to the International Association of Classification Societies (IACS), such as Lloyds Register of Shipping, Det Norske Veritas, Bureau Veritas, American Bureau of Shipping, NK etc.

The tankers and dry cargo vessels arriving from southern ports will have sufficient marine fuel onboard to make the return voyage south. The cargo vessels arriving from southern ports will carry sufficient marine fuel to resupply the tugboats

The following marine shipping scenarios have been proposed for future development:

Fuel

Figure 5.4-1 Typical Handy Size Tanker

Scenario: Two Ice Class 30000 DWT, Double hull, tankers arrive consecutively anchored near Ellis Island at the Easterly end of Chesterfield Inlet. Lighter into barges for transshipment to Baker Lake. Time taken to deliver fuel cargo top Baker Lake after the tankers have arrived at Ellis Island 14 to 23 days depending on the tug/barge combination.

Scenario: Two Ice Class 30000 DWT, Handy size double hull, tankers arrive consecutively at Churchill and discharge into tank farm as tank farm capacity permits. Barges load at Churchill and shuttle fuel direct to Baker Lake. Time taken to deliver fuel cargo to Baker Lake after the tankers have discharged fuel at Churchill is 26 days to 39 days depending on the tug/barge combination.

Figure 5.4-2 Example of 15,900 DWT Tanker

Scenario: Three 18300t DWT Ice Class, Double hull, Tankers arriving consecutively, anchored near Ellis Island at the Easterly end of Chesterfield Inlet. Lighter into barges for transshipment to Baker Lake. Plus one 5000t barge load from Churchill. The time taken to deliver the fuel cargo to Baker Lake after the tankers have arrived at Ellis Island is 17 days to 28 days depending on the tug/barge combination.

Figure 5.4-3 Example of ATB Tank Barge

Scenario: Tug and Barge load at Churchill and deliver fuel direct to Baker Lake. Fuel is delivered by rail from Edmonton to Churchill. Time taken to deliver fuel cargo to Baker Lake is 26 days to 53 days depending on the tug/barge combination.

Dry Cargo

Figure 5.4-4 Example of Geared Cargo Vessel

<u>Scenario</u>: 660 TEU geared cargo ships will make various trips from southern ports to a lightering position at Ellis Island near the entrance to Chesterfield Inlet. Shuttle Barges will load remaining TEUs in Southern port and mobilize to Baker Lake to make up 3600 TEUs. Time taken to deliver cargo after arriving in Chesterfield Inlet varies between 22 days to 33 days depending on the type of Tug/Barges used.

Figure 5.4-5 Port of Churchill

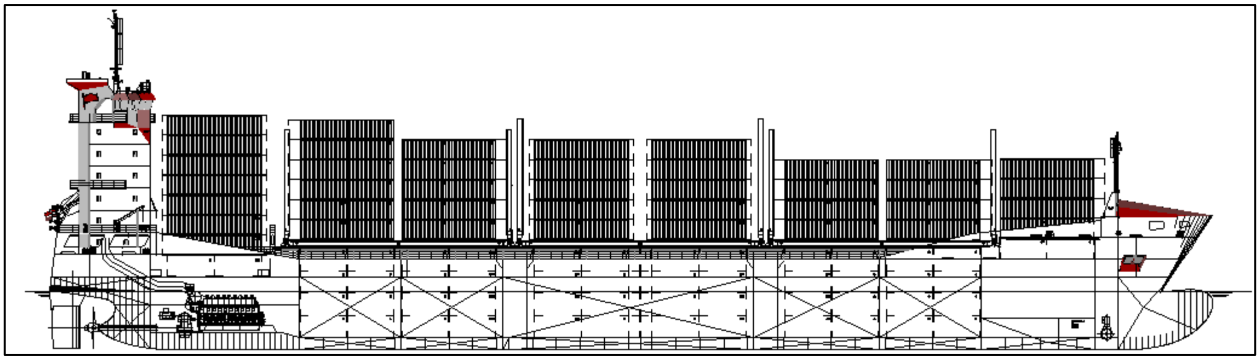


Figure 5.4-6 1000 TEU non geared container vessel

Scenario: Three 1000 TEU Container ships will make one trip each from southern ports to Churchill. Barges will load 250 or 375 TEU each in Southern port and mobilize direct to Helicopter Island from Southern ports. Time taken to deliver cargo after arriving in Churchill/Chesterfield Inlet varies between 22 days to 63 days depending on the type of Tug/Barges used.

Scenario: Tugs and barges mobilize direct to Baker Lake from south with 700 or 1050 TEU. Remaining TEUs are shipped to Churchill by rail then loaded on Barges in Churchill and deliver direct to Baker Lake. Time taken to deliver cargo after arriving in Churchill/Chesterfield Inlet varies between 29 days to 63 days depending on the type of Tug/Barges used.

Tug/Barge variations

Various Tug - Barge arrangements have been studied. New tugs and barges for the Kiggavik project will be designed and built in collaboration with a reputable Canadian Shipping Company yet to be selected. Priority will be given to tug barge arrangements which provide the best maneuverability for safe and efficient operation. Tug barge arrangements must be capable of delivering the entire dry cargo and fuel cargo requirements within a 60 day open water window. The following tug barge arrangements have been studied.

- 4 New 7500 DWT ATB Double Hull Barges and 2 New/mod 4500 hp tugs
- 2 new 7500 DWT & 2 New 5000 DWT ATB Double Hull Barges and 2 new/mod 4500 hp tugs
- 4 new 5000 DWT ATB Double Hull Barges and 2 new/mod 3500 hp tugs
- 4 new 5000 DWT Std Double Hull Barges and 2 existing 3500 hp Std tugs

Figure 5.4-7 Example of ATB Tug in Notch of Barge

Note. ATB refers to Articulating Tug Barge. With this arrangement the forward portion of the tug fits into a deep notch in the stern of the barge. The bow of the barge is ship shaped. The barge can be fitted with a bow thruster which enhances maneuverability. The tug is connected to the barge by a patented mechanical arrangement which give the tug/barge unit ship like maneuverability and performance. The barges may all be dual purpose, capable of carrying fuel or dry cargo or they may be a combination of duel purpose and dry bulk barges.

6 NAVIGATION

6.1 INTRODUCTION

The Shipping Management Plan will contain operating procedures to deal with contingencies for events peculiar to the RSA and LSA. The plan calls for operation in the open water season only with a 30 day contingency for variations in start in season opening and end of season freeze up. The assumed open water season for the shipping plan is 60 days; recent experience indicates that an open water season of approximately 90 days might occur. Barges and tugs will be capable of navigating in reduced draft situations caused by lower water levels. A 30 % contingency has been applied to cover possible reductions in cargo lift due to low water levels. The Tug/barges will be highly maneuverable and capable of handling low water levels and changes in current patterns. Navigation in restricted areas will be in daylight hours only with good visibility. Under keel clearance guidelines will be established by the shipping company for all restricted draft areas. These guidelines will be will closely monitored.

Traffic in the Chesterfield Inlet and particularly in the Narrows will be coordinated and managed to enhance safety. For instance, it is proposed that passage at the Narrows be one way traffic on each high tide, with a maximum of two cargo barges/vessels transiting on each high tide. The operation would be single tug single barge only (i.e., no tandem or double towing will be carried out in restricted navigation areas.

Masters of Tugs will be responsible for the safe navigation of their tug as well as the barge they towing or pushing. When the barge is secured to the dock site a shore supervisor will take charge of the barge. When a barge is laid alongside a dry cargo vessel or tanker for lightering purposes a trained loading supervisor will take charge of the barge. Masters of tankers and dry cargo vessels will be responsible for their vessels at all times while operating in the RSA. A marine traffic controller (MTC) will provide useful traffic information to all vessel Masters in the RSA. The MTC will insure that tug-barges do not encounter one another in passing situations at difficult navigation areas such as Chesterfield Narrows.

Tugs will be equipped with the latest generation of navigation aids including electronic charting system (ECDIC) with AIS interface and radar overlay, Differential Global Positioning Systems, Automatic Identification System (AIS), Type X band radar with Automated Radar Plotting Aid (ARPA), Type S band radar with ARPA. Communications equipment on Tugs and other vessels will use the latest satellite based technology. Standard VHF, UHF and SSB communication equipment will also be used.

The following measures will be implemented to ensure safe navigation conditions:

- The dry cargo ships, tankers and tugs will be equipped with a complete electronic navigation package for navigation in restricted waters.

- Vessels transiting difficult navigation sections on Chesterfield inlet will have dual redundancy for all critical equipment.

- Detailed Passage plans will be used by all navigators.

- Navigators will be trained using marine simulators. Residents of the RSA and LSA with local knowledge of the navigation areas will be consulted when setting up simulator programs for the shipping routes. Persons with local knowledge acting as Mammal Monitors onboard vessels will also be a valuable source of information for ship Masters regarding weather and water flow anomalies along the shipping routes.

- All tankers and fuel barges will be constructed with a double hull. Contact as a result of groundings will greatly reduce the probability of a pollution incident.

- Tugs and barges will be highly maneuverable and will be designed for reduced draft operation.

- Navigation in restricted areas such as the Chesterfield narrows will be restricted to high tide, daylight navigation with good visibility.

- A vessel traffic management system will be in place to organize the vessel traffic flow for all operators thus avoiding situations where collisions or groundings might occur.

6.2 REVIEW OF NAVIGATION HAZARDS

Navigation in the Hudson Strait and Hudson Bay is not challenging during the open water season. Marine navigation in the Chesterfield inlet presents several challenges. The following comments on various sections of Chesterfield Inlet provide a description of navigation hazards that will be encountered.

Ellis Island to Helicopter Island

The maximum range of large tides in this stretch is between 5.2 m (17 ft) at Ellis Island to 2.3 m (8 ft) at Helicopter Island. Out flow currents of 3 to 4 knots and up to 5 knots on the ebb are experienced. These strong tidal streams and cross currents can set a vessel across the channel. The currents are particularly strong in Deer Island Channel (Reference Marine Chart 5621) and in the vicinity of Skua Reef (Reference Marine Chart 5621). Vessels will time their arrival at these areas to coincide with a reduced current flow. Vessels navigating in opposite directions would time their arrival to avoid passing at these locations. The ebb tidal stream which reaches a maximum rate at low water runs for 8 hours, the flood for 4 hours. The shores of the inlet consist mostly of rocky slopes rising gently from the water to elevations seldom exceeding 162 feet (50 m) and covered with moss, lichens and dwarf shrubs. Islands and headlands generally blend into the back ground and are difficult to distinguish – there are few prominent features useful for navigation. Beacon ranges are established in the most confined water ways consisting of lattice towers with fluorescent-orange day marks. Navigational buoys, beacons and range lights do not exist. Water depths range from > 70 m to 17 m. Vessels navigating this section will use ARPA radars, GPS, Electronic Charts and visual aids to maintain courses. Detailed voyage plans are essential for safe navigation.

Helicopter Island to Chesterfield Narrows

The maximum range of large tides in this stretch is 2.3 m (8 ft). Currents up to 4 knots are estimated. Between Schooner Harbor and Eddy Point, situated 1 mile east of Chesterfield Narrows, channel depths are mostly over 20 m (11 fathoms). Between Eddy Point and Chesterfield Narrows, depths are 7 to 9 m (23 to 30 ft). A depth of 3m (10 ft) can be carried through the narrows and vessels drawing up to 4.6 m (15 ft) have passed through the narrows safely at high water levels. Vessels navigating this section will use ARPA radars, GPS, Electronic Charts and visual aids to maintain courses. Detailed voyage plans are essential for safe navigation. Vessels will time their arrival at these areas to coincide with high tide slack water. A vessel management system will be required to coordinate vessel movements through this area to insure that vessels do not meet in these areas.

Chesterfield Narrows

The height of the tide and the strength of the tidal currents in Chesterfield Narrows may be appreciably influenced by the water level in and subsequent outflow from Baker Lake. The lake varies by 0.6 to 0.9 m (2 to 3 ft) from the high levels in late June and early July to the lower levels in September and October. The tidal information given below is for summer conditions. The ranges of mean tides and large tides at Chesterfield Narrows have been measured to be 2.4 and 2.7 m (8 and 9 ft), respectively. High water at Norton Island, 2 miles east of the narrows, follows high water at Churchill by ½ to 1 hour. High water at Chesterfield Narrows might then be expected to begin 1 to 1½ hours after high water at Churchill.

Tidal currents flow westward for the 3 to 4 hours of flood and can reach rates up to approximately 4 knots. Flood flow is preceded and followed by ½ hour periods of slack water. The eastward ebb flow lasts 8 hours, reaching maximum rates at low water. Ebb flows up to 8 knots have been reported. The tidal effect at the east end of Baker Lake, north of the narrows, is negligible. The navigation channel through the narrows is narrow and demands two tug & barge course alterations of > 30 degrees. Passage through Chesterfield Narrows is possible only at high water slack during day light hours in good visibility. Given a chart datum depth of 3.0 m (10 ft) and a mean tide height of 2.4 m (8 ft) the maximum available summer water depth is 5.4 m (17.7 ft). Assuming an under keel clearance of .75 m (2.5 ft) the maximum fresh water draft for tug & barge is 4.65 m (15.25 ft). Traffic in the Chesterfield Inlet and particularly in the Narrows will be coordinated and managed to enhance safety. For instance, it is proposed that as a precautionary measure passage at the Narrows is one way traffic on each high tide, with a maximum of two cargo barges/vessels transiting on each high tide. The operation would be single tug single barge only (i.e., no tandem or double towing will be carried out in restricted navigation areas. Passage at the narrows will be carried out in daylight hours with good visibility

Chesterfield Narrows to Baker Lake

Baker Lake is a fresh water lake extending westward for 50 miles from Chesterfield Narrows to the mouth of the Thelon River, near which the Hamlet of Baker Lake is located. The northern two-thirds of Baker Lake is a comparatively deep basin; the southern one-third appears to be shallow and strewn with shoals. Depths west of

Christopher Island along the “track usually followed” range generally between 20 and 40 fathoms (37 & 73 m), reducing to less than 10 fathoms (18.3 m) about 3 miles east of the Hamlet.

7 BAKER LAKE DOCK SITE AND STORAGE FACILITY

The primary use of the dock will be to handle the Kiggavik annual cargo requirements. When the dock is not in use the unloading facilities may be used for other cargo purposes at the discretion of Areva.

Marine Chart 5626 shows the existing Agnico Eagle dock site (AE, Position N64º 18' 14" – W95º 57' 9") and Areva potential Sites. The following potential Dock site locations have been identified and marked on Marine Chart 5626.

- Dock site 1- (Position N 64º 17' 60" – W95º 56' 21")
- Dock site 2 (Position - N64º 17' 23"- W95º 51' 49")
- Dock site 3 (Position - N64º 17' 6" – N95º 50' 45")
- Dock site 4 (Position – N64º 16' 59" – W95º 50' 4")
- Dock site 5 (Position - N64º 16' 52" – W95º 48' 60")

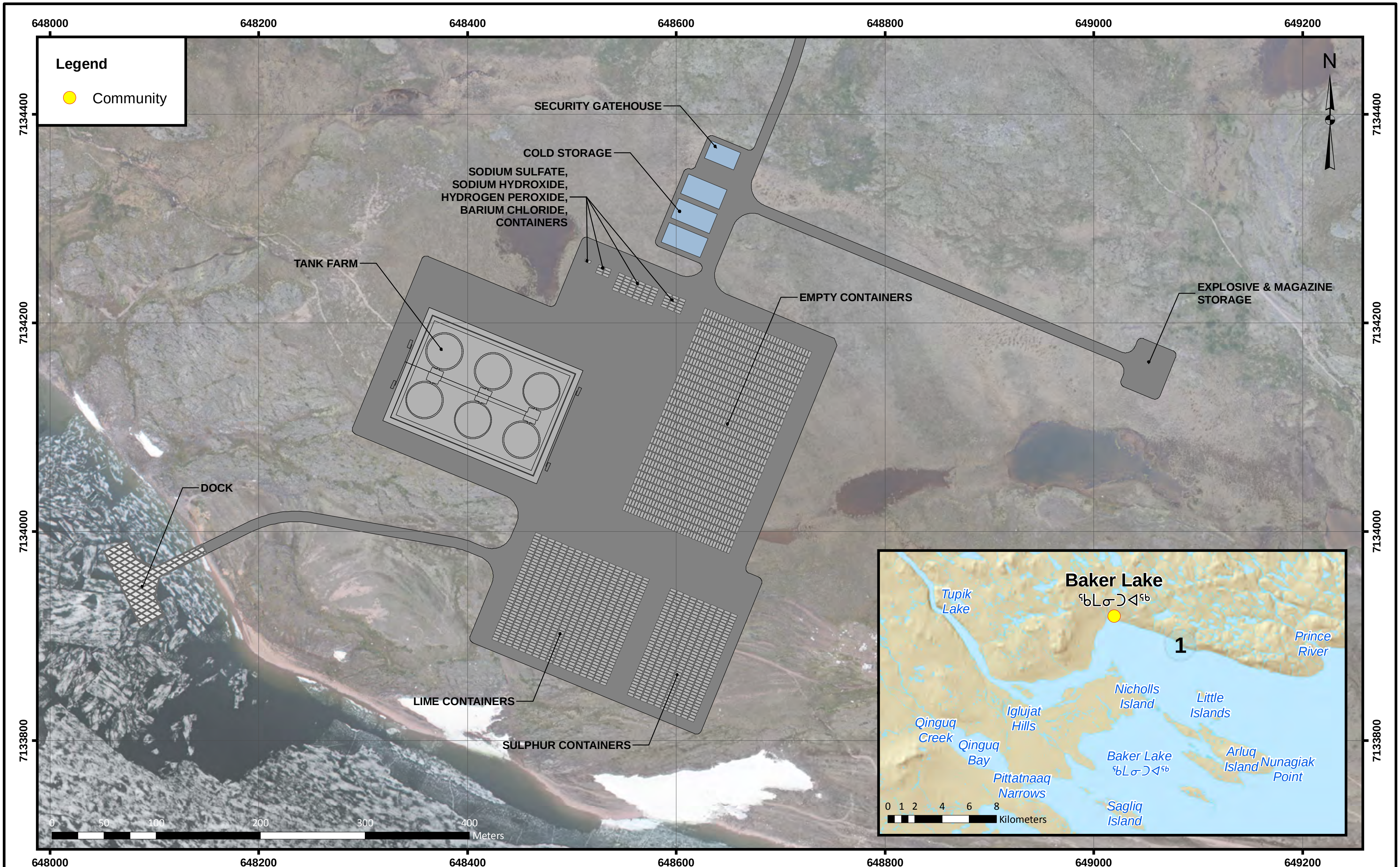
Dock site #1 is the preferred site (Figure 7.1-1).

Existing sea based navigational aids are limited to manual visual aids. The use of modern electronic positioning verification equipment such as Laser Fan beam and Radius electronic targets will be considered to assist with navigation. Tugs will be equipped with the latest generation of navigation aids including electronic charting system (ECDIC) with AIS interface and radar overlay, Differential Global Positioning Systems, Automatic Identification System (AIS), Type X band radar with Automated Radar Plotting Aid (ARPA), Type S band radar with ARPA. Communications equipment on Tugs and other vessels will use the latest satellite based technology. Standard VHF, UHF and SSB communication equipment will also be used.

Transfer of fuel and any hazardous/dangerous goods/cargo

Steel piping will lead down to the loading dock from the diesel fuel tank farm. The size of the piping will be sufficient to maintain a flow rate of 500 cu. m per hour, approximately. The discharge hose will be a marine grade bunker hose rated at 17 bar. The discharge hose(s) will be connected to the fuel receiving manifold on the dock using a dry break coupling(s). A powered hose reel and hose crane will be fitted on the barge. All connection points will be protected with save-alls. The dock area will be well lit as required for work being conducted under low light conditions. A ready use pollution kit will be stored on the dock. A containment boom will be deployed between the dock and the barge hull during fuel transfers as a precaution to contain any fuel that may accidentally spill.

A team of trained personnel will be in charge of the barge discharge equipment. Fire-fighting equipment will be fitted on the dock as well as on each barge as required by Transport Canada.



Projection: NAD 1983 UTM Zone 14N
Creator: CDC
Date: 04/18/2011 Scale: 1:5,000
File:
Data Sources: *Natural Resources Canada, Geobase®, Nation Topographic Database, AREVA Resources Canada Inc.*

FIGURE 7.1-1

PROPOSED BAKE LAKE PORT FACILITY LAYOUT

MARINE TRANSPORTATION

Kiggavik Project

AREVA

AREVA Resources Canada Inc - P.O. Box 9204 - 817 - 45th Street West - Saskatoon, SK - S7K 3X5

8 FUEL AND EXPLOSIVES FACILITIES

Fuel will be loaded at terminals in Montreal, Rotterdam or New York then transported to Ellis Island anchorage at the east end of Chesterfield Inlet using oceangoing Ice Class double hull tankers. The ocean going tankers will anchor at Ellis Island and lighter their cargoes into double hull barges. Procedures conforming to Transport Canada Guidelines TP10783E will be used for fuel lightering. The barges will lie alongside and tie up to the tanker during this process. Floating Yokohama type fenders will be used between the barges and the tanker. The double hull barges will also deliver the fuel direct to Baker Lake from southern ports. Double Hull tankers may also deliver fuel to the tank farm in Churchill.

A containment boom will be placed between the tanker and the bow and stern of the barge as a precautionary measure to contain any fuel should a spill occur. A work boat and a barge containing oil spill equipment barge will be stationed at Ellis Island during all fuel transfers. A containment boom which will encircle the entire length of the tanker and barge will be available onsite, ready to be deployed if necessary.

The oil handling facility (OHF) will be constructed and operated in accordance with Transport Canada Arctic waters Oil Transfer Guidelines TP 10783E and Oil Handling facility Guidelines TP 12402E. The OHF supervisors will be trained in accordance with Transport Canada Supervisor of Oil Transfer Operation course TP 12402 or equivalent

9 LOADING AND OFFLOADING PROCEDURES

Pre Transfer Procedures for Lightering Fuel from Tankers to Barges and from Barges to Storage facilities ashore,

- Inform Prairie and Northern Region, Marine, via NORDREG, or the nearest CCG Radio Station of the intended nature and duration of transfer, 48 hours prior to the start of transfer operations, or as practicable, in sufficient time that would allow a Pollution Prevention Officer to arrive at the site and witness the transfer;

- Inform local authorities as appropriate;

- Where local traffic warrants and if the transfer location is outside "port" facilities areas, broadcast navigational warnings on VHF before starting, announcing the name(s) of vessel(s), the geographic location, the nature and expected duration, and requesting a wide berth;

- Cancel the warning when transfer operations are complete and secured;

- In all transfers, each party has the right to suspend operations at any time, if they decide it is necessary;

- Conduct a pre-transfer conference between Supervisors of Oil Transfer Operations in Arctic Waters (North of 60°00'N) of Supplier and Recipient vessels/facilities to:

    - inform each party involved of the dimensions of the other's key facilities, such as manifold/fuelling station location, maximum and minimum draught, barge/ship length, fendering arrangements, shore manifold connections, and jetty/shore characteristics such as tides, bollards, mooring and positioning aids, hidden hazards;

    - Inform all participating personnel of their duties and responsibilities during the transfer, and ensure they are used versed in emergency procedures, and know the oil spill contingency plan to be followed in the event of an incident;

- Ensure engines, steering, thrusters, and maneuvering controls, are tested and remain on stand by during transfer;

- Unless vessels are in open water, clear of land and traffic routes, with no ice present, ensure they are secured alongside or anchored, with due consideration for prevailing and expected wind, weather, ice, and tide conditions;

- Ensure that moorings (including shore moorings) are adequate to allow for draught and tidal changes during transfer;

- Suspend all operations that could cause ignition hazards around deck tank vent areas, such as:
  - welding and other hot work,
  - use of portable electrical apparatus, particularly extension cords,
  - use of portable combustion engine driven equipment,
  - other operations which could cause ignition hazards;
- Ensure all cargo manifold valves and/or fuelling connections which will not be used in the current transfer are isolated and blanked;
- Ensure sea valves in cargo pump rooms are closed and sealed;
- Ensure valves which will be used for the transfer, are free of ice or other obstructions, and are easy to operate through their full range;
- Ensure all deck scuppers are plugged to contain any oil spilled, and that freeing ports and other open areas where spillage could go overboard are closed;
- Ensure absorbent material is readily available at the flexible hose connections on deck and other predictable minor spill locations;
- Ensure containers, or drip trays of suitable size are placed under tank vents, manifolds, fuelling connections, or other locations where adequate permanent containment arrangements are not fitted;
- Ensure accommodation deck doors, deadlights or shutters, ports, and vents are closed;
- Ensure flame arrestors or gauze screens and pressure/vacuum relief valves (PVR) are checked;
- Ensure no helicopter landings or takeoffs occur during transfer operations;
- Ensure vessel air conditioning systems are on recirculation mode;
- Ensure vessels hoist the appropriate signals by day and night; and
- Ensure that all valves and pipelines required for the current transfer are open, and that all other valves and pipelines in connected systems are closed and secured. Ensure this is double checked by the assigned crew members and the Transfer Supervisor/Cargo Officer.
- Check for a valid hose certificate, confirming that the hose has been satisfactorily inspected during the past 12 months, according to the Oil Pollution Prevention Regulations;
- Check individual hose test markings or tags;

- Define who will supply the transfer hose and establish hose configuration -- diameter, total hose length, coupling type and number, operating pressure of hose and couplings, type of terminal flange (size/class, etc.);
- Define hose purging method between products, and after final transfer;
- Examine "O" rings and joints in couplings and replace any damaged seals or gaskets;
- Inspect hose-to-coupling clamps visually to ensure good condition and security and repair or replace any damaged clamps, where possible, or use spare hose lengths;
- Check that an insulating flange or coupling is in place;
- Secure hose coupling clips with safety wire;
- Ensure lifting and restraining arrangements are suitable for the type and dimensions of hose used, and that the apparatus will prevent hose damage due to ship movement in swells or draught changes;
- Ensure the hose is suitably supported throughout the hand-over, and during the transfer, to avoid damage and prevent kinks;
- When transferring sea hose ashore, ensure the hose is free from chafing, or pinching between ice floes or rocks;
- Use hose strain relief system with long floating hose transfers to prevent strain on the hose string from winds, tides, and ice;
- Examine the completely installed hose string carefully and repair or replace any damaged hoses, flanges or joints, before starting the transfer;
- Minimize the number of couplings by using longer hose lengths; and
- In ship to shore transfers use a suitable boat to send the hose ashore.

Transfer Procedures

- Complete the pre-transfer check list;
- Have a responsible person, with an operational radio set on the correct channel/frequency, near the cargo/transfer pump start/stop control throughout the transfer;
- Start pumping at a previously agreed slow rate, while rechecking hose string for leaks;
- Ensure the product is going to the correct recipient tank;
- Maintain the normal pumping rate, as agreed with the other party, until topping off is required;

- Examine the hose string regularly during transfer and watch for signs of undue strain, bulging, and other evidence of real or potential leaks;
- For floating hose, patrol the string, check the water in the area for leakage signs, and look for coupling problems, or snags on ice floes;
- Check both Supplier and Recipient tanks regularly for both content level and product, and investigate any anomalies, suspending the transfer if necessary;
- Keep a constant check on the pumping pressure and immediately investigate any pressure variations of an unexpected nature;
- Make regular visual checks of the water immediately surrounding the vessel(s) and transfer area;
- Reduce transfer rate, when Recipient tanks are nearly full, for topping off; and
- Use an automatic stop device which will shut down the pump when the flow rate or back pressure exceeds a pre-set level.

Emergency Procedures

If any of the following conditions occur, the transfer should be stopped immediately:

- Lost communications;
- Loss of ability to monitor hose to shore;
- Sign of spillage, or damage to hoses and couplings;
- Any detection of accumulated gases;
- Major increase in wind and/or swells;
- When an electrical storm is present or predicted;
- Sever deterioration in ice or visibility conditions;
- Helicopter landings or take offs; and
- Any other situation deemed dangerous by the transfer supervisor;

Post Transfer Procedures

When the transfer has been completed, the following procedures should be followed:

- Purge the hose by previously agreed method (see II - Recommendation for Purging), and shut all manifold and tank valves; when purging ensure that no air will be introduced to the tanks at the shore facility;

- Sound all tanks, (after waiting for settling, if necessary), and confirm with both parties that quantities of fuel/cargo have been properly transferred;

- Stow hoses securely for sea passage;

- Complete transfer checklists;

- Ensure the ship's and facility's Oil Books and Checklists are signed, kept up to date, and retained for examination by a Pollution Prevention Officer or other authorized official, (by prior arrangement with Prairie and Northern Region, Marine, organizations may use their existing checklists for recording transfer preparation conditions, provided all major aspects are covered in those checklists);

- Forward the transfer particulars checklist or a post-season summary of operations and quantities, for statistical records and prevention guidelines improvement purposes, to Prairie and Northern Region, Marine by the calendar year-end.

10 REVIEW OF KEY MANAGEMENT PLANS

10.1 SHIPPING MANAGEMENT PLAN

The Shipping Management Plan (SMP) will ensure that all equipment and operating procedures conforms to the requirements of the Canada Shipping Act, The Arctic Waters Pollution Prevention Act, Canada Oceans Act, 1997, MARPOL 73/78 Annex I (Mineral oils), Annex II (Noxious Liquid Substances carried in bulk), Annex III (Harmful substances carried in packaged forms), Annex IV (Sewage), Annex V (Garbage) and Annex VI (Air Pollution). Solas 74 with amendments.

Lessons learned from previous marine operations in the LSA and RSA will be incorporated into the SMP and documented site specific operating procedures will be incorporated into the SMP. Adherence to approved procedures will be verified by annual audits. The marine equipment used on the Kiggavik project will be selected on the basis of best value meeting rigorous task performance criteria for: reliability, safety and capability of meeting stringent environmental standards. The Marine Shipping Company selected for the Kiggavik Project will have a proven history of excellent performance in Arctic Transportation. The Marine Shipping Company will be required to carry third part Liability Insurance.

The SMP will include protocols for the transportation of dangerous goods into Baker Lake. Documented procedures following Transport Canada guidelines outlined in TP 10783E will be used for all vessel to vessel and vessel to shore fuel transfers. A supervisor trained and experienced in marine fuel transfers will supervise fuel transfers. The specification for diesel fuel will meet CGSB or equivalent standards for arctic diesel. The SMP will also include specific protocols for the marine transportation of diesel fuel into Baker Lake. All diesel fuel will be carried in tankers and/or barges which have been constructed with a double hull. A watertight void space will be constructed around the perimeter of the cargo tanks therefore insuring that the cargo does not come in contact with the vessel's outside steel shell. Should the vessel run aground or otherwise breach the outer shell, no cargo fuel will spill from the cargo tanks into the surrounding water.

The SMP will include a Ballast Water management plan which meets the Ballast Water Control and Management Regulations (SOR/2006 – 129) of the Canada Shipping Act. Vessels arriving from southern ports or outside the RSA will be in the loaded condition therefore no ballast water will be carried on the vessels when they arrive.

The SMP will include onboard waste management policies and guidelines for handling solid waste, sewage and other domestic waste generated by vessels. All vessels will be fitted with sewage treatment plants that meet Marpol 73/78 Annex IV requirements. All vessels will be required to implement a garbage management plan that meets Marpol 73/78 Annex V requirements. The plan will maximize recycling of solid materials and minimizes the use of incinerators. Baker Lake and Chesterfield Inlet will be treated as special areas as defined by Annex V meaning no garbage of any kind will be discharged.

The SMP will address smuggling prevention as part of the Vessel Security. All manned vessels will be certified in accordance with the Canadian Ship Security Regulations (SOR/2004 – 144). An International Ship Security Certificate will be required for all SOLAS vessels. All cargo will be manifested and accounted for when loaded and unloaded at the origin, transfer and final delivery port. A Ship Security Plan will be required by all SOLAS and non SOLAS vessels. The marine Shipping Company will be required to enforce a zero Alcohol and Drug Policy.

The SMP will ensure that all vessels have documented approved SOPEPs which include contingency plans for accidental spills of fuel and Chemicals, extreme weather conditions and malfunctions during shipping operations, with reporting action procedures. All vessels involved in the carriage of fuel and chemicals will have an approved SOPEP. The Plan will contain all information and operational instructions as required by the "Guidelines for the development of the Shipboard Marine Pollution Emergency Plan" as developed by (IMO) and published under MEPC.85 (44) and MEPC.54 (32) amended by MEPC.86 (44). (See Item 10.4)

The SOPEP for each vessel will contain the following instructions: Note. This paragraph is also used in the Paragraph 7 of item 10.4. It is most appropriate for 10.4 therefore a reference to 10.4 would be sufficient here.

- Response Team Organizational Structure which will include, Master, designated Spill Officer, Spill Squad, and Repair Squad.

- Procedures for the crew to mitigate Fuel transfer incidents including: Transfer System Leak (Oil), System Leak (NLS), Tank Overflow (Oil), Tank Overflow (NLS), Suspected Fuel Tank or Hull Leak,

- Procedures for Crew to Mitigate Casualty Discharge from: Stranding, Grounding, Collisions, Fire and Explosion, Hull Failure, Excessive List, Dangerous Reactions of Cargo, Other Dangerous Cargo Release, Loss of Tank Environmental Control, Cargo Contamination Yielding a Hazardous Condition, Equipment Failure, Steering Gear Failure, Main Engine Failure, Use of Anchors, Damage Stability, Emergency Ship – to – Ship Transfer, Emergency Towing and Hull Stress Considerations, Location of Salvage, Stability, Shipboard Mitigation Equipment and Stress Assessment information.

- Crew responsibilities for taking and recording samples of spilled product.

- Master's responsibility and instructions for reporting oil spills.

- o An inventory of ready use spill response equipment to be kept onboard.

- o An inventory of Spill Response equipment stored ashore on location

10.2 OCCUPATIONAL HEALTH AND SAFETY PLAN

AREVA will ensure that the Marine shipping company has a Health, Safety and Environmental Protection Plan which includes the following elements:

1. Health Policy that recognizes interaction with the Nunavut Medical Health system, Safety Policy, Environmental Protection Policy, Drug & Alcohol Policy, and Healthy Workplace Policies.

2. The HSE System Manuals, which describe the Shipping company's Policies, System-level Procedures and Work Instructions;

3. A defined and documented organizational structure, with clear levels of responsibility and authority and lines of communication between shore-based and shipboard personnel;

4. Appointment of a Designated Person/Management Representative with specific responsibilities for all HSE System matters;

5. Documented procedures for the control of HSE System Documents and Records;

6. Programs through which Top Management ensures that the importance of meeting regulatory and AREVA's requirements is communicated throughout the organization;

7. Periodical establishment of measurable HSE objectives and performance review against these objectives;

8. A System for integrating quality, health, wellness and safety into daily processes as well as maintaining the integrity of the HSE system when changes take place;

9. Procedures for carrying out periodical Shore side Management and Master's Reviews of the HSE System;

10. A system to ensure that:

    - All personnel performing work that affects safety, environmental protection or service quality are competent on the basis of education, training, skills and experience, fully conversant with the HSE System, and aware of the importance of their activities and their impact on the company's HSE objectives;

    - All vessels are manned with properly certified, experienced, trained and medically fit seafarers, in accordance with international and national regulations. Special training will be provided to all seafarers and dock workers for the handling and transportation of Uranium concentrate;

- All new personnel and those transferred to new assignments are provided with proper familiarization with their duties;

- All vessel personnel are capable of communicating effectively with each other;

- Additional training in support of the HSE System to deal with situations unique to the LSA and RSA.

11. Instructions and Procedures to ensure the safe and efficient operation of the vessels and protection of the environment in general with a particular focus on the RSA and LSA environment. The instructions will include documented voyage plans, loading plans, discharge plans and SOPEPs developed from sources such as Job Safety Analysis (JSA), Traditional Knowledge and Risk assessments of all critical marine activities ;

12. Offshore and Onshore Safety Committees representation and regular conduct of Safety Meetings, which provide a forum for all personnel to work together in identifying and resolving Health, Wellness, Safety and Environmental hazards on board the vessels and ashore;

13. Emergency Response Plans, to identify and effectively respond to potential emergency situations, and a program of drills and exercises to test these plans;

14. A system for maintaining identification and traceability of the vessels' activities and products supplied to the vessels;

15. Procedures to ensure that all vessels are maintained and certified in accordance with all international and national rules and regulations and any additional requirements of the shipping company;

16. Procedures to exercise care with Areva owned products while under the Marine Shipping Company's control;

17. Procedures for calibrating, verifying, adjusting, identifying and protecting, monitoring and measuring devices which are critical to the safety of the ship, protection of the environment or service quality;

18. Documented procedures for reporting and analyzing accidents, incidents, illnesses, near misses and non-conformities, and controlling non-conforming products or services, for the purpose of developing and implementing preventive or corrective actions to prevent occurrence or recurrence. A system to communicate Lessons learned to all vessels ;

19. Specific methods through which HSE System processes and the shipping company's performance overall, are monitored and measured against specified objectives, relevant data analyzed, and corrective action is taken when deviations are observed;

20. A program for conducting Internal HSE System Audits and Inspections at planned intervals and procedures that govern the conduct of these audits

10.3 SPILL CONTINGENCY PLAN

The spill contingency plans for the maritime transportation of the Kiggavik Project will include the following:

- Areva Environmental Policy
- Scope of the Plan
- Response Organization
- Org Chart with positions identified. In times of emergency all available human and material resources must be available to provide mutual assistance. The organization should include members from the Local community Emergency Response organizations, other mining and shipping companies working in the area.
- Bridging document to allocate responsibilities between Areva and Shipping Company Emergency Response teams
- Internal and External Contacts including Regulatory bodies
- Media coordinator
- Onsite response Team
- Offsite (3rd Party) Response Organization
- Description of Response Team member's duties
- Weather reports
- Notification directives
- Define training requirements for all team members from team leads to first responders.

Arctic transportation and Logistics Plan

- Pre arranged contracts for emergency shipment of equipment and personnel
- Transportation plan to be designed with consideration of arctic conditions

Spill Response Containment Plans

- Location of Containment Material in LSA, RSA and other
- Inventory of Containment Material

Spill Response Clean up plans

- Location of Clean Up Material in LSA, RSA and other
- Inventory of Clean Up Material

Emergency Response Exercise Plan

- Define frequency and extent of Exercises
- Exercise review process
- Incident review process

Maintenance of Emergency Response Equipment

- Documented Maintenance plan
- Responsibility Org Chart
- Review process

Reference material

- Marine Charts
- Tide Tables
- Maps showing locations of materials
- Names, Contact numbers and Specifications of all vessels working in the RSA

All persons involved in the transfer of pollutants will receive spill response training commensurate with their level of responsibility. Spill response exercises will be carried out on a regular basis to practice spill response techniques and to improve spill response reaction time and organization. Spill kits will be carried on tugs, barges, tankers and dry cargo vessels in accordance with individual Shipboard Oil Pollution Emergency Plans. Additional spill kits will be available at lightering positions and at the dock site in Baker Lake. Spill kits positioned at lightering sites will include containment booms of sufficient length to completely surround the largest tanker or barge. Oil recovery skimmers will be of sufficient capacity to recover oil quantities equal to the volume of one cargo tank within 48 hours. A contract will be arranged with a spill response organization with equipment and personnel to respond to a larger incident. Back up equipment and a plan to transport the equipment to a remote spill site will be available.

10.4 SHIFBOARD OIL POLLUTION EMERGENCY PLAN

Plan Outline is provided; detailed plans will have to be developed later in conjunction with shipping companies.

Requirements of National laws and regulations, as well as International Regulations and standards apply to the proposed marine shipping for the Kiggavik mine. The Shipboard Marine Pollution Emergency Plan will be written in accordance with the requirements of regulation 37 of Annex I and regulation 17 of Annex II of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto and amended by Res.MEPC.78 (43).

The Shipboard Oil Pollution Emergency Plan (SOPEP) will contain all information and operational instructions as required by the “Guidelines for the development of the Shipboard Marine Pollution Emergency Plan” as developed by the Organization (IMO) and published under MEPC.85 (44) and MEPC.54 (32) amended by MEPC.86 (44) .

The SOPEP plan will contain instructions to the Master with a list of Contacts for reporting a Marine Accident/Incident. The contact list will include the Marine Shipping Company’s

Emergency Response team ashore, Client contact (Areva), Regulatory bodies, third party Emergency Response organization and may include insurance contacts.

The SOPEP is designed as a ship-specific tool however it will also contain links to shore-based plans. The Plan will allow an efficient co-ordination between the ship and the shore-based Authorities/ Organizations in mitigating the effects of any pollution incident. A shore based third party emergency response team with access to significant oil spill containment and clean up resources will be available to assist the ship's master.

The Plan will contain all information and operational instructions as required by the "Guidelines for the development of the Shipboard Marine Pollution Emergency Plan" as developed by (IMO) and published under MEPC.85 (44) and MEPC.54 (32) amended by MEPC.86 (44).

The SOPEP for each vessel will contain the following instructions:

- Response Team Organizational Structure which will include, Master, designated Spill Officer, Spill Squad, and Repair Squad.

- Procedures for the crew to mitigate Fuel transfer incidents including: Transfer System Leak (Oil), System Leak (NLS), Tank Overflow (Oil), Tank Overflow (NLS), Suspected Fuel Tank or Hull Leak,

- Procedures for Crew to Mitigate Casualty Discharge from: Stranding, Grounding, Collisions, Fire and Explosion, Hull Failure, Excessive List, Dangerous Reactions of Cargo, Other Dangerous Cargo Release, Loss of Tank Environmental Control, Cargo Contamination Yielding a Hazardous Condition, Equipment Failure, Steering Gear Failure, Main Engine Failure, Use of Anchors, Damage Stability, Emergency Ship – to – Ship Transfer, Emergency Towing and Hull Stress Considerations, Location of Salvage, Stability, Shipboard Mitigation Equipment and Stress Assessment information.

- Crew responsibilities for taking and recording samples of spilled product.

- Master's responsibility and instructions for reporting oil spills.

- An inventory of ready use spill response equipment to be kept onboard.

- An inventory of Spill Response equipment stored ashore on location

A response plan for a large oil spill from a vessel in transit will be in place which will compliment and support the SOPEPs on individual vessels. The Emergency Spill Response Plan (ESRP) will be designed to address oil spills which are beyond the capacity of the individual vessel to mitigate. The ESRP will be organized along a similar format to a SOPEP however it will be designed to deal with a worst case scenario and will be capable of bringing larger shore based resources of personnel and equipment to mitigate the spill. The Management structure which will include: Senior Areva person in charge, Baker Lake Community Liaison, Nunavut and Federal Government liaison, Marine Advisor, Oil Spill Response Team Lead, Information Liaison, Traditional Knowledge advisor. The plan will incorporate an initial response capability which is designed to mitigate worst case scenarios. A support plan to mobilize equipment and personnel stationed at strategic points in the LSA, RSA and at other locations outside of the RSA. The ESRP will carry out exercises to practice Oil Spill Response.

10.5 ACCIDENT/INCIDENT REPORTING

Accidents and incidents will be reported as required by AWPP regulations.

- All accidents, incidents and near misses involving marine operations will be reported on Accident- Incident forms and a follow up identification number will be assigned to each event.
- An event log will be maintained.
- Events will be investigated using Systematic Causal Analysis Techniques to determine root cause.
- The investigation of the event will not be considered closed until appropriate corrective action has been taken and the results of the investigation have been published within the shipping company fleet.
- Accident prevention will be the cornerstone of the Safety program and will be supported by a pro-active program to identify and correct potential hazards before an accident occurs.

10.6 WASTE MANAGEMENT PLAN

Sewage

All manned vessels will have an approved Sewage Treatment Plant installed which meets MARPOL 73/78 Annex IV requirements. The RSA and the LSA will be considered as a special region where the discharge of raw sewage and grey water will not be allowed.

Contingency measures for the disposal of sewage/grey water during periods of sewage plant malfunction and/or disturbances, with details regarding the associated disposal and treatment technologies and facilities;

Sewage treatment plants will be designated as critical equipment with stringent preventative maintenance programs and suitable spare parts inventories. In the event of a malfunction of a treatment plant, the sewage/grey water will be retained onboard in holding tanks until the plant has been repaired. Sewage may be disposed of in the onboard incinerator.

Domestic waste

Domestic waste will be kept to a minimum by adherence to a comprehensive recycling program. All recycled plastics, paper, metal and wood products will be segregated and loaded into containers and transported south as back haul cargo. Galley waste will be incinerated.

Ship based domestic waste generated by dry cargo vessels from cargo amounts to 49 kg per day. Approximately 50% of the waste consists of wood products which will be dealt with onboard by incineration.

Food waste is estimated to be 2.25 kg per person per day which amounts to 25 kgs per day for a tug and 60 kgs per day for a cargo ship or tanker. Food waste will be dealt with onboard by incineration.

Hazardous Waste

The majority of Hazardous waste will be disposed of using onboard approved incinerators. Waste which cannot be incinerated such as PCBs and plastics will be packaged and loaded into designated ISO containers for backhaul to southern ports where they will be recycled or disposed of at approved facilities.

Used lubricating oil, hydraulic fluid, cleaning solvents, dirty fuel and oil recovered from Oily Water Separators are held onboard in waste oil tanks as regulated by International Oil Pollution Prevention (IOPP) regulations. All may be burned in a waste incinerator. Larger cargo vessels generally will have adequate storage capacity onboard which will allow them to dispose of the waste at approved facilities at southern ports. Smaller vessels such as tugs may load waste oil into marine liquid ISO containers and shipped to southern ports as back haul cargo or may be able to burn waste oil in onboard incinerators.

The annual volume of waste fluids generated by tug boats is estimated to be approximately three cubic meters per tug/season based on 0.5% of annual fuel consumption. Large cargo vessels burning intermediate fuel oil (IFO) will generate 20 cubic meters of liquid waste per vessel based on 2% of IFO consumed. The waste oil generated by vessels will be disposed of the vessel’s incinerator or stored onboard in designated dirty oils tanks and discharged ashore in southern ports to approved facilities.

Waste oil and rags that are incinerated onboard do not need containers. Oil may be loaded into 20 foot ISO oil containers for shipment to southern ports where the oil can be transferred to approved receiving facilities for disposal.

Incinerators

All marine incinerators will meet IMO MEPC76 (40) standards. They will be capable of handling solid waste, including domestic waste, oil waste and in most cases sewage. Modern marine incinerators operate at very high combustion temperatures in the range of 850º - 1200º C. Automatic combustion controls and rapid cooling of exhaust gasses maintain emissions within stringent limits of IMO MEPC.76 (40).

Waste generated by tugs will be minimal and will consist of residual ash from incineration mounting to less than 10% of the total waste onboard. This residual ash will be sealed in heavy duty fabric containers loaded into a designated waste shipping container which when filled or at the end of the season will be shipped south as backhaul and disposed of at an approved receiving facility at a southern port. Waste generated from the recycling program will be loaded into a designated recycling container and shipped south as a backhaul cargo and then turned over to an approved recycling depot at a southern port.

10.7 BALLAST WATER MANAGEMENT PLAN

All vessels will comply with the Ballast Water management Plan. There will be no ballast water carried onboard vessels arriving from outside the RSA therefore no ballast water will be discharged into the waters of the RSA. The ship management plan will not permit contaminants of any kind to be discharged into the RSA or LSA.

All vessels will be required to have a Ballast Water Management Plan which conforms to the following Regulations:

- International Maritime Organization (IMO) Assembly Resolution A.868 (20);
- “Guidelines for the control and management of ships ballast water to minimize the transfer of harmful aquatic organisms and pathogens”
- “International convention for the control and management of ships ballast water and sediments”
- “The Canada shipping act’s ballast water control and management regulations"

Ballast Water Management Procedures will vary from ship to ship depending on its installed equipment and tank layout however all vessels will have the Ballast Water Management Plan will contain the following information and instructions:

1. SHIP PARTICULARS
2. BALLAST WATER MANAGEMENT PLAN
    - 2.1 Introduction
    - 2.2 Usage of the Plan
    - 2.3 Crew training and Familiarization
3. BALLAST WATER ARRANGEMENT Drawings
    - 3.1 Ballast System and Condition Arrangements
    - 3.2 Ballast Pumps
    - 3.3 Ballast Monitoring
4. BALLAST WATER SAMPLING POINTS
    - 4.1 Purpose
    - 4.2 Table of Sampling Points
5. BALLAST WATER PLANNING
    - 5.1 When to Exchange Ballast Water
    - 5.2 Uptake of Ballast Water in Harbor
    - 5.3 Removing of Ballast Sediments
    - 5.4 Exchange of Ballast Water in Open Sea
    - 5.5 Reduced Discharge of Ballast Water in Harbor
6. SAFETY
    - 6.1 Limitations
    - 6.2 Potential Hazards Connected to Ballast Exchange in Open Sea.
    - 6.3 Examples of Limitations due to Weather – Sequential Exchange.
7. BALLAST WATER EXCHANGE PROCEDURES
    - 7.1 General
    - 7.2 Exchange by Sequential Method
    - 7.2.2 Proposed ballast exchange sequence
    - 7.3 Flow through Method
    - 7.3.1 General
    - 7.3.2 Tanks for which the flow through method should be applied

7.3.3 Operating procedure

7.3.4 Calculated tank pressure and time consumption

8. BALLAST WATER REPORTING FORM

9. BALLAST WATER HANDLING LOG

10.8 WILDLIFE MITIGATION AND MONITORING PLAN

Marine Mammal Monitors (MMM) will be required to have Marine Emergency Duties Training in addition to training that they will require for Marine mammal Observations and Reporting. The MMM will receive orientation training on arrival onboard the vessel. The MMM will participate in marine drills such as fire drill and abandon ship drills. The MMM will participate in the safety and environmental management program.

11 OTHER ENVIRONMENTAL CONSIDERATIONS

11.1 AIR QUALITY

All vessels will be installed with engines meeting IMO Annex VI - Tier 1 exhaust gas emission limits. Vessels built after 2011 will meet Tier II exhaust gas emission limits. Tier III exhaust gas emission limits will come into effect in 2016. Tier 1 Sulfur content in marine fuel is also regulated by IMO Annex VI.

Tier	Effective Date	NOx Limit g/kwhr		
		n ≤ 130 kw	n ≥130 ≤ 2000 kw	n ≥ 2000 kw
I	2000	17.0	45.n-0.2	9.8
II	2011	14.4	44.n-0.23	7.7
III	2016	3.4	9.n-0.2	1.96
Note. n= engine power in kw				

The sulfur content in marine fuel is the main controlling factor in SOx emissions. The maximum Sulfur content for marine fuel is limited to 1% as of 2010 and 0.1% as at 2015.

Domestic waste will be disposed of in onboard marine incinerators which will comply with IMO MEPC.76(40). Modern marine incinerators operate at very high combustion temperatures in the range of 850º - 1200º C. Automatic combustion controls and rapid cooling of exhaust gasses maintain emissions within stringent limits of IMO MEPC.76(40) . CO in flue gas is limited to 200mg/MJ. The incineration of domestic waste will have the least negative impact.

Vessel Masters will be encouraged to reduce fuel consumption by shutting down machinery that is not immediately required. Idling of propulsion engines is to be avoided whenever possible. Full power maneuvering is to be avoided wherever possible to reduce fuel consumption. New tugs will be designed to meet current and future exhaust emission standards.

11.2 NOISE AND VIBRATION

All vessels have been constructed to meet allowable noise levels for persons working onboard. Hearing protection is provided for personnel as required. Full power maneuvering is to be avoided wherever possible to reduce propeller noise due to cavitation. Propeller designs will consider underwater noise reductions as well as efficiencies.

11.3 TERRESTIAL ENVIRONMENT

The ocean- going tanker vessels that will be used to transport fuel will be of a size commonly referred to as handy size from 15,000 tonne deadweight up to 30,000 tonne deadweight. These vessels will proceed at a slow speed as they enter the eastern entrance to Chesterfield Inlet and proceed to an anchorage near Ellis Island. The inlet is 5 km wide at the narrowest point in this area. There will be no destructive wake generated by these ships.

The smaller dry cargo ships will proceed down the Chesterfield Inlet as far as helicopter Island where they will anchor and lighter there cargo onto barges for the last leg of the voyage to Baker Lake. Tank barges will transit from Ellis Island to Baker Lake. The vessels will be travelling at relatively slow speeds and the wake affects will be minimal.

The tug and barge operation will for the most part operate between Helicopter Island and the dock site east of the Baker lake village. The vessels will be travelling at a relatively low speed. On clearing the North channel at the entrance to Baker Lake the tug and barge nearest distance to the north shore will be approximately 4.5 km from Ingilik point and Helix point. The affect on the shore will be minimal.

11.4 RISK OF INTRODUCING INTO WATERS TOXINS LEACHING FROM SHIPS

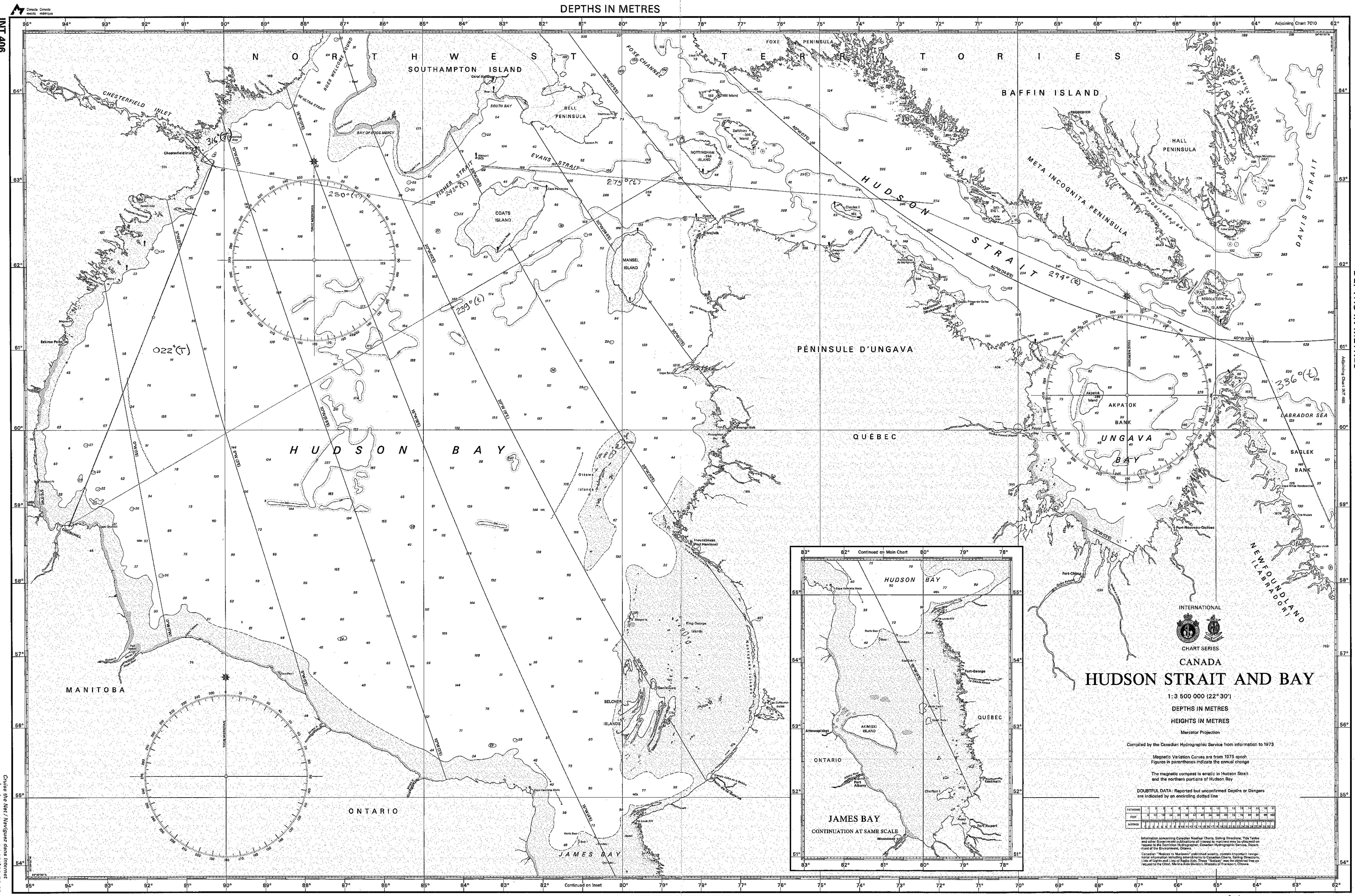
As of January 1, 2008, organotin compounds acting as biocides (eg. Tributyltin) cannot be applied to the outer hull of a ship. Only TBT free anti fouling coatings will be used on project vessels. All vessels will carry an International Anti-Fouling System Certificate (IFAS) to document the state of compliance. The underwater hulls and sea inlets of all vessels will be coated with approved TBT free anti-fouling coatings. Sea bays and sea inlet chests will be treated with an approved biocide and flushed before entering the RSA.

ATTACHMENT A - MARINE CHARTS

Charts No. 5620
Charts No. 5621
Charts No. 5622
Charts No. 5623
Charts No. 5624
Charts No. 5625
Charts No. 5626

INT 406
5002

DEPTHS IN METRES



DEPTHS IN METRES

Cruise the Net / Naviguez dans Internet
www.charts.gc.ca www.cartes.gc.ca

NEW CHART July 25 1975
Corrected to NOTICES TO MARINERS / Corrigé jusqu'à l'AVIS AUX NAVIGATEURS : 2006-06-09
See *Notices to Mariners* for subsequent corrections / Voir *Avis aux navigateurs* pour les corrections subséquentes

WARNING

Mariners may find port hand buoys painted black or green and fairway buoys painted black and white or red and white. In both cases, either presentation is to be interpreted as having the same navigational significance. See Notice to Mariners No. 430 of 1982.

AVERTISSEMENT

Les navigateurs peuvent trouver les bouées de bâbord noires ou vertes et celles de mi-chenal noires et blanches ou rouges et blanches. Dans ces deux cas, les présentations communiquent la même signification en ce qui concerne la navigation. Voir Avis aux navigateurs No. 430 de 1982.

PUBLISHED BY THE CANADIAN HYDROGRAPHIC SERVICE
DEPARTMENT OF THE ENVIRONMENT, OTTAWA

Nautical Charts Protect Lives, Property and the Marine Environment
Les cartes marines protègent la vie, la propriété et l'environnement marin

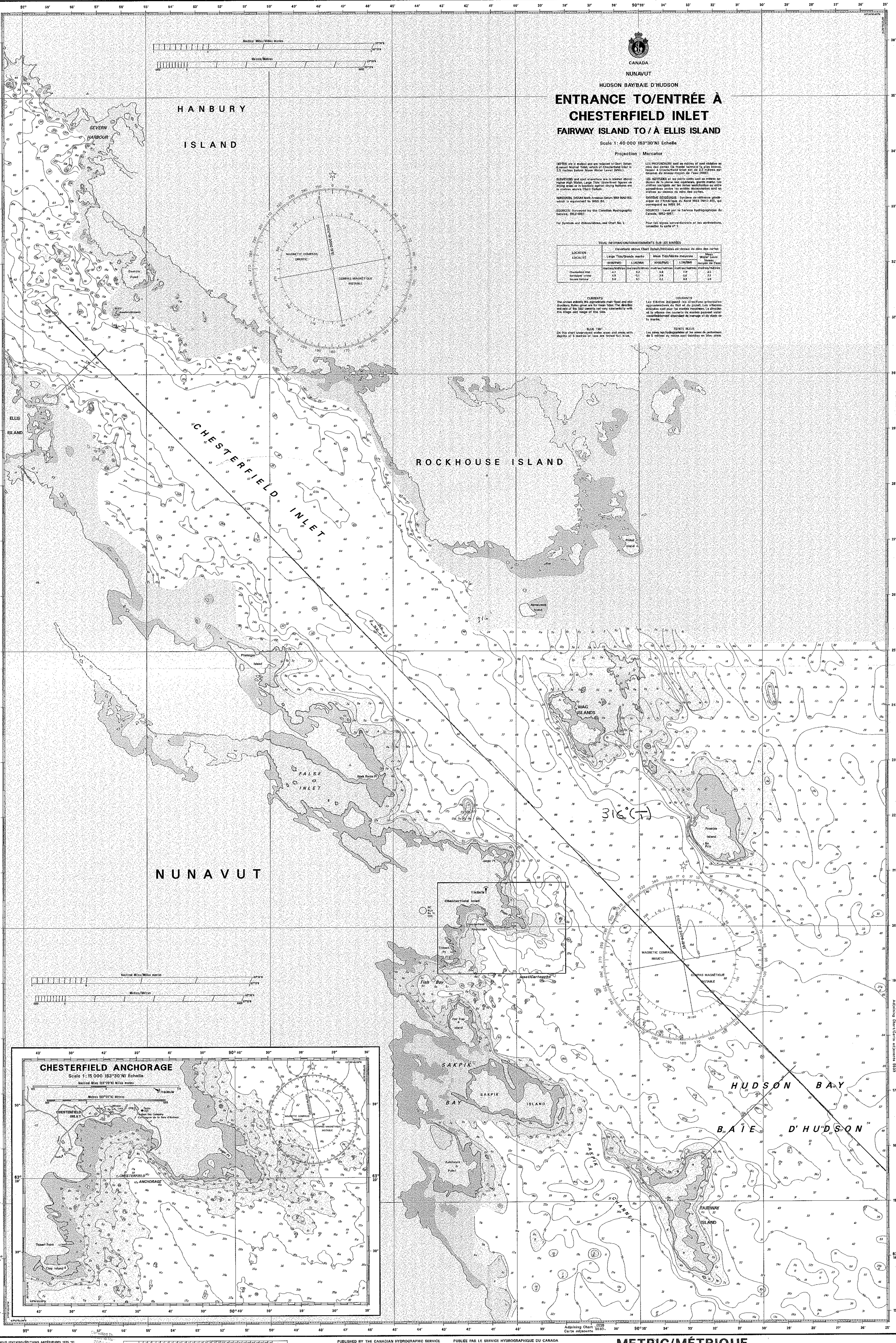
Canada
HUDSON STRAIT AND BAY

INT 406
5002

Fisheries and Oceans Canada / Pêches et Océans Canada

Canada

5620



CANADA

NUNAVUT

HUDSON BAY/BAIE D'HUDSON

ENTRANCE TO/ENTRÉE À CHESTERFIELD INLET

FAIRWAY ISLAND TO / À ELLIS ISLAND

Scale 1: 40 000 (63°30'N) Échelle

Projection : Mercator

DEPTHS are in metres and are reduced to Chart Datum (Lowest Normal Tide), which at Chesterfield Inlet is 2.5 metres below Mean Water Level (MWL).

ELEVATIONS and spot elevations are in metres above Higher High Water, Large Tide. Underlined figures on drying areas or in brackets against drying features are in metres above Chart Datum.

HORIZONTAL DATUM: North American Datum 1983 (NAD 83), which is equivalent to WGS 84.

SOURCES: Surveyed by the Canadian Hydrographic Service, 1952-1997.

For Symbols and Abbreviations, see Chart No. 1.

LES PROFONDEURS sont en mètres et sont réduites au zéro des cartes (la marée normale la plus basse), lequel à Chesterfield Inlet est de 2.5 mètres au-dessous du niveau moyen de l'eau (NME).

LES ALTITUDES et les points cotés sont en mètres au-dessus de la pleine mer supérieure, grande marée. Les chiffres soulignés sur les zones assèchantes ou entre parenthèses contre les entités découvrantes sont en mètres au-dessus du zéro des cartes.

SYSTÈME GÉODÉSIQUE : Système de référence géodésique de l'Amérique du Nord 1983 (NAD 83), qui correspond au WGS 84.

SOURCES : Levé par le Service hydrographique du Canada, 1952-1997.

Pour les signes conventionnels et les abréviations, consulter la carte nº 1.

TIDAL INFORMATION/RENSEIGNEMENTS SUR LES MARÉES

LOCATION / LOCALITÉ	Elevations above Chart Datum/Altitudes au-dessus du zéro des cartes				
	Large Tide/Grande marée		Mean Tide/Marée moyenne		Mean Water Level / Niveau moyen de l'eau
	HHW/PMS	LLW/BMI	HHW/PMS	LLW/BMI	
	metres/mètres	metres/mètres	metres/mètres	metres/mètres	metres/mètres
Chesterfield Inlet	4.7	0.2	4.0	0.9	2.5
Sandpiper Island	4.5	-0.1	3.8	0.6	2.2
Severn Harbour	5.0	0.1	4.2	0.8	2.6

CURRENTS

The arrows indicate the approximate main flood and ebb directions. Rates given are for mean tides. The direction and rate of the tidal currents can vary substantially with the stage and range of the tide.

COURANTS

Les flèches indiquent les directions principales approximatives du flot et du jusant. Les vitesses indiquées sont pour les marées moyennes. La direction et la vitesse des courants de marées peuvent varier considérablement dépendant du marnage et du stade de la marée.

BLUE TINT

On this chart unsurveyed water areas and areas with depths of 5 metres or less are tinted full blue.

TEINTE BLEUE

Les zones non hydrographiées et les zones de profondeurs de 5 mètres ou moins sont teintées en bleu plein.

Cruise the Net/Naviguez dans Internet www.charts.gc.ca www.cartes.gc.ca

5620

PREVIOUS EDITIONS/ÉDITIONS ANTÉRIEURES 1975 '91
NEW EDITION/NOUVELLE ÉDITION DEC/DÉC 29 2000
NOTICES TO MARINERS/AVIS AUX NAVIGATEURS 2001-04-13 2004-06-18

METRES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	MÈTRES
FEET	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102															PIEDS
FATHOMS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17															BRASSES

PUBLISHED BY THE CANADIAN HYDROGRAPHIC SERVICE
PUBLIÉE PAR LE SERVICE HYDROGRAPHIQUE DU CANADA

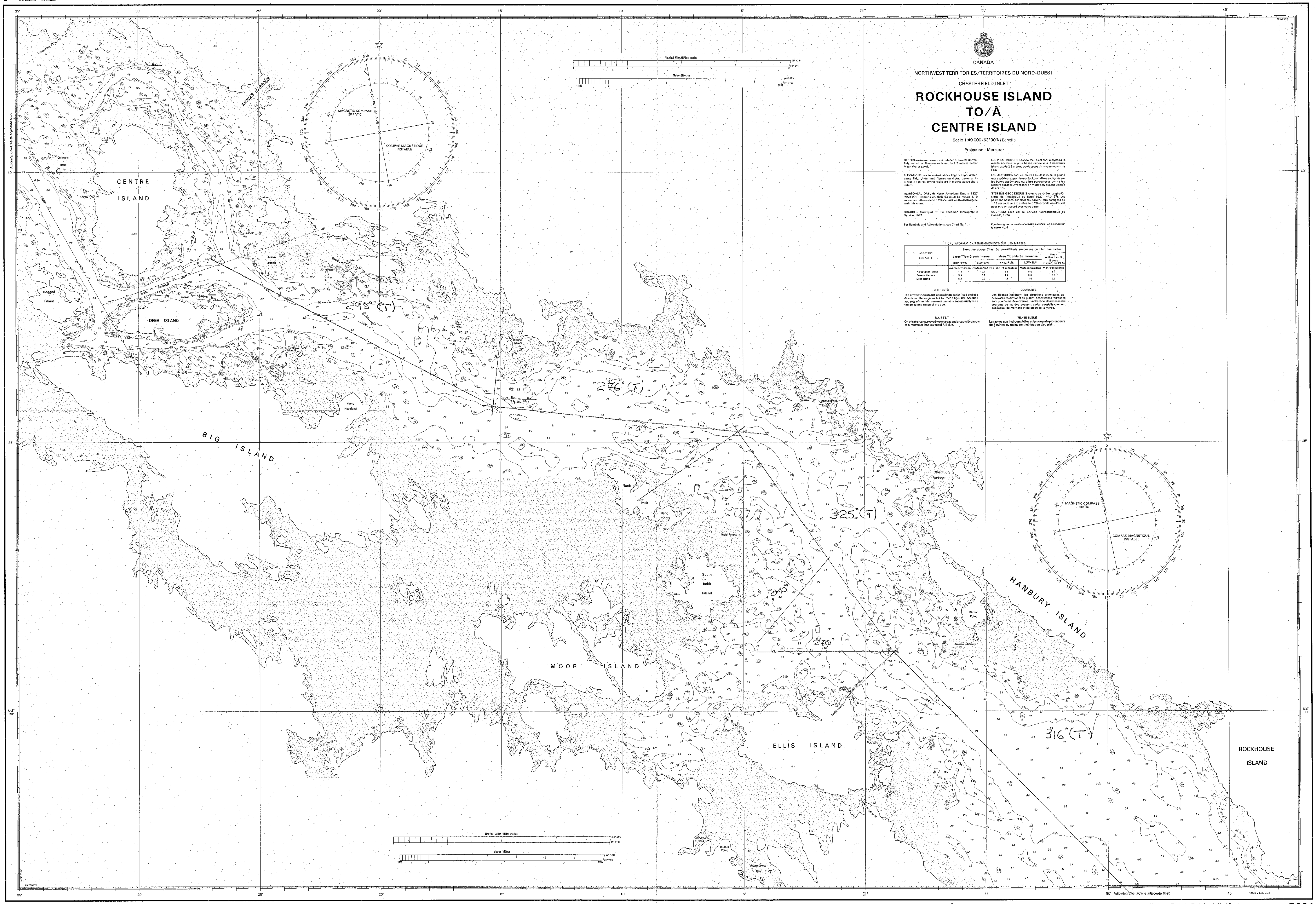
Nautical Charts Protect Lives, Property and the Marine Environment
Les cartes marines protègent la vie, la propriété et l'environnement marin

METRIC/MÉTRIQUE

Fisheries and Oceans / Pêches et Océans

Canada

5621



CANADA

NORTHWEST TERRITORIES/TERRITOIRES DU NORD-OUEST

CHESTERFIELD INLET

ROCKHOUSE ISLAND TO/À CENTRE ISLAND

Scale 1:40 000 (63°30'N) Échelle

Projection : Mercator

DEPTHS are in metres and are reduced to Lowest Normal Tide, which at Akreavenek Island is 2.2 metres below Mean Water Level.

LES PROFONDEURS sont en mètres et sont réduites à la marée normale la plus basse, laquelle à Akreavenek Island est de 2.2 mètres au-dessous du niveau moyen de l'eau.

ELEVATIONS are in metres above Higher High Water, Large Tide. Underlined figures on drying banks or in brackets against drying rocks are in metres above chart datum.

LES ALTITUDES sont en mètres au-dessus de la pleine mer supérieure, grande marée. Les chiffres soulignés sur les bancs asséchants ou entre parenthèses contre les rochers qui découvrent sont en mètres au-dessus du zéro des cartes.

HORIZONTAL DATUM: North American Datum 1927 (NAD 27). Positions on NAD 83 must be moved 1.19 seconds southward and 0.28 seconds westward to agree with this chart.

SYSTEME GÉODÉSIQUE: Système de référence géodésique de l'Amérique du Nord 1927 (NAD 27). Les positions basées sur NAD 83 doivent être corrigées de 1.19 seconde vers le sud et de 0.28 seconde vers l'ouest pour être en accord avec cette carte.

SOURCES: Surveyed by the Canadian Hydrographic Service, 1974.

SOURCES: Levé par le Service hydrographique du Canada, 1974.

For Symbols and Abbreviations, see Chart No. 1.

Pour les signes conventionnels et les abréviations, consulter la carte No. 1.

TIDAL INFORMATION/RENSEIGNEMENTS SUR LES MARÉES

LOCATION LOCALITÉ	Elevation above Chart Datum/Altitude au-dessus du zéro des cartes				
	Large Tide/Grande marée		Mean Tide/Marée moyenne		Mean Water Level Niveau moyen de l'eau
	HHW/PMS	LLW/BMI	HHW/PMS	LLW/BMI	
	metres/mètres	metres/mètres	metres/mètres	metres/mètres	metres/mètres
Akreavenek Island	4.5	-0.1	3.8	0.6	2.2
Severn Harbour	5.0	0.1	4.2	0.8	2.5
Deer Island	5.4	0.2	4.6	1.0	2.9

CURRENTS

The arrows indicate the approximate main flood and ebb directions. Rates given are for mean tide. The direction and rate of the tidal currents can vary substantially with the stage and range of the tide.

COURANTS

Les flèches indiquent les directions principales approximatives du flot et du jusant. Les vitesses indiquées sont pour la marée moyenne. La direction et la vitesse des courants de marées peuvent varier considérablement dépendant du marnage et du stade de la marée.

BLUE TINT

On this chart unsurveyed water areas and areas with depths of 5 metres or less are tinted full blue.

TEINTE BLEUE

Les zones non hydrographiées et les zones de profondeurs de 5 mètres ou moins sont teintées en bleu plein.

PREVIOUS EDITIONS/ÉDITIONS ANTÉRIEURES 1975
NEW EDITION/NOUVELLE ÉDITION APRIL/AVRIL 26 1991
NOTICE TO MARINERS/AVIS AUX NAVIGATEURS

Corrected Through Notices to Mariners 2004-06-25
Corrigée par le biais des Avis aux navigateurs à la date susmentionnée

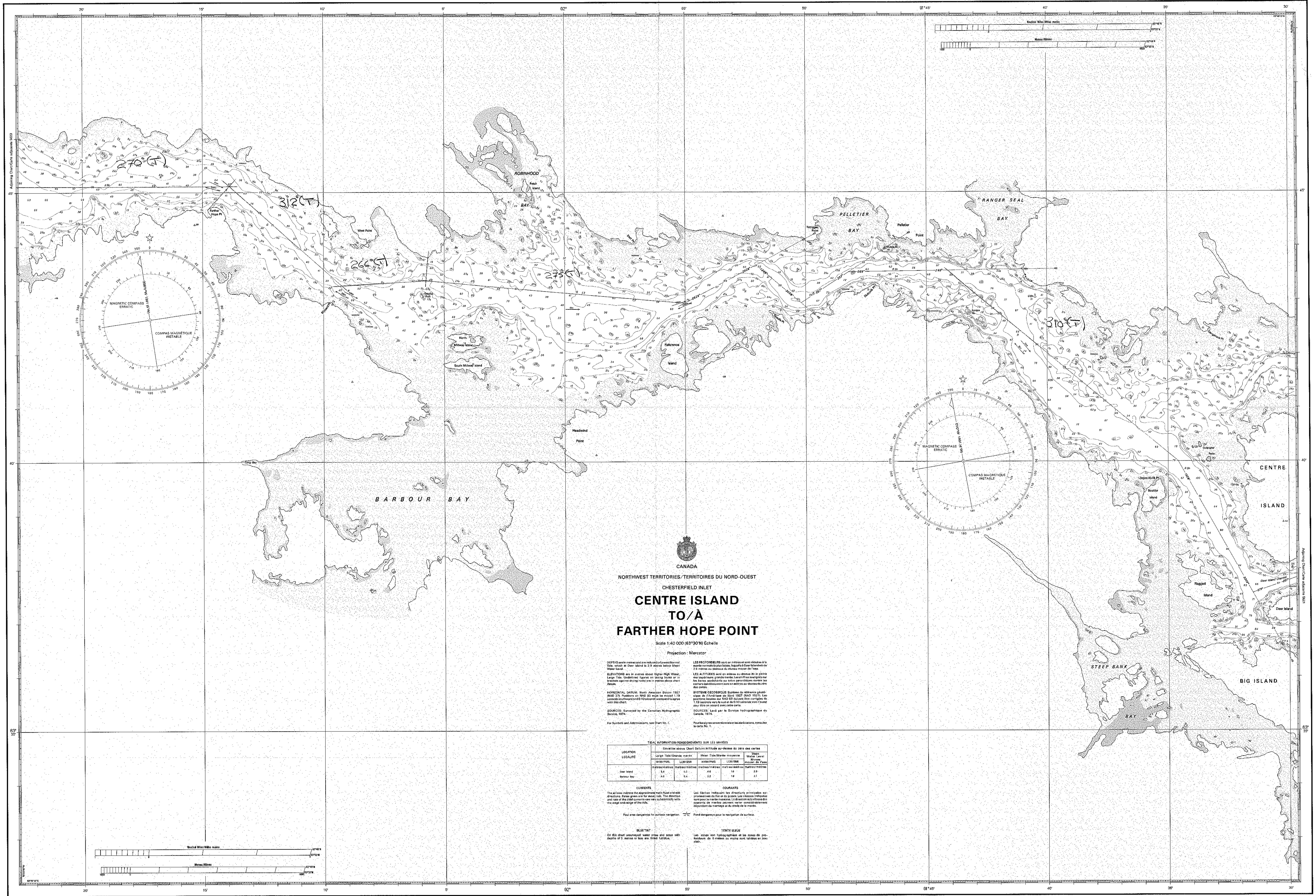
FATHOMS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	BRASSES
FEET	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	PIEDS

PUBLISHED BY THE CANADIAN HYDROGRAPHIC SERVICE
PUBLIÉE PAR LE SERVICE HYDROGRAPHIQUE DU CANADA

Nautical Charts Protect Lives, Property and the Marine Environment.
Les cartes marines protègent la vie, la propriété et l'environnement marin.

METRIC/MÉTRIQUE

Cruise the Net - Naviguez dans Internet
www.charts.gc.ca www.cartes.gc.ca



CANADA

NORTHWEST TERRITORIES/TERRITOIRES DU NORD-OUEST

CHESTERFIELD INLET

CENTRE ISLAND TO/À FARTHER HOPE POINT

Scale 1:40 000 (63°30'N) Échelle

Projection : Mercator

DEPTHS are in metres and are reduced to Lowest Normal Tide, which at Deer Island is 2.9 metres below Mean Water Level.

ELEVATIONS are in metres above Higher High Water, Large Tide. Underlined figures on drying banks or in brackets against drying rocks are in metres above chart datum.

HORIZONTAL DATUM: North American Datum 1927 (NAD 27). Positions on NAD 83 must be moved 1.19 seconds southward and 0.10 seconds westward to agree with this chart.

SOURCES: Surveyed by the Canadian Hydrographic Service, 1974.

For Symbols and Abbreviations, see Chart No. 1.

LES PROFONDEURS sont en mètres et sont réduites à la marée normale la plus basse, laquelle à Deer Island est de 2.9 mètres au-dessous du niveau moyen de l'eau.

LES ALTITUDES sont en mètres au-dessus de la pleine mer supérieure, grande marée. Les chiffres soulignés sur les bancs asséchants ou entre parenthèses contre les rochers qui découvrent sont en mètres au-dessus du zéro des cartes.

SYSTÈME GÉODÉSIQUE: Système de référence géodésique de l'Amérique du Nord 1927 (NAD 1927). Les positions basées sur NAD 83 doivent être corrigées de 1.19 seconde vers le sud et de 0.10 seconde vers l'ouest pour être en accord avec cette carte.

SOURCES: Levé par le Service hydrographique du Canada, 1974.

Pour les signes conventionnels et les abréviations, consulter la carte No. 1.

TIDAL INFORMATION/RENSEIGNEMENTS SUR LES MARÉES

LOCATION LOCALITÉ	Elevation above Chart Datum/Altitude au-dessus du zéro des cartes				
	Large Tide/Grande marée		Mean Tide/Marée moyenne		Mean Water Level Niveau moyen de l'eau
	HHW/PMS	LLW/BMI	HHW/PMS	LLW/BMI	
	metres/mètres	metres/mètres	metres/mètres	metres/mètres	metres/mètres
Deer Island	5.4	0.2	4.6	1.0	2.9
Barbour Bay	4.0	0.4	3.2	1.0	2.1

CURRENTS

The arrows indicate the approximate main flood and ebb directions. Rates given are for mean tide. The direction and rate of the tidal currents can vary substantially with the stage and range of the tide.

COURANTS

Les flèches indiquent les directions principales approximatives du flot et du jusant. Les vitesses indiquées sont pour la marée moyenne. La direction et la vitesse des courants de marées peuvent varier considérablement dépendant du marnage et du stade de la marée.

Foul area dangerous for surface navigation. / Fond dangereux pour la navigation de surface.

BLUE TINT

On this chart unsurveyed water areas and areas with depths of 5 metres or less are tinted full blue.

TEINTE BLEUE

Les zones non hydrographiées et les zones de profondeurs de 5 mètres ou moins sont teintées en bleu plein.

PREVIOUS EDITIONS/ÉDITIONS ANTÉRIEURES 1975
NEW EDITION/NOUVELLE ÉDITION DEC./DÉC. 27 1991
NOTICE TO MARINERS/AVIS AUX NAVIGATEURS

Corrected Through Notices to Mariners 2004-06-25
Corrigée par le biais des Avis aux navigateurs à la date susmentionnée

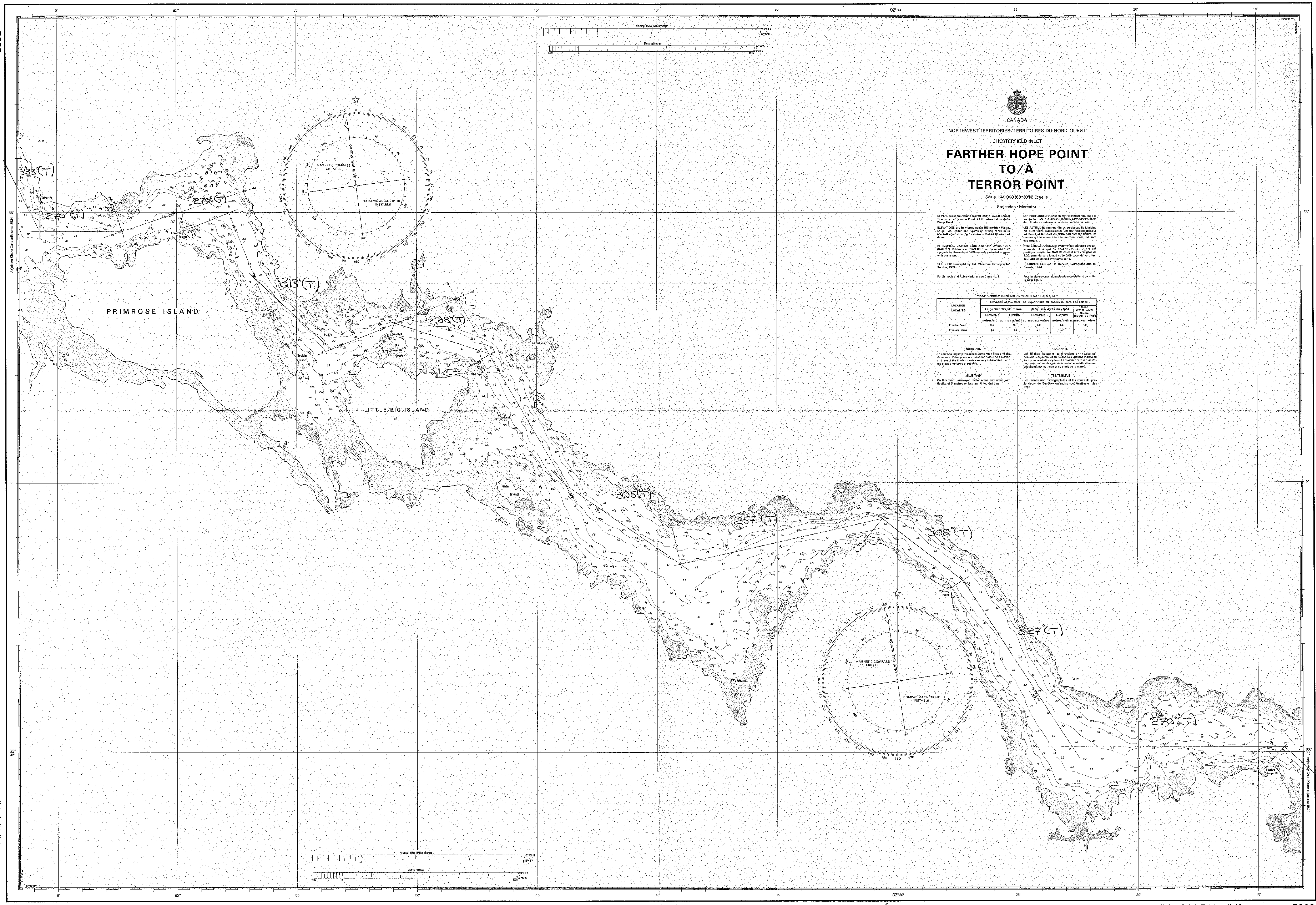
FATHOMS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	BRASSES
FEET	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	PIEDS

PUBLISHED BY THE CANADIAN HYDROGRAPHIC SERVICE
PUBLIÉE PAR LE SERVICE HYDROGRAPHIQUE DU CANADA

Nautical Charts Protect Lives, Property and the Marine Environment
Les cartes marines protègent la vie, la propriété et l'environnement marin.

METRIC/MÉTRIQUE

Canada



CANADA

NORTHWEST TERRITORIES/TERRITOIRES DU NORD-OUEST

CHESTERFIELD INLET

FARTHER HOPE POINT TO/À TERROR POINT

Scale 1:40 000 (63°30'N) Échelle

Projection : Mercator

DEPTHS are in metres and are reduced to Lowest Normal Tide, which at Promise Point is 1.8 metres below Mean Water Level.

ELEVATIONS are in metres above Higher High Water, Large Tide. Underlined figures on drying banks or in brackets against drying rocks are in metres above chart datum.

HORIZONTAL DATUM: North American Datum 1927 (NAD 27). Positions on NAD 83 must be moved 1.22 seconds southward and 0.06 seconds eastward to agree with this chart.

SOURCES: Surveyed by the Canadian Hydrographic Service, 1974.

For Symbols and Abbreviations, see Chart No. 1.

LES PROFONDEURS sont en mètres et sont réduites à la marée normale la plus basse, laquelle à Promise Point est de 1.8 mètre au-dessous du niveau moyen de l'eau.

LES ALTITUDES sont en mètres au-dessus de la pleine mer supérieure, grande marée. Les chiffres soulignés sur les bancs asséchants ou entre parenthèses contre les rochers qui découvrent sont en mètres au-dessus du zéro des cartes.

SYSTÈME GÉODÉSIQUE: Système de référence géodésique de l'Amérique du Nord 1927 (NAD 1927). Les positions basées sur NAD 83 doivent être corrigées de 1.22 seconde vers le sud et de 0.06 seconde vers l'est pour être en accord avec cette carte.

SOURCES: Levé par le Service hydrographique du Canada, 1974.

Pour les signes conventionnels et les abréviations, consulter la carte No. 1.

TIDAL INFORMATION/RENSEIGNEMENTS SUR LES MARÉES

LOCATION LOCALITÉ	Elevation above Chart Datum/Altitude au-dessus du zéro des cartes				
	Large Tide/Grande marée		Mean Tide/Marée moyenne		Mean Water Level Niveau moyen de l'eau
	HHW/PMS	LLW/BMI	HHW/PMS	LLW/BMI	
	metres/mètres	mètres/mètres	metres/mètres	metres/mètres	metres/mètres
Promise Point	3.6	0.1	3.0	0.5	1.8
Primrose Island	2.2	0.2	2.1	0.3	1.2

CURRENTS

The arrows indicate the approximate main flood and ebb directions. Rates given are for mean tide. The direction and rate of the tidal currents can vary substantially with the stage and range of the tide.

COURANTS

Les flèches indiquent les directions principales approximatives du flot et du jusant. Les vitesses indiquées sont pour la marée moyenne. La direction et la vitesse des courants de marées peuvent varier considérablement dépendant du marnage et du stade de la marée.

BLUE TINT

On this chart unsurveyed water areas and areas with depths of 5 metres or less are tinted full blue.

TEINTE BLEUE

Les zones non hydrographiées et les zones de profondeurs de 5 mètres ou moins sont teintées en bleu plein.

PREVIOUS EDITIONS/ÉDITIONS ANTÉRIEURES 1975
NEW EDITION/NOUVELLE ÉDITION NOV. 8 1991
NOTICE TO MARINERS/AVIS AUX NAVIGATEURS

Corrected Through Notices to Mariners 2004-06-25
Corrigée par le biais des Avis aux navigateurs à la date susmentionnée

FATHOMS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	BRASSES
FEET	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	PIEDS

PUBLISHED BY THE CANADIAN HYDROGRAPHIC SERVICE
PUBLIÉE PAR LE SERVICE HYDROGRAPHIQUE DU CANADA

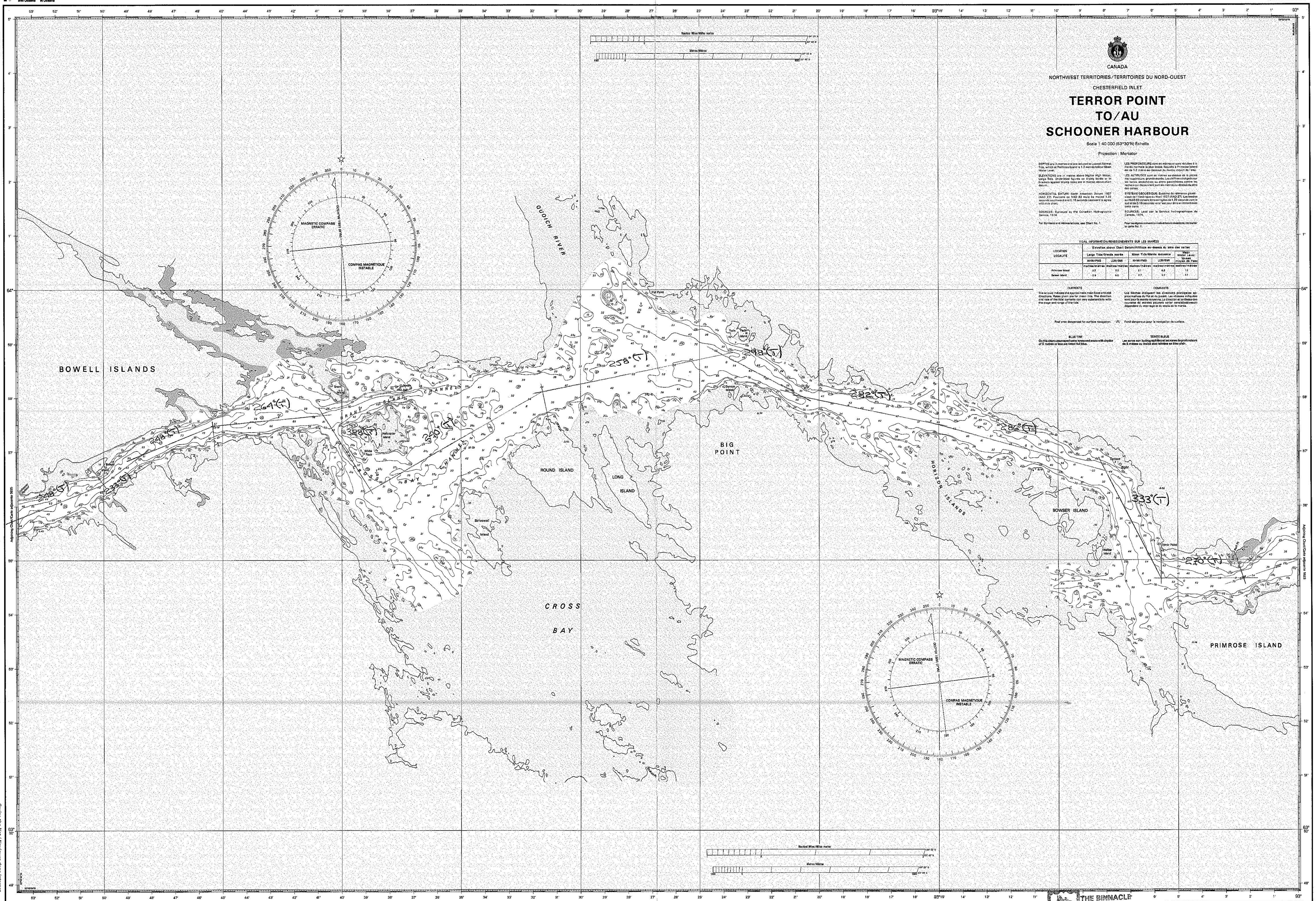
Nautical Charts Protect Lives, Property and the Marine Environment.
Les cartes marines protègent la vie, la propriété et l'environnement marin.

METRIC/MÉTRIQUE

Fisheries and Oceans / Pêches et Océans

Canada

5624



Cruise the Net / Naviguez dans Internet
www.charts.gc.ca www.cartes.gc.ca

PREVIOUS EDITIONS/ÉDITIONS ANTÉRIEURES 1975
NEW EDITION/NOUVELLE ÉDITION APRIL/AVRIL 26 1991
NOTICE TO MARINERS/AVIS AUX NAVIGATEURS

FATHOMS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	BRASSES
FEET	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	PIEDS

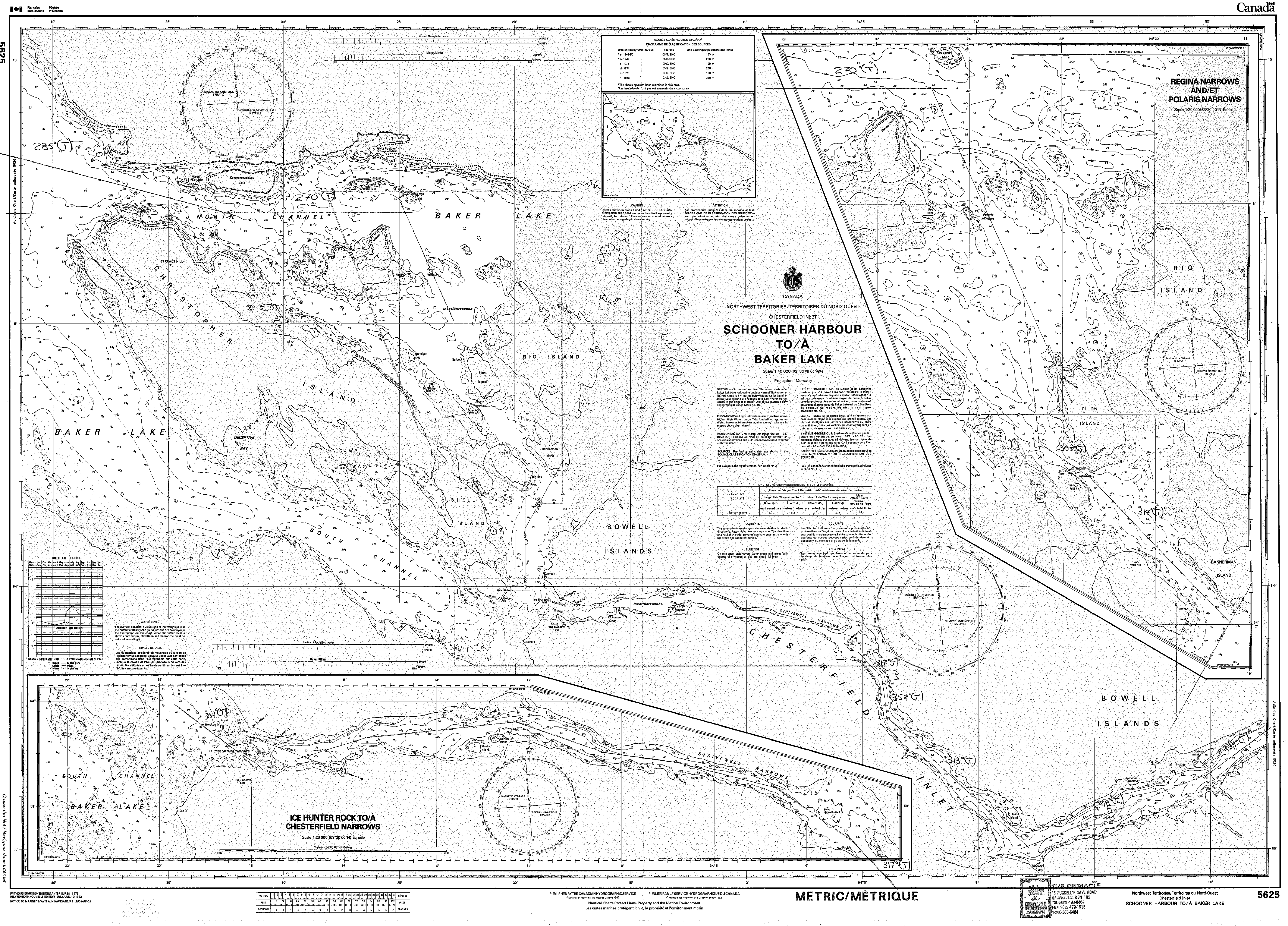
PUBLISHED BY THE CANADIAN HYDROGRAPHIC SERVICE
PUBLIÉE PAR LE SERVICE HYDROGRAPHIQUE DU CANADA

Nautical Charts Protect Lives, Property and the Marine Environment
Les cartes marines protègent la vie, la propriété et l'environnement marin

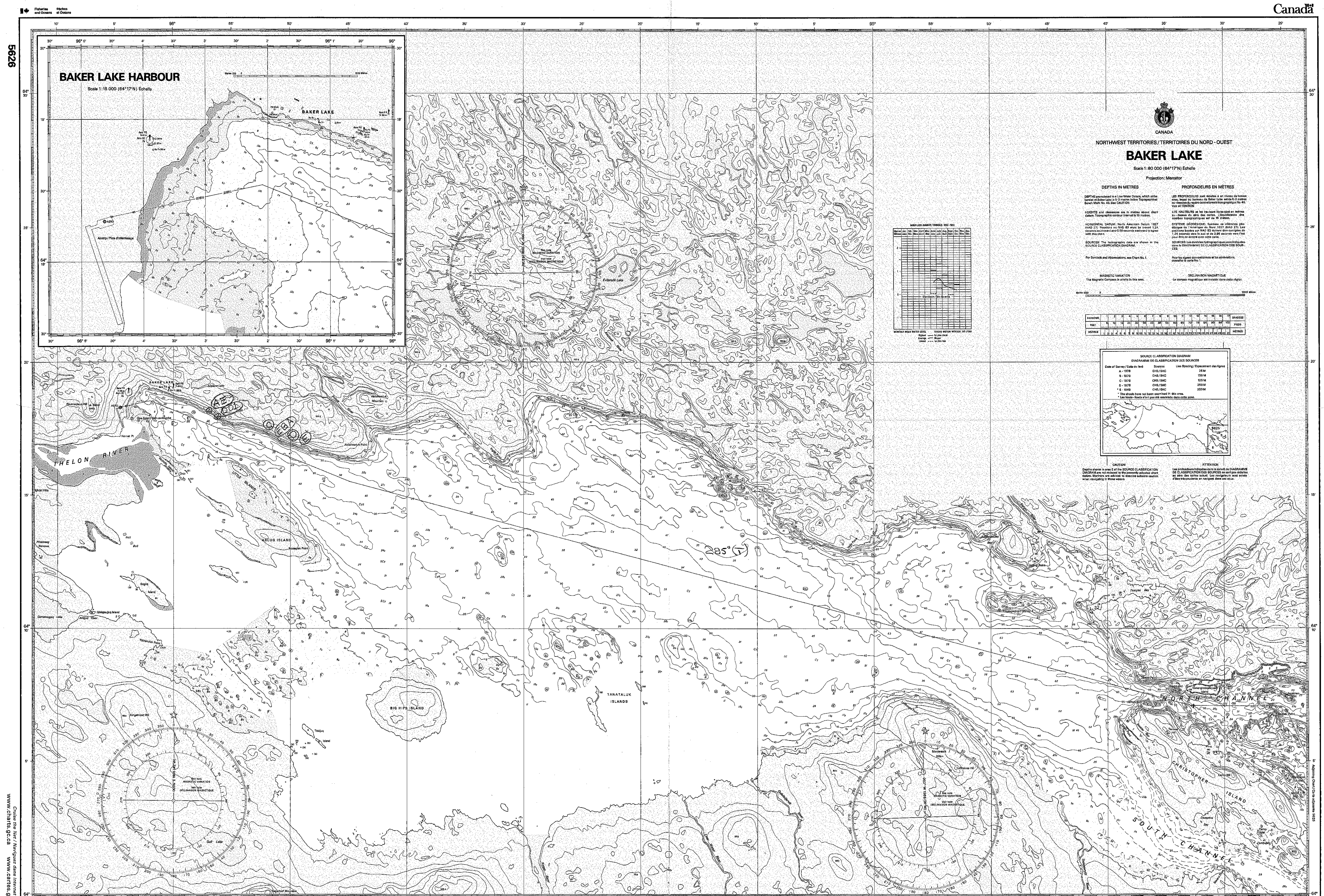
METRIC/MÉTRIQUE

Northwest Territories/Territoires du Nord-Ouest
Chesterfield Inlet
TERROR POINT TO/AU SCHOONER HARBOUR

5624



Canada
5625
NORTH CHANNEL
BAKER LAKE
CHRISTOPHER ISLAND
RIO ISLAND
SHELL ISLAND
SOUTH CHANNEL
BOWELL ISLANDS
CHESTERFIELD INLET
STRIVEWELL NARROWS
REGINA NARROWS AND/ET POLARIS NARROWS
Scale 1:20 000 (63°30'00"N) Échelle
PILON ISLAND
BANNERMAN ISLAND
ICE HUNTER ROCK TO/À CHESTERFIELD NARROWS
Scale 1:20 000 (63°30'00"N) Échelle
CANADA
NORTHWEST TERRITORIES/TERRITOIRES DU NORD-OUEST
CHESTERFIELD INLET
SCHOONER HARBOUR TO/À BAKER LAKE
Scale 1:40 000 (63°30'N) Échelle
Projection : Mercator
DEPTHS are in metres and from Schooner Harbour to Baker Lake are reduced to Lowest Normal Tide which at Norton Island is 1.4 metres below Mean Water Level. In Baker Lake depths are reduced to a Low Water Datum which at the hamlet of Baker Lake is 5.3 metres below Topographical Bench Mark No. 45.
LES PROFONDEURS sont en mètres et de Schooner Harbour jusqu' à Baker Lake sont réduites à la marée normale la plus basse, laquelle à Norton Island est de 1.4 mètre au-dessous du niveau moyen de l'eau. À Baker Lake les profondeurs sont réduites à un niveau de basses eaux, lequel au hameau de Baker Lake est de 5.3 mètres au-dessous du repère de nivellement topographique No. 45.
ELEVATIONS and spot elevations are in metres above Higher High Water, Large Tide. Underlined figures on drying banks or in brackets against drying rocks are in metres above chart datum.
LES ALTITUDES et les points cotés sont en mètres au-dessus de la pleine mer supérieure, grande marée. Les chiffres soulignés sur les bancs asséchants ou entre parenthèses contre les rochers qui découvrent sont en mètres au-dessus du zéro des cartes.
HORIZONTAL DATUM: North American Datum 1927 (NAD 27). Positions on NAD 83 must be moved 1.24 seconds southward and 0.41 seconds eastward to agree with this chart.
SYSTÈME GÉODÉSIQUE: Système de référence géodésique de l'Amérique du Nord 1927 (NAD 27). Les positions basées sur NAD 83 doivent être corrigées de 1.24 seconde vers le sud et de 0.41 seconde vers l'est pour être en accord avec cette carte.
SOURCES: The hydrographic data are shown in the SOURCE CLASSIFICATION DIAGRAM.
SOURCES: Les données hydrographiques sont indiquées dans le DIAGRAMME DE CLASSIFICATION DES SOURCES.
For Symbols and Abbreviations, see Chart No. 1.
Pour les signes conventionnels et les abréviations, consulter la carte No. 1.
TIDAL INFORMATION/RENSEIGNEMENTS SUR LES MARÉES
LOCATION / LOCALITÉ | Elevation above Chart Datum/Altitude au-dessus du zéro des cartes
Large Tide/Grande marée HHW/PMS LLW/BMI | Mean Tide/Marée moyenne HHW/PMS LLW/BMI | Mean Water Level / Niveau moyen de l'eau
Norton Island 2.7 0.2 2.4 0.3 1.4 (metres/mètres)
CURRENTS
The arrows indicate the approximate main flood and ebb directions. Rates given are for mean tide. The direction and rate of the tidal currents can vary substantially with the stage and range of the tide.
COURANTS
Les flèches indiquent les directions principales approximatives du flot et du jusant. Les vitesses indiquées sont pour la marée moyenne. La direction et la vitesse des courants de marées peuvent varier considérablement dépendant du marnage et du stade de la marée.
BLUE TINT
On this chart unsurveyed water areas and areas with depths of 5 metres or less are tinted full blue.
TEINTE BLEUE
Les zones non hydrographiées et les zones de profondeurs de 5 mètres ou moins sont teintées en bleu plein.
METRIC/MÉTRIQUE
PUBLISHED BY THE CANADIAN HYDROGRAPHIC SERVICE
PUBLIÉE PAR LE SERVICE HYDROGRAPHIQUE DU CANADA
Nautical Charts Protect Lives, Property and the Marine Environment
Les cartes marines protègent la vie, la propriété et l'environnement marin
Northwest Territories/Territoires du Nord-Ouest
Chesterfield Inlet
SCHOONER HARBOUR TO/À BAKER LAKE
5625



NEW CHART / CARTE NOUVELLE AUG. / AOÛT 8 1986

NOTICES TO MARINERS / AVIS AUX NAVIGATEURS 1993 049

PUBLISHED BY THE CANADIAN HYDROGRAPHIC SERVICE
PUBLIÉE PAR LE SERVICE HYDROGRAPHIQUE DU CANADA

Nautical Charts Protect Lives, Property and the Marine Environment
Les cartes marines protègent la vie, la propriété et l'environnement marin

METRIC / MÉTRIQUE

Northwest Territories / Territoires du Nord - Ouest
BAKER LAKE

5626

ATTACHMENT B – RISK ASSESSMENT METHODOLOGY

1. Hazard/Risk Definition

- **Hazard:** A condition with the potential to cause personal injury or death, property damage or mission degradation
- **Risk:** An expression of possible loss in terms of severity and probability.

2. Operations Analysis

- The Study of Marine Transportation Options for the High Volume Sealift was used as a basis for the risk screening.
- Marine operations were broken down into various scenarios based on the logistics plan.

3. Hazard Identification

- A tug master, with experience in the Chesterfield Inlet/Baker Lake tug barge operation participated in the hazard identification and risk rating
- Free input technique was used to identify and evaluate hazards

4. Root Causal Analysis of Hazards

- Preliminary Hazard Analysis (PHA)
- Root causes were targeted versus symptoms

Hazard Severity Rating

- **Severity 1 -** Probably will not cause injury to personnel or harm to the environment. Commercial loss is less than $10,000.

- **Severity 2 –** Exposes personnel to minor reportable injury less not requiring lost time. Mitigated by the use of control procedures, Personal Protection Equipment and training. Minor exposure to environmental damage mitigated by procedures and Emergency Response Plans. Commercial loss exposure of $10,000 to $50,000.

- **Severity 3 –** Exposes personnel to modest injury including lost time of 3 days or over. Mitigated by the use of control procedures, Personal Protection Equipment and training. Modest exposure to environmental damage mitigated by the use of procedures and Emergency Response Plans. Commercial loss exposure of $50,000 to $250,000.

- **Severity 4 -** Exposes personnel to serious injury, serious harm to the environment or commercial loss of $250,000 to $1,000,000.

Severity 5 – Exposes personnel to severe injury or death, severe harm to the environment or commercial loss of $1,000,000 or greater**.**

5. **Probability Ranking**

- **Highly Unlikely –**Improbable or remote under any circumstances. 0 - 10% chance of happening.

- **Unlikely –** Unlikely under normal conditions. Has been planned for and may be possible. 11 - 40% chance of happening

- **Possible –** Known to have occurred in the past. 41 - 60% chance of happening.

- **Likely –** Likely the risk will occur. 61 – 90% chance of happening.

- **Probable –** Very likely to happen. 91 – 100% chance of happening.

Severity	Probability of Occurrence				
	Highly Unlikely	Unlikely	Possible	Likely	Probable
	1	2	3	4	5
1	1	2	3	4	5
2	2	4	6	8	10
3	3	6	9	12	15
4	4	8	12	16	20
5	5	10	15	20	25
	Risk levels				

6. Risk Levels

- Level 1 – 3. Low Risk. Acceptable Risk no controls required. Negligible potential for harm to the well being of people, the environment and/or the commercial interests of Areva. Mitigation controls not required.

- Level 4 – 6. Low to Moderate Risk. Acceptable Risk with controls. Minor potential for harm to the well being of people, the environment and/or the commercial interests of Areva. Mitigated by providing hazard specific training and by investigating engineering controls to minimize reliance on procedures and Personal Protection Equipment.

- Level 8 – 10. Moderate Risk. Acceptable Risk with Stringent Controls. Moderate potential for harm to the well being of people, the environment and/or the commercial interests of Areva. Mitigation measures include the examination the areas of exposure in the process. Agree on a mitigation plan and implementation time table.

- Level 12 - 25 Unacceptable Risk. High potential for harm to the well being of people, the environment and/or the commercial interests of Areva. Work must be stopped and immediate action must be taken to reduce the risk to an acceptable level. Mitigation Controls are mandatory.

7. Assess Probability

- Probability is expressed in descriptive or quantitative terms
- Experience data was used wherever possible
- Uncertainty is acknowledged where appropriate

8. Complete Hazard/Risk Assessment

- Potential Mitigation Measures are listed for each risk
- An experienced Tug Master provided operator input
- Mitigation measures were examined for conflict
- Mitigation effects were examined and risks were re-evaluated after mitigation

ATTACHMENT C – RISK ASSESSMENT RESULTS

ACTIVITY: 1. BARGE MOBILISATION DRY CARGO								
Scenario "A": One standard tug tows two standard single hull barges. Load containers in southern port and mobilise direct to Baker Lake								
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Labour Unrest delays loading	3	3	**9**	• Confirm labour status prior to loading • Prepare contingency plans for alternate load ports	3	2	**6**
2	Containers get damaged or washed overboard in heavy weather	3	3	**9**	• Fit Container locks to barges • Reduce stacking by one level for ocean voyage • Fit side frames on barges • Slow tow speed in heavy weather	3	2	**6**
3	Barges get delayed due to weather	3	4	**12**	• Make allowance for delays in estimate	2	4	**8**
4	Barge tow line parts due to bad weather	2	3	**6**	• Install emergency tow line on barges • Slow tow speed in heavy weather	2	2	**4**
5	Tug or Barge grounds in Chesterfield inlet due to Navigation or Manoeuvring error	4	3	**12**	• Provide marine simulator training including bridge resource management • Improve fixed aids to Navigation, i.e. lighted range markers • Install channel buoys • Use Electronic Charts • Use Marine Simulator Model of passage to design operating procedures • Monitor adherence to procedures and performance. • Provide DGPS cover for this area	4	2	**8**
6	Tug or Barge grounds in Chesterfield inlet passage due to mechanical failure	4	3	**12**	• Design tug with 100% redundancy for critical systems • Provide Marine Simulator Training for Contingencies • Use Marine Simulator to design operating procedures • Use predictive maintenance systems	4	2	**8**
7	Tug/ Barge grounds in Chesterfield Narrows due to Navigation or Manoeuvring error	4	4*	**16**	• See Mitigation Controls Hazard Item 5	4	3	**12****
8	Tug/ Barge grounds in Chesterfield Narrows due to mechanical failure	4	3	**12**	• See Mitigation Controls Hazard Item 6	4	2	**8**
9	Tug/ Barge collides or grounds due to conflicting traffic	4	4*	**16**	• Install AIS on all tugs • Establish notification protocol and vessel scheduling information for all operators	4	2	**8**
10	Tug encounters ice and is severely damaged or sinks	4	2	**8**	• Sail tugs/barges to arrive in open water • Slow speed to avoid damage	3	1	**3**
11	Barge encounters ice and is severely damaged or sinks	4	2	**8**	• Sail tugs/barges to arrive in open water • Slow speed to avoid damage	3	1	**3**
12	Tow lines foul Tandem tow	4***	3	**12**	• Secure barges together for Chesterfield Inlet passage, not recommended for Narrows passage	4	3	**12****

* Note: A standard tug towing two barges is less manoeuvrable than an ATB Tug pushing one barge and towing the second barge.
**Note: Mitigation Controls do not reduce Risk level to an acceptable level. Passage of tug with two barges in tow through the Chesterfield Narrows is considered to carry unacceptable risk.
***Note High severity level if incident occurs in Chesterfield Inlet or the Narrows

ACTIVITY: 1. BARGE MOBILISATION DRY CARGO								
Scenario "B": One standard tug tows two standard single hull barges. Load containers in southern port and mobilises to Helicopter Island. One Barge is dropped at an anchorage at Helicopter Island and the tug then proceeds through the Chesterfield Narrows with one barge to Baker Lake.								
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Labour Unrest delays loading	3	3	**9**	• Confirm labour status prior to loading • Prepare contingency plans for alternate load ports	3	2	**6**
2	Containers get damaged or washed overboard in heavy weather	3	3	**9**	• Fit Container locks to barges • Reduce stacking by one level for ocean voyage • Fit side frames on barges • Slow tow speed in heavy weather	3	2	**6**
3	Barges delayed due to weather	3	4	**12**	• Make allowance for delays in estimate	2	4	**8**
4	Barge tow line parts due to bad weather	2	3	**6**	• Install emergency tow line on barges • Slow tow speed in heavy weather	2	2	**4**
5	Crew members injured during anchor operation at Helo Island	3	4	**12**	• Use PPE and safe work procedures • Use pre installed anchor systems	3	3	**9**
6	Tug or Barge grounds in Chesterfield inlet due to Navigation or Manoeuvring error	4	3	**12**	• Provide marine simulator training including bridge resource management • Improve fixed aids to Navigation, i.e. lighted range markers • Install channel buoys • Use Electronic Charts • Use Marine Simulator Model of passage to design operating procedures • Monitor adherence to procedures and performance. • Provide DGPS cover for this area	4	2	**8**
7	Tug or Barge grounds in Chesterfield inlet passage due to mechanical failure	4	3	**12**	• Design tug with 100% redundancy for critical systems • Provide Marine Simulator Training for Contingencies • Use Marine Simulator to design operating procedures • Use predictive maintenance systems	4	2	**8**
8	Tug/ Barge grounds in Chesterfield Narrows due to Navigation or Manoeuvring error	4	2	**8**	• See Mitigation Controls Hazard Item 6	4	1	**4**
9	Tug/ Barge grounds in Chesterfield Narrows due to mechanical failure	4	3	**12**	• See Mitigation Controls Hazard Item 7	4	2	**8**
10	Tug/ Barge collides or grounds due to conflicting traffic	4	4*	**16**	• Install AIS on all tugs • Establish notification protocol and vessel scheduling information for all operators	4	2	**8**
11	Tug encounters ice and is severely damaged or sinks	4	2	**8**	• Sail tugs/barges to arrive in open water • Slow speed to avoid damage	3	1	**3**
12	Barge encounters ice and is severely damaged or sinks	4	2	**8**	• Sail tugs/barges to arrive in open water • Slow speed to avoid damage	3	1	**3**
13	Tow lines foul Tandem tow	4	3	**12**	• Secure barges together for Chesterfield Inlet passage, drop one barge for Narrows passage	4	2	**8**

ACTIVITY: 1. BARGE MOBILISATION DRY CARGO								
Scenario "C": One Articulating tug with two ATB double hull barges, one barge being pushed in the notch and the second barge is towed. Load containers in southern port and mobilise direct to Baker Lake								
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Labour Unrest delays loading	3	3	**9**	• Confirm labour status prior to loading • Prepare contingency plans for alternate load ports	3	2	**6**
2	Containers get damaged or washed overboard in heavy weather	3	3	**9**	• Fit Container locks to barges • Reduce stacking by one level for ocean voyage • Fit side frames on barges • Slow tow speed	3	2	**6**
3	Barges get delayed due to weather	2	3	**6**	• Make allowance for delays in estimate	2	2	**4**
4	Barge tow line parts due to bad weather	2	3	**6**	• Install emergency tow line on barges	2	2	**4**
5	Crew members injured during anchor operation at Helo Island	0	0	**0**	• Integrated Tug Barge (ITB) system provides sufficient manoeuvrability to move two barges safely through Narrows	0	0	**0**
6	Tug or Barge grounds in Chesterfield inlet due to Navigation or Manoeuvring error	4	2*	**8**	• Provide marine simulator training including bridge resource management • Improve fixed aids to Navigation, i.e. lighted range markers • Install channel buoys • Use Electronic Charts • Use Marine Simulator Model of passage to design operating procedures • Monitor adherence to procedures and performance. • Provide DGPS coverage for this area	4	1	**4**
7	Tug or Barge grounds in Chesterfield inlet due to mechanical failure	4	3	**12**	• Design tug with 100% redundancy for critical systems • Provide Marine Simulator Training for Contingencies • Use Marine Simulator to design operating procedures • Use predictive maintenance systems	3	2	**6**
8	Tug/ Barge grounds in Chesterfield Narrows due to Navigation or Manoeuvring error	4	3*	**12**	• See Mitigation Controls Hazard Item 6	4	2	**8**
9	Tug/ Barge grounds in Chesterfield Narrows due to mechanical failure	4	3	**12**	• See Mitigation Controls Hazard Item 7	4	2	**8**
10	Tug/ Barge collides with conflicting traffic	4	2*	**8**	• Install AIS on all tugs • Provide notification protocol and scheduling information to all operators	4	1	**4**
11	Tug encounters ice and is severely damaged or sinks	2	1**	**2**	• Sail tugs/barges to arrive in open water • Slow speed to avoid damage	2	1	**2**
12	Barge encounters ice and is severely damaged or sinks	4	2	**8**	• Sail tugs/barges to arrive in open water • Slow speed to avoid damage	3	1	**3**

* Note ATB system provides high degree of manoeuvrability
**Note: ATB tug is protected by barge

ACTIVITY: 2. CONTAINER SHIP TO CHURCHILL								
Scenario "A": Load Container ship at Southern Port and deliver containers to Churchill								
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Labour unrest delays loading or discharging	3	3	**9**	• Confirm labour status prior to loading or discharging • Prepare contingency plans for alternate load ports	3	2	**6**
2	Containership runs aground in Churchill due to Navigation or Manoeuvring error	3	2	**6**	• Use Marine Simulator Training for Pilots	3	1	**3**
3	Stevedores injured during unloading process	2	3	**6**	• Implement formal Safety Management System • Use trained personnel • Use correct PPE	2	2	**4**
4	Containership catches fire in Churchill	4	2	**8**	• Use IACS Classed vessels • Carry out pre contract inspections of vessels	4	1	**4**
5	Containership delayed due to weather	2	3	**6**	• Use weather routing • Allow for weather delays in contingency planning	2	2	**4**
6	Mechanical breakdown of unloading equipment	2	3	**6**	• Implement Planned maintenance system	2	2	**4**
7	Canadian Container ship not available	5	5	**25**	• Import Foreign Flagged vessel • Load cargo in foreign port use foreign flag vessel • Use rail system to move freight	2	1	**2**
8	Containers damaged by heavy weather in transit	3	3	**9**	• Critical cargo loaded in protected area on vessel	3	1	**3**
9	Vessel encounters ice and is severely damaged or sinks	5	2	**10**	• Do not sail vessel until route is ice free	5	1	**5**
10	Delays due to insufficient number of pilots to navigate ships in and out of Churchill	3	4*	12	• Train Additional Pilots • Obtain exemptions for Tugs and barges	3	1	**3**
11	Mooring Lines Part	3	3	9	• Watch procedures to include close attention to line tension	3	1	**3**

*Note: Currently there is only one pilot stationed at the port of Churchill. Due to sensitive environment, compulsory pilotage may be required for barges.

ACTIVITY: 3. BARGE CONTAINERS FROM CHURCHILL TO BAKER LAKE								
Scenario "A": One standard tug tows two standard single hull barges. Load containers in Churchill and deliver to Baker Lake								
		Before controls				After controls		
Hazard Id No.	Hazard	Severity	Probability	Risk Level	Mitigation Controls	Severity	Probability	Risk Level
1	Labour Unrest delays loading	3	2	6	• Confirm labour status prior to loading	3	1	3
2	Containers get damaged or washed overboard in heavy weather	3	3	9	• Fit Container locks to barges • Reduce stacking by one level for ocean voyage • Fit side frames on barges • Slow tow speed in heavy weather	3	2	6
3	Barges delayed due to weather	3	4	12	• Make allowance for delays in estimate	2	4	8
4	Barge tow line parts due to bad weather	2	3	6	• Install emergency tow line on barges • Slow tow speed	2	2	4
5	Crew members injured during anchor operation at Helo Island	3	4	12	• Use PPE and safe work procedures • Use pre installed anchor systems	3	3	9
6	Tug or Barge grounds in Chesterfield inlet due to Navigation or Manoeuvring error	4	3	12	• Provide marine simulator training including bridge resource management • Improve fixed aids to Navigation, i.e. lighted range markers • Install channel buoys • Use Electronic Charts • Use Marine Simulator Model of passage to design operating procedures • Monitor adherence to procedures and performance. • Provide DGPS cover for this area	4	2	8
7	Tug or Barge grounds in Chesterfield inlet passage due to mechanical failure	4	3	12	• Design tug with 100% redundancy for critical systems • Provide Marine Simulator Training for Contingencies • Use Marine Simulator to design operating procedures • Use predictive maintenance systems	4	2	8
8	Tug/Barge grounds in Chesterfield Narrows due to Navigation or Manoeuvring error	4	4*	16	• See Mitigation Controls Hazard Item 6	4	3	12**
9	Tug/ Barge grounds in Chesterfield Narrows due to mechanical failure	4	3	12	• See Mitigation Controls Hazard Item 6	4	2	8
10	Tug/Barge collides or grounds due to conflicting traffic	4	4*	16	• Install AIS on all tugs • Establish notification protocol and vessel scheduling information for all operators	4	2	8
11	Tug sinks after collision	5	1	5	• Develop Emergency Response plan to rescue survivors and limit environmental damage	5	1	5
12	Barge sinks after collision	5	2	10	• Develop Emergency Response plan to limit environmental damage	5	2	10***
13	Tow lines get fouled	4	3	12	• Secure barges together for Chesterfield Inlet passage, not practical for Narrows passage	4	3	12***
14	Mooring lines part	3	3	9	• Assign watchman to tend lines	3	1	3

* Note: A standard tug towing two barges is less manoeuvrable than an ATB Tug pushing one barge and towing the second barge.

ACTIVITY: 3. BARGE CONTAINERS FROM CHURCHILL TO BAKER LAKE								
Scenario "B": One standard tug tows two standard single hull barges. Load containers in Churchill and mobilises to Helicopter Island. One Barge is dropped at an anchorage at Helicopter Island and the tug then proceeds through the Chesterfield Narrows with one barge to Baker Lake.								
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Labour Unrest delays loading	3	2	**6**	• Confirm labour status prior to loading	3	1	**3**
2	Containers get damaged or washed overboard in heavy weather	3	3	**9**	• Fit Container locks to barges • Reduce stacking by one level for ocean voyage • Fit side frames on barges • Slow tow speed	3	2	**6**
3	Barges delayed due to weather	3	4	**12**	• Make allowance for delays in estimate	2	4	**8**
4	Barge tow line parts due to bad weather	2	3	**6**	• Install emergency tow line on barges • Slow tow speed	2	2	**4**
5	Crew members injured during anchor operation at Helo Island	3	4	**12**	• Use PPE and safe work procedures • Use pre installed anchor systems	3	3	**9**
6	Tug or Barge grounds in Chesterfield inlet due to Navigation or Manoeuvring error	4	3	**12**	• Provide marine simulator training including bridge resource management • Improve fixed aids to Navigation, i.e. lighted range markers • Install channel buoys • Use Electronic Charts • Use Marine Simulator Model of passage to design operating procedures • Monitor adherence to procedures and performance. • Provide DGPS cover for this area	4	2	**8**
7	Tug or Barge grounds in Chesterfield inlet passage due to mechanical failure	4	3	**12**	• Design tug with 100% redundancy for critical systems • Provide Marine Simulator Training for Contingencies • Use Marine Simulator to design operating procedures • Use predictive maintenance systems	4	2	**8**
8	Tug/ Barge grounds in Chesterfield Narrows due to Navigation or Manoeuvring error	4	3*	**12**	• See Mitigation Controls Hazard Item 6	4	2	**8**
9	Tug/ Barge grounds in Chesterfield Narrows due to mechanical failure	4	3	**12**	• See Mitigation Controls Hazard Item 7	4	2	**8**
10	Tug/ Barge collides or grounds due to conflicting traffic	4	3*	**12**	• Install AIS on all tugs • Establish notification protocol and vessel scheduling information for all operators	4	2	**8**
11	Tow lines get fouled	4	3	**12**	• Secure barges together for Chesterfield Inlet passage, one barge dropped before Narrows passage	4	2	**8**
12	Mooring lines part	3	3	**9**	• Assign watchman to tend lines	3	1	**3**

* Note: A standard tug towing one similar in manoeuvrability to an ATB Tug pushing one barge and towing the second barge.

ACTIVITY: 3. BARGE CONTAINERS FROM CHURCHILL TO BAKER LAKE								
Scenario "C": One standard tug tows one single hull barge, load containers in Churchill and deliver to Baker Lake								
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Labour Unrest delays loading/discharging	3	2	**6**	• Confirm labour status prior to loading	3	1	**3**
2	Containers get damaged or washed overboard in heavy weather	3	3	**9**	• Fit Container locks to barges • Reduce stacking by one level for ocean voyage • Fit side frames on barges • Slow tow speed in heavy weather	3	2	**6**
3	Barges get delayed due to weather	2	3	**6**	• Make allowance for delays in estimate	2	2	**4**
4	Barge tow line parts due to bad weather	2	3	**6**	• Install emergency tow line on barges • Slow tow speed in heavy weather	2	2	**4**
5	Tug or Barge grounds in Chesterfield inlet due to Navigation or Manoeuvring error	4	2	**8**	• Provide marine simulator training including bridge resource management • Improve fixed aids to Navigation, i.e. lighted range markers • Install channel buoys • Use Electronic Charts • Use Marine Simulator Model of passage to design operating procedures • Monitor adherence to procedures and performance. • Provide DGPS coverage for this area	4	1	**4**
6	Tug or Barge grounds in Chesterfield inlet due to mechanical failure	4	3	**12**	• Design tug with 100% redundancy for critical systems • Provide Marine Simulator Training for Contingencies • Use Marine Simulator to design operating procedures • Use predictive maintenance systems	4	2	**8**
7	Tug/ Barge grounds in Chesterfield Narrows due to Navigation or Manoeuvring error	4	3	**12**	• See Mitigation Controls Hazard Item 6	4	2	**8**
8	Tug/ Barge grounds in Chesterfield Narrows due to mechanical failure	4	3	**12**	• See Mitigation Controls Hazard Item 7	4	2	**8**
9	Tug/ Barge collides with conflicting traffic	4	2	**8**	• Install AIS on all tugs • Provide notification protocol and scheduling information to all operators	4	1	**4**
10	Mooring lines part	3	3	**9**	• Assign watchman to tend lines	3	1	**3**
11	Tug has mechanical failure/accident lost for season	4	3	**12**	• Have additional tug for back up • Charter in replacement	2	3	**6**
12	Barge is damaged and lost for season	4	3	**12**	• Additional barge as back up • Barge repair facility in Baker Lake area	2	3	**6**

ACTIVITY: 3. BARGE CONTAINERS FROM CHURCHILL TO BAKER LAKE								
Scenario "D": One Articulating tug with two ATB double hull barges, one barge being pushed in the notch and the second barge is towed. Load containers in Churchill and deliver to Baker Lake								
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Labour Unrest delays loading/discharging	3	2	**6**	• Confirm labour status prior to loading	3	1	**3**
2	Containers get damaged or washed overboard in heavy weather	3	3	**9**	• Fit Container locks to barges • Reduce stacking by one level for ocean voyage • Fit side frames on barges • Slow tow speed	3	2	**6**
3	Barges get delayed due to weather	2	3	**6**	• Make allowance for delays in estimate	2	2	**4**
4	Barge tow line parts due to bad weather	2	3	**6**	• Install emergency tow line on barges	2	2	**4**
5	Crew members injured during anchor operation at Helo Island	0	0	**0**	• Integrated Tug Barge (ITB) system provides sufficient manoeuvrability to move two barges safely through Narrows	0	0	**0**
6	Tug or Barge grounds in Chesterfield inlet due to Navigation or Manoeuvring error	4	2*	**8**	• Provide marine simulator training including bridge resource management • Improve fixed aids to Navigation, i.e. lighted range markers • Install channel buoys • Use Electronic Charts • Use Marine Simulator Model of passage to design operating procedures • Monitor adherence to procedures and performance. • Provide DGPS coverage for this area	4	1	**4**
7	Tug or Barge grounds in Chesterfield inlet due to mechanical failure	4	3	**12**	• Design tug with 100% redundancy for critical systems • Provide Marine Simulator Training for Contingencies • Use Marine Simulator to design operating procedures • Use predictive maintenance systems	4	2	**8**
8	Tug/ Barge grounds in Chesterfield Narrows due to Navigation or Manoeuvring error	4	3*	**12**	• See Mitigation Controls Hazard Item 6	4	2	**8**
9	Tug/ Barge grounds in Chesterfield Narrows due to mechanical failure	4	3	**12**	• See Mitigation Controls Hazard Item 7	4	2	**8**
10	Tug/ Barge collides with conflicting traffic	4	2*	**8**	• Install AIS on all tugs • Provide notification protocol and scheduling information to all operators	4	1	**4**
11	Mooring lines part	3	3	**9**	• Assign watchman to tend lines	3	1	**3**

* Note ATB system provides high degree of ship-like manoeuvrability and sea keeping

ACTIVITY: 3. BARGE CONTAINERS FROM CHURCHILL TO BAKER LAKE								
Scenario "E": One Articulating tug with one ATB double hull barge being pushed in the notch. Load containers in Churchill and deliver to Baker Lake								
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Labour Unrest delays loading/discharging	3	2	**6**	• Confirm labour status prior to loading	3	1	**3**
2	Containers get damaged or washed overboard in heavy weather	3	2	**6**	• Fit Container locks to barges • Reduce stacking by one level for ocean voyage • Fit side frames on barges • Slow tow speed	3	1	**3**
3	Barges get delayed due to weather	2	2	**4**	• Make allowance for delays in estimate	2	2	**4**
6	Tug or Barge grounds in Chesterfield inlet due to Navigation or Manoeuvring error	4	2*	**8**	• Provide marine simulator training including bridge resource management • Improve fixed aids to Navigation, i.e. lighted range markers • Install channel buoys • Use Electronic Charts • Use Marine Simulator Model of passage to design operating procedures • Monitor adherence to procedures and performance. • Provide DGPS coverage for this area	4	1	**4**
7	Tug or Barge grounds in Chesterfield inlet due to mechanical failure	4	3	**12**	• Design tug with 100% redundancy for critical systems • Provide Marine Simulator Training for Contingencies • Use Marine Simulator to design operating procedures • Use predictive maintenance systems	4	2	**8**
8	Tug/ Barge grounds in Chesterfield Narrows due to Navigation or Manoeuvring error	4	2**	**8**	• See Mitigation Controls Hazard Item 6	4	1	**4**
9	Tug/ Barge grounds in Chesterfield Narrows due to mechanical failure	4	2*	**8**	• See Mitigation Controls Hazard Item 7	4	1	**4**
10	Tug/ Barge collides with conflicting traffic	4	2*	**8**	• Install AIS on all tugs • Provide notification protocol and scheduling information to all operators	4	1	**4**
11	Mooring lines part	3	3	**9**	• Assign watchman to tend lines	3	1	**3**
12	Tug has mechanical failure/accident lost for season	4	3	**15**	• Have additional ATB tug for back up	2	3	**6**
13	Barge is damaged and lost for season	4	3	**15**	• Use landing craft type vessels as back up • Additional ATB barge as back up • Barge repair facility in Baker Lake area	2	3	**6**

*Note: The probability of mechanical failure is reduced due to the limited time exposure
**Note: The ATB Tug with one barge is very manoeuvrable

ACTIVITY: 4. BARGE EMPTY CONTAINERS FROM BAKER LAKE TO CHURCHILL								
Scenario "A": One standard tug tows two standard towed single hull barges. Load empty containers in Baker Lake and delivers them to Churchill								
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Containers get damaged or washed overboard in heavy weather	2	3	**6**	• Fit Container locks to barges • Reduce stacking by one level for bad weather • Fit side frames on barges • Slow tow speed	2	1	**3**
2	Tug or Barge grounds in Chesterfield inlet due to Navigation or Manoeuvring error	4	3	**12**	• Provide marine simulator training including bridge resource management • Improve fixed aids to Navigation • Use Electronic Charts • Use Marine Simulator Model of passage plan to design operating procedures • Monitor adherence to procedures and performance.	4	2	**8**
3	Tug or Barge grounds in Chesterfield Narrows due to Navigation or Manoeuvring error	4	4	**16**	• Provide marine simulator training • Improve fixed aids to Navigation • Use Electronic Charts • Use Marine Simulator Model of passage plan to design operating procedures • Monitor adherence to procedures and performance.	4	3*	**12***
4	Tug or Barge grounds in Chesterfield inlet or Narrows due to mechanical failure	4	3	**12**	• Design tug with 100% redundancy for critical systems • Provide Marine Simulator Training for Contingencies • Use Marine Simulator to design operating procedures • Use predictive maintenance systems	4	2	**8**
5	Grounded Barge blocks channel at narrows	5	3	**15**	• Emergency response plan to recover barge and cargo	3	3	**9**
6	Mooring lines part	3	3	**9**	• Assign watchman to tend lines	3	1	**3**
7	Tow lines get fouled	4	3	**12**	• Secure barges together for Chesterfield Inlet passage, not recommended for Narrows passage	4	3	**12***

*Note: Mitigation Controls do not reduce Risk level to an acceptable level. Passage of tug with two barges in tow through the Chesterfield Narrows is considered to carry unacceptable risk.

ACTIVITY: 4. BARGE EMPTY CONTAINERS FROM BAKER LAKE TO CHURCHILL								
Scenario "B": One standard tug and one standard towed single hull barge loads empty containers at Baker Lake and delivers to Churchill. *								
		Before controls				**After controls**		
Hazard Id No.	**Hazard**	**Severity**	**Probability**	**Risk Level**	**Mitigation Controls**	**Severity**	**Probability**	**Risk Level**
1	Containers get damaged or washed overboard in heavy weather	2	3	**6**	• Fit Container locks to barges • Reduce stacking by one level for bad weather • Fit side frames on barges • Slow tow speed	2	1	**3**
2	Tug or Barge grounds in Chesterfield inlet due to Navigation or Manoeuvring error	4	3	**12**	• Provide marine simulator training including bridge resource management • Improve fixed aids to Navigation • Use Electronic Charts • Use Marine Simulator Model of passage plan to design operating procedures • Monitor adherence to procedures and performance.	4	2	**8**
3	Tug or Barge grounds in Chesterfield Narrows due to Navigation or Manoeuvring error	4	3	**12**	• Provide marine simulator training • Improve fixed aids to Navigation • Use Electronic Charts • Use Marine Simulator Model of passage plan to design operating procedures • Monitor adherence to procedures and performance.	4	2	**8**
4	Tug or Barge grounds in Chesterfield inlet or Narrows due to mechanical failure	4	3	**12**	• Design tug with 100% redundancy for critical systems • Provide Marine Simulator Training for Contingencies • Use Marine Simulator to design operating procedures • Use predictive maintenance systems	4	2	**8**
5	Grounded Barge blocks channel at narrows	5	3	**15**	• Emergency response plan to recover barge and cargo	3	3	**9**
6	Mooring lines part	3	3	**9**	• Assign watchman to tend lines • Install emergency tow line	3	1	**3**

***** Note: There are no anchorages identified on the west side of the Chesterfield Narrows

ACTIVITY: 4. BARGE EMPTY CONTAINERS FROM BAKER LAKE TO CHURCHILL								
Scenario "C": One ATB tug tows two ATB double hull barges. Load empty containers in Baker Lake and delivers them to Churchill								
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Containers get damaged or washed overboard in heavy weather	2	2	**4**	• Fit Container locks to barges • Reduce stacking by one level for bad weather • Fit side frames on barges • Slow tow speed in heavy weather	2	1	**2**
2	Tug or Barge grounds in Chesterfield inlet or Narrows due to Navigation or manoeuvring error	4	3	**12**	• Provide marine simulator training including bridge resource management • Improve fixed aids to Navigation • Use Electronic Charts • Use Marine Simulator Model of passage plan to design operating procedures • Monitor adherence to procedures and performance.	4	1	**4**
3	Tug or Barge grounds in Chesterfield inlet or Narrows due to mechanical failure	4	3	**12**	• Design tug with 100% redundancy for critical systems • Provide Marine Simulator Training for Contingencies • Use Marine Simulator to design operating procedures • Use predictive maintenance systems	4	2	**8**
4	Tug has mechanical failure/accident lost for season	5	2	**10**	• Use landing craft type vessels as back up • Have additional tug for back up	5	1	**5**
5	Grounded Barge blocks channel at narrows	5	3	**15**	• Emergency response plan to recover barge and cargo • Use double hull barges	5	1	**5**

ACTIVITY: 5. GEARED CARGO VESSEL DELIVERS DRY CARGO TO HELICOPTER ISLAND							
Scenario "A": Scenario "A": Geared cargo vessels load containers in southern ports and proceed to lightering anchorage at Helicopter Island at the western end of Chesterfield Inlet.							
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Labour unrest delays loading or discharging	3	3	**9**	• Confirm labour status prior to loading or discharging • Prepare contingency plans for alternate load ports	3	2	**6**
2	Cargo ship runs aground in Chesterfield Inlet due to navigation error	3	2	**6**	• Use Marine Simulator Training for Navigators • Two navigators on bridge	3	1	**3**
3	Seamen injured during unloading process	2	3	**6**	• Implement formal Safety Management System • Use trained personnel • Use correct PPE	2	2	**4**
4	Cargo ship catches fire at Helicopter Island	4	2	**8**	• Use IACS Classed vessels • Carry out pre contract inspections of vessels	4	1	**4**
5	Cargo ship delayed due to weather	2	3	**6**	• Use weather routing • Allow for weather delays in contingency planning	2	2	**4**
6	Mechanical breakdown of unloading equipment	2	3	**6**	• Implement Planned maintenance system	2	2	**4**
7	Containers damaged by heavy weather in transit	5	3	**9**	• Critical cargo loaded in protected area	3	1	**3**
8	Vessel encounters ice and is severely damaged or sinks	5	2	**10**	• Sail in open water season only • Use ice class vessels	5	1	**5**

ACTIVITY: 5. GEARED CARGO VESSEL DELIVERS DRY CARGO TO HELICOPTER ISLAND								
Scenario "B": Load containers on standard barges at Helicopter Island and deliver to Baker Lake								
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Labour unrest delays loading	3	2	**6**	• Confirm labour status prior to loading	3	1	**3**
2	Containers get damaged or washed overboard in heavy weather	3	3	**9**	• Fit Container locks to barges • Reduce stacking by one level for ocean voyage • Fit side frames on barges Slow tow speed	3	2	**6**
3	Barges get delayed due to weather	3	4	**12**	• Make allowance for delays in estimate	2	4	**8**
4	Barge tow line parts due to bad weather	2	3	**6**	• Install emergency tow line on barges • Slow tow speed	2	2	**4**
5	Crew members injured during anchor operation at Helo Island	3	4	**12**	• Use PPE and safe work procedures • Use pre installed anchor systems	3	3	**9**
6	Tug/ Barge grounds in Chesterfield inlet due to Navigation error	4	3	**12**	• Provide marine simulator training including bridge resource management • Improve fixed aids to Navigation, i.e. lighted range markers • Install channel buoys • Use Electronic Charts • Use Marine Simulator Model of passage to design operating procedures • Monitor adherence to procedures and performance. • Provide differential GPS cover for this area	4	2	**8**
7	Tug/ Barge grounds in Chesterfield inlet due to mechanical failure	4	3	**12**	• Design tug with 100% redundancy for critical systems • Provide Marine Simulator Training for Contingencies • Use Marine Simulator to design operating procedures • Use predictive maintenance systems	4	2	**8**
8	Tug/ Barge grounds in Chesterfield Narrows due to Navigation error	4	3*	**12**	• See Mitigation Controls Hazard Item 6	4	2	**8**
9	Tug/ Barge grounds in Chesterfield Narrows due to mechanical failure	4	3	**12**	• See Mitigation Controls Hazard Item 7 •	4	2	**8**
10	Tug/ Barge collides with conflicting traffic	4	3*	**12**	• Install AIS on all tugs • Establish notification protocol and vessel scheduling information for all operators	4	2	**8**
11	Tug sinks after collision	4	3	**12**	• Secure barges together for Chesterfield Inlet passage, one barge dropped before Narrows passage	4	2	**8**
12	Barge sinks after collision	3	3	**9**	• Assign watchman to tend lines	3	1	**3**
13	Tow lines get fowled	4	3	**12**	• Secure barges together for Chesterfield Inlet passage, not practical for Narrows passage	4	3	**12*****
14	Mooring lines part	3	3	**9**	• Assign watchman to tend lines	3	1	**3**
					•			

ACTIVITY: 5. GEARED CARGO VESSEL DELIVERS DRY CARGO TO HELICOPTER ISLAND								
Scenario "C": Load containers on ATB barges at Helicopter Island and deliver to Baker Lake								
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Labour Unrest delays loading/discharging	3	2	**6**	• Confirm labour status prior to loading	3	1	**3**
2	Containers get damaged or washed overboard in heavy weather	3	2	**6**	• Fit Container locks to barges • Reduce stacking by one level for ocean voyage • Fit side frames on barges • Slow tow speed	3	1	**3**
3	Barges get delayed due to weather	2	2	**4**	• Make allowance for delays in estimate	2	2	**4**
6	Tug or Barge grounds in Chesterfield inlet due to Navigation or Manoeuvring error	4	2	**8**	• Provide marine simulator training including bridge resource management • Improve fixed aids to Navigation, i.e. lighted range markers • Install channel buoys • Use Electronic Charts • Use Marine Simulator Model of passage to design operating procedures • Monitor adherence to procedures and performance. • Provide DGPS coverage for this area	4	1	**4**
7	Tug or Barge grounds in Chesterfield inlet due to mechanical failure	4	3	**12**	• Design tug with 100% redundancy for critical systems • Provide Marine Simulator Training for Contingencies • Use Marine Simulator to design operating procedures • Use predictive maintenance systems	4	2	**8**
8	Tug/ Barge grounds in Chesterfield Narrows due to Navigation or Manoeuvring error	4	2	**8**	• See Mitigation Controls Hazard Item 6	4	1	**4**
9	Tug/ Barge grounds in Chesterfield Narrows due to mechanical failure	4	2	**8**	• See Mitigation Controls Hazard Item 7 •	4	1	**4**
10	Tug/ Barge collides with conflicting traffic	4	2	**8**	• Install AIS on all tugs • Provide notification protocol and scheduling information to all operators	4	1	**4**
11	Mooring lines part	3	3	**9**	• Assign watchman to tend lines	3	1	**3**
12	Tug has mechanical failure/accident lost for season	4	3	**15**	• Have additional ATB tug for back up	2	3	**6**
13	Barge is damaged and lost for season	4	3	**15**	• Use landing craft type vessels as back up • Additional ATB barge as back up • Barge repair facility in Baker Lake area	2	3	**6**
					•			

ACTIVITY: 5. GEARED CARGO VESSEL DELIVERS DRY CARGO TO HELICOPTER ISLAND								
Scenario "D": Load empty containers on ATB barges in Baker Lake and deliver them to cargo vessels at Helicopter Island								
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Containers get damaged or washed overboard in heavy weather	2	2	**4**	• Fit Container locks to barges • Reduce stacking by one level for bad weather • Fit side frames on barges • Slow tow speed in heavy weather	2	1	**2**
2	Tug or Barge grounds in Chesterfield inlet or Narrows due to Navigation or manoeuvring error	4	3	**12**	• Provide marine simulator training including bridge resource management • Improve fixed aids to Navigation • Use Electronic Charts • Use Marine Simulator Model of passage plan to design operating procedures • Monitor adherence to procedures and performance.	4	1	**4**
3	Tug or Barge grounds in Chesterfield inlet or Narrows due to mechanical failure	4	3	**12**	• Design tug with 100% redundancy for critical systems • Provide Marine Simulator Training for Contingencies • Use Marine Simulator to design operating procedures • Use predictive maintenance systems	4	2	**8**
4	Tug has mechanical failure/accident lost for season	5	2	**10**	• Use landing craft type vessels as back up • Have additional tug for back up	5	1	**5**
5	Grounded Barge blocks channel at narrows	5	3	**15**	• Emergency response plan to recover barge and cargo • Use double hull barges	5	1	**5**
					•			

ACTIVITY: 5. GEARED CARGO VESSEL DELIVERS DRY CARGO TO HELICOPTER ISLAND								
Scenario "E": Load empty containers on standard barges in Baker Lake and deliver them to cargo vessels at Helicopter Island								
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Containers get damaged or washed overboard in heavy weather	2	3	**6**	• Fit Container locks to barges • Reduce stacking by one level for bad weather • Fit side frames on barges • Slow tow speed	2	1	**3**
2	Tug or Barge grounds in Chesterfield inlet due to Navigation or Manoeuvring error	4	3	**12**	• Provide marine simulator training including bridge resource management • Improve fixed aids to Navigation • Use Electronic Charts • Use Marine Simulator Model of passage plan to design operating procedures Monitor adherence to procedures and performance.	4	2	**8**
3	Tug or Barge grounds in Chesterfield Narrows due to Navigation or Manoeuvring error	4	3	**12**	• Provide marine simulator training • Improve fixed aids to Navigation • Use Electronic Charts • Use Marine Simulator Model of passage plan to design operating procedures • Monitor adherence to procedures and performance.	4	2	**8**
4	Tug or Barge grounds in Chesterfield inlet or Narrows due to mechanical failure	4	3	**12**	• Design tug with 100% redundancy for critical systems • Provide Marine Simulator Training for Contingencies • Use Marine Simulator to design operating procedures • Use predictive maintenance systems	4	2	**8**
5	Grounded Barge blocks channel at narrows	5	3	**15**	• Emergency response plan to recover barge and cargo	3	3	**9**
6	Mooring lines part	3	3	**9**	• Assign watchman to tend lines	3	1	**3**

ACTIVITY: 5. GEARED CARGO VESSEL DELIVERS DRY CARGO TO HELICOPTER ISLAND								
Scenario "F": Load containers on ATB barges at Helicopter Island and deliver to Baker Lake								
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Labour unrest delays loading or discharging	3	3	**9**	• Confirm labour status prior to loading or discharging • Prepare contingency plans for alternate load ports	3	2	**6**
2	Containership runs aground in Churchill due to Navigation or Manoeuvring error	3	2	**6**	Use Marine Simulator Training for Pilots	3	1	**3**
3	Stevedores injured during unloading process	2	3	**6**	• Implement formal Safety Management System • Use trained personnel • Use correct PPE	2	2	**4**
4	Containership catches fire in Churchill	4	2	**8**	• Use IACS Classed vessels • Carry out pre contract inspections of vessels	4	1	**4**
5	Containership delayed due to weather	2	3	**6**	• Use weather routing • Allow for weather delays in contingency planning	2	2	**4**
6	Mechanical breakdown of unloading equipment	2	3	**6**	• Implement Planned maintenance system	2	2	**4**
7	Containers damaged by heavy weather in transit	5	3	**9**	• Critical cargo loaded in protected area	3	1	**3**
8	Vessel encounters ice and is severely damaged or sinks	5	2	**10**	• Sail in open water season only • Use ice class vessels	5	1	**5**

ACTIVITY: 6. TANKER DELIVERS FUEL TO CHURCHILL								
Scenario "A": Double Hull Tanker Loads fuel in southern port and delivers fuel to Churchill								
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Labour unrest at ports delays loading or discharging	2	2	**4**	• Confirm labour status prior to loading or discharging • Prepare contingency plans for alternate load ports	2	1	**2**
2	Tanker runs aground in Churchill due to Navigation error	4	2	**8**	• Use Marine Simulator to confirm viability of Tanker harbour entrance plans • Engage harbour pilots and tanker operator in preparing close approach procedures • Use escort tugs as required • Review suitability of existing fixed navigation aids in Churchill • Establish minimum navigation aids requirement for tanker • Monitor compliance with procedures	4	1	**4**
3	Tanker runs aground in Churchill due to mechanical failure	4	3	**12**	• Use escort tugs • Tanker uses adequate close quarter critical equipment set up • Use only IACS Classed vessels	4	1	**4**
4	Tanker catches fire in Churchill	4	2	**8**	• Use only IACS Classed vessels • Carry out pre hire inspections of vessels for compliance with Areva safety guidelines	4	1	**4**
5	Tanker delayed due to weather	2	3	**6**	• Use weather routing service • Allow for weather delays in contingency planning	2	2	**4**
6	Tanker encounters heavy ice and is severely damaged or sinks	5	2	**10**	• Do not sail tanker until route is ice free	5	1	**5**
7	Tanker collides with vessel entering or leaving Churchill due to conflicting traffic	5	3	**15**	• Tanker uses AIS system • Review Churchill Marine Traffic Control measures	5	1	**5**
8	Tanker spills cargo in Churchill	4	3	**12**	• Tanker is double hull which limits severity and probability • Emergency response plan is devised to match anticipated potential fuel spill • Oil Spill clean up equipment staged at Churchill • Root causes of spill addressed in mitigation controls to reduce probability	4	2	**8**
9	Tanker Sinks	5	2	10	• Use IACS Class tankers • Inspect tanker prior to loading	5	1	5
10	Tanker Loads off Spec fuel	5	2	10	• Provide detailed Spec to refinery • Analyse fuel sample for compliance with spec. prior to loading	5	1	5

ACTIVITY: 6. TANKER DELIVERS FUEL TO CHURCHILL								
Scenario "B": Tanker discharges fuel to Churchill tank farm								
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Mechanical breakdown of unloading pumps on tanker	2	1*	**2**	• No mitigation required tanker has adequate back up pumps	2	1	**3**
2	Tanker has discharge hose/connection failure	2	3	**6**	• Install boom between dock and ship • Have adequate emergency oil spill procedures and equipment on hand • Insure that hose/connection maintenance and testing procedures are adequate • Monitor compliance with procedures • Use dry break couplings	2	2	**4**
3	Tank farm over flows tank	3**	3	**9**	• Review tank farm loading procedures for compliance with Areva safety guidelines • Review tanker discharge procedures for compliance with Areva and tank farm safety guidelines • Monitor compliance with procedures	3	1	**3**
4	Fuel quantity delivered differs from manifest	2	3	**6**	• Carry out independent cargo survey at load and discharge port	2	1	**2**
5	Tanker delivers off spec or contaminated fuel.	4	2	**8**	• Provide detailed specification for fuel during procurement • Fuel samples taken at loading and analysed for compliance with specification • Fuel Samples taken at discharge port and analysed for compliance with specification • Inspect tanks on vessel prior to loading	4	1	**4**
6	Tanker parts mooring lines at Churchill	3	3	**9**	• Watch procedures to include close attention to line tension	3	1	**3**

*Note: Tanker has multiple discharge pumps
**Note: Tank Farm has bermed area to contain leakage from each tank

ACTIVITY: 7. BARGES LOAD FUEL IN CHURCHILL AND DELIVER TO BAKER LAKE								
Scenario "A": One standard tug and two standard double hull barges transport fuel from Churchill to Baker Lake. Tug drops one barge at Helicopter Island and proceeds through Narrows towing one barge.								
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Tug or Barge grounds in Chesterfield inlet due to Navigation or manoeuvring error	4*	3	**12**	• Install electronic fixed Nav Aids on waterway • Install electronic charts on tugs • Use Marine simulator to train crews • Use voyage planning and bridge Resource Management procedures • Monitor adherence to procedures	4	2	**8**
2	Tug or Barge grounds in Chesterfield Narrows due to Navigation or manoeuvring error	4*	3	**12**	• Install electronic fixed Nav Aids on waterway • Install electronic charts on tugs • Use Marine simulator to train crews • Use voyage planning and bridge Resource Management procedures • Monitor adherence to procedures	4	2	**8**
3	Tug or Barge grounds in Chesterfield inlet or Narrows due to mechanical failure	4*	3	**12**	• Design tug with duplicate back up on critical systems, including propulsion, navigation, electrical and steering • Use IACS Classed Tugs and Barges • Tugs and Barges to be subject to a comprehensive predictive maintenance plan • Monitor compliance with maintenance plan	4	2	**8**
4	Tug barge involved in collision with conflicting traffic in Narrows or Chesterfield Inlet	4*	3	**12**	• Install AIS on all tugs • Provide notification protocol and scheduling information to all operators • Design additional barge control with ITB system	4	2	8
5	Tug Barge collides with dock Baker Lake	2	4	**8**	• Provide additional tug to assist with docking	2	1	**2**
6	Tug barge crew injured during docking and undocking operation	4	3	**12**	• Use safety managemnt procedures • Personnel use PPE	4	2	**8**
7	Tug barge crew injured during barge tow hook up and disconnect operation	4	3	**12**	• Use safety managemnt procedures • Personnel use PPE	4	2	**8**
8	Tug is damaged by serious season ending fire/mechanical failure	4	3	**12**	• Design tug with duplicate back up on critical systems, including propulsion, navigation, electrical and steering • Use IACS Classed Tugs and Barges • Tugs and Barges to be subject to a comprehensive predictive maintenance plan • Monitor compliance with maintenance plan • Plan for additional tug as back up	4	2	**8**

*Note: The double hull barge design significantly reduces the severity level of the hazard

9	Tug Barge does not complete supply program in weather window	5	3	**15**	• Maintain a conservative estimate of weather window • Use a conservative contingency	4	2	**8**
10	Barge Spills fuel at the Narrows or in Chesterfield inlet	3*	3	**9**	• Locate first response oil spill equipment on each barge and tug • Locate secondary Oil Spill response equipment at Helicopter Island and at the east entrance to Chesterfield inlet • Locate another Oil Spill response kit including reaction team at Baker lake • Establish an oil spill response plan and exercise the plan • Root causes of spill addressed in mitigation controls to reduce probability	3	2	**6**
11	Barge Spills fuel at Baker Lake	5	3	**15**	• Locate first response oil spill equipment on each barge and tug • Locate secondary Oil Spill response equipment at Helicopter Island and at the east entrance to Chesterfield inlet • Locate another Oil Spill response kit including reaction team at Baker lake • Establish an oil spill response plan and exercise the plan • Root causes of spill addressed in mitigation controls to reduce probability	5	2	**10**
12	Tow lines get fouled	4	3	**12**	• Secure barges together for Chesterfield Inlet passage, one barge dropped at Helicopter Island , navigate Chesterfield Narrows with one barge	4	2	**8**

*Note: The double hull barge design significantly reduces the severity level of the hazard

ACTIVITY: 7. BARGES LOAD FUEL IN CHURCHILL AND DELIVER TO BAKER LAKE								
Scenario "B": One standard tug and one standard double hull barge transport fuel from Churchill to Baker Lake. Tug drops one barge at Helicopter Island and proceeds through Narrows towing one barge.								
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Tug or Barge grounds in Chesterfield inlet due to Navigation or manoeuvring error	4*	2	8	• Install electronic fixed Nav Aids on waterway • Install electronic charts on tugs • Use Marine simulator to train crews • Use voyage planning and bridge Resource Management procedures • Monitor adherence to procedures	4	1	4
2	Tug or Barge grounds in Chesterfield Narrows due to Navigation or manoeuvring error	4*	3	12	• Install electronic fixed Nav Aids on waterway • Install electronic charts on tugs • Use Marine simulator to train crews • Use voyage planning and bridge Resource Management procedures • Monitor adherence to procedures	4	2	8
3	Tug or Barge grounds in Chesterfield inlet or Narrows due to mechanical failure	4*	3	12	• Design tug with duplicate back up on critical systems, including propulsion, navigation, electrical and steering • Use IACS Classed Tugs and Barges • Tugs and Barges to be subject to a comprehensive predictive maintenance plan • Monitor compliance with maintenance plan	4	2	8
4	Tug barge involved in collision with conflicting traffic in Narrows or Chesterfield Inlet	4*	3	12	• Install AIS on all tugs • Provide notification protocol and scheduling information to all operators • Design additional barge control with ITB system	4	2	8
5	Tug Barge collides with dock Baker Lake	2	4	8	• Provide additional tug to assist with docking	2	1	2
6	Tug barge crew injured during docking and undocking operation	4	3	12	• Use safety managemnt procedures • Personnel use PPE	4	2	8
7	Tug barge crew injured during barge tow hook up and disconnect operation	4	3	12	• Use safety managemnt procedures • Personnel use PPE	4	2	8
8	Tug is damaged by serious season ending fire/mechanical failure	4	3	12	• Design tug with duplicate back up on critical systems, including propulsion, navigation, electrical and steering • Use IACS Classed Tugs and Barges • Tugs and Barges to be subject to a comprehensive predictive maintenance plan • Monitor compliance with maintenance plan • Plan for additional tug as back up	4	2	8
9	Tug Barge does not complete supply program in weather window	5	3	15	• Maintain a conservative estimate of weather window • Use a conservative contingency	4	2	8
10	Barge Spills fuel at the Narrows or in Chesterfield inlet	3*	3	9	• Locate first response oil spill equipment on each barge and tug • Locate secondary Oil Spill response equipment at Helicopter Island and at the east entrance to Chesterfield inlet • Locate another Oil Spill response kit including reaction team at Baker lake	3	2	6

					• Establish an oil spill response plan and exercise the plan • Root causes of spill addressed in mitigation controls to reduce probability			
11	Barge Spills fuel at Baker Lake	4	3	**12**	• Locate first response oil spill equipment on each barge and tug • Locate secondary Oil Spill response equipment at Helicopter Island and at the east entrance to Chesterfield inlet • Locate another Oil Spill response kit including reaction team at Baker lake • Establish an oil spill response plan and exercise the plan • Root causes of spill addressed in mitigation controls to reduce probability	4	2	**8**

*Note: The double hull barge design significantly reduces the severity level of the hazard

ACTIVITY: 7. BARGES LOAD FUEL IN CHURCHILL AND DELIVER TO BAKER LAKE								
Scenario "C": One ATB tug and two ATB double hull barges transport fuel from Churchill to Baker Lake								
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Tug or Barge grounds in Chesterfield inlet due to Navigation or manoeuvring error	4*	2	**8**	• Install electronic fixed Nav Aids on waterway • Install electronic charts on tugs • Use Marine simulator to train crews • Use voyage planning and bridge Resource Management procedures • Monitor adherence to procedures	4	1	**4**
2	Tug or Barge grounds in Chesterfield Narrows due to Navigation or manoeuvring error	4*	3	**12**	• Install electronic fixed Nav Aids on waterway • Install electronic charts on tugs • Use Marine simulator to train crews • Use voyage planning and bridge Resource Management procedures • Monitor adherence to procedures	4	2	**8**
3	Tug or Barge grounds in Chesterfield inlet or Narrows due to mechanical failure	4*	3	**12**	• Design tug with duplicate back up on critical systems, including propulsion, navigation, electrical and steering • Use IACS Classed Tugs and Barges • Tugs and Barges to be subject to a comprehensive predictive maintenance plan • Monitor compliance with maintenance plan	4	2	**8**
4	Tug barge involved in collision with conflicting traffic in Narrows or Chesterfield Inlet	4*	3	**12**	• Install AIS on all tugs • Provide notification protocol and scheduling information to all operators • Design additional barge control with ITB system	4	2	8
5	Tug Barge collides with dock Baker Lake	2	1*	**2**	• No mitigation required	2	1	**2**
6	Tug barge crew injured during docking and undocking operation	2	2	**4**	• Use safety managemnt procedures • Personnel use PPE	2	1	**2**
7	Tug barge crew injured during barge tow hook up and disconnect operation	2	2	**4**	• Use safety managemnt procedures • Personnel use PPE	2	1	**2**
8	Tug is damaged by serious season ending fire/mechanical failure	4	3	**12**	• Design tug with duplicate back up on critical systems, including propulsion, navigation, electrical and steering • Use IACS Classed Tugs and Barges • Tugs and Barges to be subject to a comprehensive predictive maintenance plan • Monitor compliance with maintenance plan • Plan for additional tug as back up	4	2	**8**
9	Tug barge cannot find work outside of Arctic	4	2	**8**	• Design the tug barges so that they are commercially viable in southern markets • Partner with Tug Barge operator that is knowledgeable with Arctic and southern operations	3	1	**3**
10	Tug barge tied up due to labour unrest	4	2	**8**	• Secure labour agreements that exclude work stoppages	4	1	**4**

11	Barge Spills fuel at the Narrows or in Chesterfield inlet	3*	3	**9**	• Locate first response oil spill equipment on each barge and tug • Locate secondary Oil Spill response equipment at Helicopter Island and at the east entrance to Chesterfield inlet • Locate another Oil Spill response kit including reaction team at Baker lake • Establish an oil spill response plan and exercise the plan • Root causes of spill addressed in mitigation controls to reduce probability	3	2	**6**
12	Barge Spills fuel at Baker Lake	4	2	**8**	• Locate first response oil spill equipment on each barge and tug • Locate secondary Oil Spill response equipment at Helicopter Island and at the east entrance to Chesterfield inlet • Locate another Oil Spill response kit including reaction team at Baker lake • Establish an oil spill response plan and exercise the plan • Root causes of spill addressed in mitigation controls to reduce probability	4	1	**5**

*Note: The double hull barge design significantly reduces the severity level of the hazard

ACTIVITY: 7. BARGES LOAD FUEL IN CHURCHILL AND DELIVER TO BAKER LAKE								
Scenario "D: One ATB tug and one ATB double hull barge transports fuel from Churchill to Baker Lake								
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Tug or Barge grounds in Chesterfield inlet due to Navigation or manoeuvring error	4*	2	**8**	• Install electronic fixed Nav Aids on waterway • Install electronic charts on tugs • Use Marine simulator to train crews • Use voyage planning and bridge Resource Management procedures • Monitor adherence to procedures	4	1	**4**
2	Tug or Barge grounds in Chesterfield Narrows due to Navigation or manoeuvring error	4*	2	**8**	• Install electronic fixed Nav Aids on waterway • Install electronic charts on tugs • Use Marine simulator to train crews • Use voyage planning and bridge Resource Management procedures • Monitor adherence to procedures	4	1	**4**
3	Tug or Barge grounds in Chesterfield inlet due to mechanical failure	4*	3	**12**	• Design tug with duplicate back up on critical systems, including propulsion, navigation, electrical and steering • Use IACS Classed Tugs and Barges • Tugs and Barges to be subject to a comprehensive predictive maintenance plan • Monitor compliance with maintenance plan	4	1	**4**
4	Tug or Barge grounds in Chesterfield Narrows due to mechanical failure	4*	2	**8**	• Design tug with duplicate back up on critical systems, including propulsion, navigation, electrical and steering • Use IACS Classed Tugs and Barges • Tugs and Barges to be subject to a comprehensive predictive maintenance plan • Monitor compliance with maintenance plan	4	1	**4**
5	Tug barge involved in collision with conflicting traffic in Narrows or Chesterfield Inlet	4*	2	**8**	• Install AIS on all tugs • Provide notification protocol and scheduling information to all operators • Design additional barge control with ITB system	4	1	4
6	Tug Barge collides with dock Baker Lake	2	1*	**2**	• No mitigation required	2	1	**2**
7	Tug barge crew injured during docking and undocking operation	2	2	**2**	• Use safety managemnt procedures • Personnel use PPE	2	1	**2**
8	Tug barge crew injured during barge tow hook up and disconnect operation	2	2	**2**	• Use safety managemnt procedures • Personnel use PPE	2	1	**2**
9	Tug is damaged by serious season ending fire/mechanical failure	4	3	**12**	• Design tug with duplicate back up on critical systems, including propulsion, navigation, electrical and steering • Use IACS Classed Tugs and Barges • Tugs and Barges to be subject to a comprehensive predictive maintenance plan • Monitor compliance with maintenance plan • Plan for additional tug as back up	4	2	**8**

10	Barge Spills fuel at the Narrows or in Chesterfield inlet	3*	3	**9**	• Locate first response oil spill equipment on each barge and tug • Locate secondary Oil Spill response equipment at Helicopter Island and at the east entrance to Chesterfield inlet • Locate another Oil Spill response kit including reaction team at Baker lake • Establish an oil spill response plan and exercise the plan • Root causes of spill addressed in mitigation controls to reduce probability	3	2	**6**
11	Barge Spills fuel at Baker Lake	3*	3	**9**	• Locate first response oil spill equipment on each barge and tug • Locate secondary Oil Spill response equipment at Helicopter Island and at the east entrance to Chesterfield inlet • Locate another Oil Spill response kit including reaction team at Baker lake • Establish an oil spill response plan and exercise the plan • Root causes of spill addressed in mitigation controls to reduce probability	3	2	**6**

*Note: The double hull barge design significantly reduces the severity level of the hazard

ACTIVITY: 7. BARGES LOAD FUEL IN CHURCHILL AND DELIVER TO BAKER LAKE								
Scenario "E": One ATB tug and two ATB double hull barges transport fuel from Churchill to Helicopter Island. Tug drops one barge at Helicopter Island anchorage then proceeds to Baker Lake through Narrows with one barge in the notch.								
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Tug or Barge grounds in Chesterfield inlet due to Navigation or manoeuvring error	4*	2	**8**	• Install electronic fixed Nav Aids on waterway • Install electronic charts on tugs • Use Marine simulator to train crews • Use voyage planning and bridge Resource Management procedures • Monitor adherence to procedures	4	1	**4**
2	Tug or Barge grounds in Chesterfield Narrows due to Navigation or manoeuvring error	4*	2	**8**	• Install electronic fixed Nav Aids on waterway • Install electronic charts on tugs • Use Marine simulator to train crews • Use voyage planning and bridge Resource Management procedures • Monitor adherence to procedures	4	1	**4**
3	Tug or Barge grounds in Chesterfield inlet or Narrows due to mechanical failure	4*	3	**12**	• Design tug with duplicate back up on critical systems, including propulsion, navigation, electrical and steering • Use IACS Classed Tugs and Barges • Tugs and Barges to be subject to a comprehensive predictive maintenance plan • Monitor compliance with maintenance plan	4	2	**8**
4	Tug barge involved in collision with conflicting traffic in Narrows or Chesterfield Inlet	4*	3	**12**	• Install AIS on all tugs • Provide notification protocol and scheduling information to all operators • Design additional barge control with ITB system	4	1	4
5	Tug Barge collides with dock Baker Lake	2	1*	**2**	• No mitigation required	2	1	**2**
6	Tug barge crew injured during docking and undocking operation	2	2	**4**	• Use safety managemnt procedures • Personnel use PPE	2	1	**2**
7	Tug barge crew injured during barge tow hook up and disconnect operation	2	2	**4**	• Personnel use PPE	2	1	**2**
8	Tug is damaged by serious season ending fire/mechanical failure	4	3	**12**	• Design tug with duplicate back up on critical systems, including propulsion, navigation, electrical and steering • Use IACS Classed Tugs and Barges • Tugs and Barges to be subject to a comprehensive predictive maintenance plan • Monitor compliance with maintenance plan • Plan for additional tug as back up	4	2	**8**
9	Barge Spills fuel at the Narrows or in Chesterfield inlet	3**	3	**9**	• Locate first response oil spill equipment on each barge and tug • Locate secondary Oil Spill response equipment at Helicopter Island and at the east entrance to Chesterfield inlet • Locate another Oil Spill response kit including reaction team at Baker lake • Establish an oil spill response plan and exercise the plan • Root causes of spill addressed in mitigation	3	2	**6**

					controls to reduce probability			
10	Barge Spills fuel at Baker Lake	5	3	**15**	• Locate first response oil spill equipment on each barge and tug • Locate secondary Oil Spill response equipment at Helicopter Island and at the east entrance to Chesterfield inlet • Locate another Oil Spill response kit including reaction team at Baker lake • Establish an oil spill response plan and exercise the plan • Root causes of spill addressed in mitigation controls to reduce probability	5	2	**10**

*Note: Severity level based on anticipated damage to tug or barge
**Note: Reduced severity level due to double hull construction of barge

ACTIVITY: 7. BARGES LOAD FUEL IN CHURCHILL AND DELIVER TO BAKER LAKE								
Scenario "F": ATB or Standard tug/double hull barge discharges fuel into storage tanks at Baker Lake								
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Mechanical breakdown of unloading pumps on barge	2	3	**6**	• Design barge with back up discharge pump • Carry out planned maintenance plan • Monitor adherence to maintenance plan. • Carry spare discharge pump for barges	2	2	**4**
2	Barge has discharge hose/connection failure	2	3	**6**	• Install boom between barge and dock • Have adequate emergency oil spill procedures and equipment on hand • Insure that hose/connection maintenance and testing procedures are adequate • Monitor compliance with procedures • Use dry break couplings	2	2	**4**
3	Tank farm over flows tank	4	2	**8**	• Design tank farm loading procedures in compliance with Areva safety guidelines • Tank farm design includes overflow berm protection • Design tank level alarm in tank farm and integrate with Emergency Shutdown ESD on barge. • Design barge discharge procedures in compliance with Areva and tank farm safety guidelines • Monitor compliance with procedures	4	1	**4**
4	Fuel quantity delivered differs from manifest	2	1	**2**	• Tug Master verifies quantities at load and discharge port	2	1	**2**
5	Barge delivers fuel with Microbiological/ other contamination.	4	3	**12**	• Fuel samples taken from barge and tested for MBC • Keep barge tanks clean and free of moisture • Inspect tanks annually	4	1	**4**
6	Personnel injury due to fall into water	2	2	**4**	• Use PPE • Use approved gangways	2	1	**2**
7	Damage to barge due to ranging	2	4	**8**	• Use fenders to protect docks and barges • Use harbour tug to shift barges if necessary	2	2	**4**
8	Barge Spills fuel at Baker Lake	5	2	**10**	• Locate first response oil spill equipment on each barge and tug • Locate another Oil Spill response kit including reaction team at Baker lake • Establish an oil spill response plan and exercise the plan • Root causes of spill addressed in mitigation controls to reduce probability	5	1	**5**

ACTIVITY: 8. TANKER DELIVERS FUEL TO LIGHTERING POSITION IN CHESTERFIELD INLET								
Scenario "A": Double Hull Tanker Loads fuel in southern port and delivers to Ellis Island anchorage/lightering location at the Eastern end of Chestrfield Inlet								
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Labour unrest at ports delays loading or discharging	2	2	**4**	• Confirm labour status prior to loading or discharging • Prepare contingency plans for alternate load ports	2	1	**2**
2	Tanker runs aground in Chesterfield Inlet due to Navigation error	4	2	**8**	• Use Marine Simulator to confirm viability of Tanker harbour entrance plans • Use escort tugs as required • Establish minimum navigation aids requirement for tanker • Monitor compliance with procedures	4	1	**4**
3	Tanker runs aground in Chesterfield Inlet due to mechanical failure	4	3	**12**	• Use escort tugs • Tanker uses adequate close quarter critical equipment set up • Use only IACS Classed vessels • Carry out pre hire inspections of vessels for compliance with Areva safety guidelines	4	1	**4**
4	Tanker catches fire in Chesterfield Inlet	4	2	**8**	• Use only IACS Classed vessels • Carry out pre hire inspections of vessels for compliance with Areva safety guidelines	4	1	**4**
5	Tanker delayed due to weather	2	3	**6**	• Use weather routing service • Allow for weather delays in contingency planning	2	2	**4**
6	Vessel encounters ice and is severely damaged or sinks	5	2	**10**	• Do not sail tanker until route is ice free	5	1	**5**
7	Tanker collides with vessel entering or leaving Chesterfield Inlet due to conflicting traffic	5	1	**5**	• Tanker uses AIS system • Coordinate traffic in area	5	1	**5**
8	Tanker spills cargo in Chesterfield Inlet	4	3	**12**	• Tanker is double hull which limits severity and probability • Emergency response plan is devised to match anticipated potential fuel spill • Oil Spill clean up equipment staged at Lightering location • Root causes of spill addressed in mitigation controls to reduce probability	4	2	**8**
9	Tanker Sinks	5	2	10	• Use IACS Class tankers • Inspect tanker prior to loading	5	1	5
10	Tanker Loads off spec fuel	5	2	10	• Provide detailed Spec to refinery • Analyse fuel sample for compliance with spec. prior to loading	5	1	5

ACTIVITY: 8. TANKER DELIVERS FUEL TO LIGHTERING POSITION IN CHESTERFIELD INLET								
Scenario "B": ATB double hull barges load fuel from the tanker in Ellis Island and deliver it to Baker Lake pushed by a tug in a notch.								
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Tug or Barge grounds in Chesterfield inlet due to Navigation or manoeuvring error	4*	2	**8**	• Install electronic fixed Nav Aids on waterway • Install electronic charts on tugs • Use Marine simulator to train crews • Use voyage planning and bridge Resource Management procedures • Monitor adherence to procedures	4	1	**4**
2	Tug or Barge grounds in Chesterfield Narrows due to Navigation or manoeuvring error	4*	2	**8**	• Install electronic fixed Nav Aids on waterway • Install electronic charts on tugs • Use Marine simulator to train crews • Use voyage planning and bridge Resource Management procedures • Monitor adherence to procedures	4	1	**4**
3	Tug or Barge grounds in Chesterfield inlet or Narrows due to mechanical failure	4*	3	**12**	• Design tug with duplicate back up on critical systems, including propulsion, navigation, electrical and steering • Use IACS Classed Tugs and Barges • Tugs and Barges to be subject to a comprehensive predictive maintenance plan • Monitor compliance with maintenance plan	4	2	**8**
4	Tug barge involved in collision with conflicting traffic in Narrows or Chesterfield Inlet	4*	3	**12**	• Install AIS on all tugs • Provide notification protocol and scheduling information to all operators • Design additional barge control with ITB system	4	1	4
5	Tug Barge collides with dock Baker Lake	2	1*	**2**	• No mitigation required	2	1	**2**
6	Tug barge crew injured during docking and undocking operation	2	2	**4**	• Use safety managemnt procedures • Personnel use PPE	2	1	**2**
7	Tug barge crew injured during barge tow hook up and disconnect operation	2	2	**4**	• Personnel use PPE	2	1	**2**
8	Tug is damaged by serious season ending fire/mechanical failure	4	3	**12**	• Design tug with duplicate back up on critical systems, including propulsion, navigation, electrical and steering • Use IACS Classed Tugs and Barges • Tugs and Barges to be subject to a comprehensive predictive maintenance plan • Monitor compliance with maintenance plan • Plan for additional tug as back up	4	2	**8**

9	Barge Spills fuel at the Narrows or in Chesterfield inlet	3**	3	**9**	• Locate first response oil spill equipment on each barge and tug • Locate secondary Oil Spill response equipment at Helicopter Island and at the east entrance to Chesterfield inlet • Locate another Oil Spill response kit including reaction team at Baker lake • Establish an oil spill response plan and exercise the plan • Root causes of spill addressed in mitigation controls to reduce probability	3	2	**6**
10	Barge Spills fuel at Baker Lake	5	3	**15**	• Locate first response oil spill equipment on each barge and tug • Locate secondary Oil Spill response equipment at Helicopter Island and at the east entrance to Chesterfield inlet • Locate another Oil Spill response kit including reaction team at Baker lake • Establish an oil spill response plan and exercise the plan • Root causes of spill addressed in mitigation controls to reduce probability	5	2	**10**

*Note: Severity level based on anticipated damage to tug or barge
**Note: Reduced severity level due to double hull construction of barge

ACTIVITY: 8. TANKER DELIVERS FUEL TO LIGHTERING POSITION IN CHESTERFIELD INLET								
Scenario "C": Standard double hull barges load fuel from the tanker in Ellis Island and deliver it to Baker Lake towed by a tug								
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Tug or Barge grounds in Chesterfield inlet due to Navigation or manoeuvring error	4*	2	**8**	• Install electronic fixed Nav Aids on waterway • Install electronic charts on tugs • Use Marine simulator to train crews • Use voyage planning and bridge Resource Management procedures • Monitor adherence to procedures	4	1	**4**
2	Tug or Barge grounds in Chesterfield Narrows due to Navigation or manoeuvring error	4*	3	**12**	• Install electronic fixed Nav Aids on waterway • Install electronic charts on tugs • Use Marine simulator to train crews • Use voyage planning and bridge Resource Management procedures • Monitor adherence to procedures	4	2	**8**
3	Tug or Barge grounds in Chesterfield inlet or Narrows due to mechanical failure	4*	3	**12**	• Design tug with duplicate back up on critical systems, including propulsion, navigation, electrical and steering • Use IACS Classed Tugs and Barges • Tugs and Barges to be subject to a comprehensive predictive maintenance plan • Monitor compliance with maintenance plan	4	2	**8**
4	Tug barge involved in collision with conflicting traffic in Narrows or Chesterfield Inlet	4*	3	**12**	• Install AIS on all tugs • Provide notification protocol and scheduling information to all operators • Design additional barge control with ITB system	4	2	**8**
5	Tug Barge collides with dock Baker Lake	2	4	**8**	• Provide additional tug to assist with docking	2	1	**2**
6	Tug barge crew injured during docking and undocking operation	4	3	**12**	• Use safety managemnt procedures • Personnel use PPE	4	2	**8**
7	Tug barge crew injured during barge tow hook up and disconnect operation	4	3	**12**	• Use safety managemnt procedures • Personnel use PPE	4	2	**8**
8	Tug is damaged by serious season ending fire/mechanical failure	4	3	**12**	• Design tug with duplicate back up on critical systems, including propulsion, navigation, electrical and steering • Use IACS Classed Tugs and Barges • Tugs and Barges to be subject to a comprehensive predictive maintenance plan • Monitor compliance with maintenance plan • Plan for additional tug as back up	4	2	**8**
9	Tug Barge does not complete supply program in weather window	5	3	**15**	• Maintain a conservative estimate of weather window • Use a conservative contingency	4	2	**8**
10	Barge Spills fuel at the Narrows or in Chesterfield inlet	3*	3	**9**	• Locate first response oil spill equipment on each barge and tug • Locate secondary Oil Spill response equipment at Helicopter Island and at the east entrance to Chesterfield inlet • Locate another Oil Spill response kit including reaction team at Baker lake	3	2	**6**

					• Establish an oil spill response plan and exercise the plan • Root causes of spill addressed in mitigation controls to reduce probability			
11	Barge Spills fuel at Baker Lake	4	3	**12**	• Locate first response oil spill equipment on each barge and tug • Locate secondary Oil Spill response equipment at Helicopter Island and at the east entrance to Chesterfield inlet • Locate another Oil Spill response kit including reaction team at Baker lake • Establish an oil spill response plan and exercise the plan • Root causes of spill addressed in mitigation controls to reduce probability	4	2	**8**

*Note: The double hull barge design significantly reduces the severity level of the hazard