Kiggavik Project

Environmental Impact Statement

Tier 3 Technical Appendix 7A

Marine Environment Baseline

December 2011

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ABBREVIATIONS AND ACRONYMS

ASTIS.....Arctic Science and Technology Information System

CASES..... Canadian Arctic Shelf Exchange Study

COSEWIC.....Committee on the Status of Endangered Wildlife in Canada

CWS..... Canadian Wildlife Service

DFO .....Fisheries and Oceans Canada

ELT .....Emergency Locator Transmitter

EPIRB ..... Emergency Position Indicating Radio Beacon

HTO .....Hunters and Trappers Organization

GPS ..... Geographical Positioning System

IBA ..... Important Bird Area

IUCN .....International Union on the Conservation of Nature

IQ .....Inuit Qaujimajatuqangit

LSA .....Local Study Area

MBS .....Migratory Bird Sanctuary

MMO .....Marine Mammal Observer

NWMB.....Nunavut Wildlife Management Board

NRI.....Nunavut Research

RSA..... Regional Study Area

RWO ..... Regional Wildlife Organizations

SARA ..... *Species at Risk Act*

1 INTRODUCTION

1.1 OVERVIEW

AREVA Resources Canada Inc. (AREVA) is proposing a uranium mining and milling operation in the Kivalliq region of Nunavut, approximately 80 km west of the community of Baker Lake. The Project will require marine transportation of supplies to the mine and mill facilities during the open-water season.

Proposed marine transportation routes include:

- 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.

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

- Marine shipment via ocean-going vessels through Hudson Strait and Hudson Bay to Churchill. The cargo would be transhipped 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.

Shipping activity has the potential to disturb marine mammals, primarily through underwater sound production. Sound produced by vessels propagates horizontally and under certain conditions, can be detected by marine mammals at considerable distances from the area of operation (Richardson and Malme 1995). Marine mammals, birds, and fish are important cultural and subsistence resources to Nunavummiut and will potentially be affected by Project activities. The focus of this report is to develop an understanding of the baseline ecology of the marine environment and the presence and seasonal distribution of marine species in the Chesterfield Inlet, western Hudson Bay and Hudson Strait regions. Information presented in this baseline report will be used to support the environmental assessment for the Project.

1.2 PURPOSE

This report describes baseline conditions of the marine environment in the Project area to support the environmental assessment process. Most of the available information on habitat use by marine mammals, birds, and fish in Hudson Bay is not extensive or recent. The objectives of the Marine Environment Baseline studies were:

Objective 1: To collect available literature, Inuit Qaujimajatuqangit (IQ) and other expert information on marine mammal, bird, and fish habitat use and distribution near Chesterfield Inlet and in Hudson Bay and Hudson Strait;

Objective 2: To conduct focused collection of field data on seasonal marine mammal distribution, habitat use and relative abundance near Chesterfield Inlet in 2008; and

Objective 3: To collect field data on seasonal marine mammal distribution, habitat use and relative abundance along the proposed Hudson Bay vessel routes in 2009 (coastal and offshore regions).

1.3 SCOPE

This report describes the Project setting and study areas, methodology used to collect existing information and field data, results of the literature and field programs, and discussion and conclusions on marine mammal use of Chesterfield Inlet and the proposed vessel transport routes.

2 SETTING

The Kiggavik Project is located in the Kivalliq Region of Nunavut. The closest settlement to the Project site is 80 km east at Baker Lake. Chesterfield Inlet is the next community 190 km east of Baker Lake. Marine shipping involves transporting supplies to Baker Lake along the west coast of Hudson Bay, from Churchill through Chesterfield Inlet, and from Churchill and Chesterfield Inlet through Hudson Strait to southern ports. Shipping will only occur during the open water season.

The Project is located in the northwest part of the Hudson Bay marine ecosystem. This ecosystem extends over a very large geographical area including James Bay and Hudson Bay. It is bounded in the east by the coast of Québec, in the south by Ontario and Manitoba, and in the west by Nunavut.

The ecosystem receives Arctic marine water input from Foxe Basin and freshwater runoff from a catchment basin fed by several large rivers, including the Churchill and Nelson (Stewart and Lockhart 2005a). The extreme southern penetration of Arctic marine water is a unique characteristic of Hudson Bay and contributes to the unique ecosystem. For example, the presence of Arctic water enables polar bears to live and breed at relatively southern latitudes. Because of its large extent, the ecosystem offers a broad range of habitats that are used year-round by a variety of arctic and sub-arctic wildlife, and seasonally by many migratory birds, mammals, and fish.

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3 STUDY AREAS

The study area for this project was divided into a local study area (LSA) and a regional study area (RSA) to characterize the marine environment of Chesterfield Inlet and along the planned vessel routes respectively. Two field programs (2008, 2009) were conducted in these study areas to supplement existing data on marine mammals. Baseline information for other aspects of the marine environment was collected from available literature.

3.1 LOCAL STUDY AREA

The LSA includes marine waters of Chesterfield Inlet and the adjacent coastal and offshore regions at the mouth of Chesterfield Inlet where measureable effects from project specific marine vessel traffic are most likely to occur. This area includes portions of the shipping route where marine vessels will be transiting to and from the main shipping routes in Hudson Bay (see Figure 3.1-1).

3.2 REGIONAL STUDY AREA

The RSA includes the LSA and extends beyond to encompass the shipping route in Hudson's Bay between Churchill and Chesterfield Inlet and the shipping route through Hudson Strait to the extent of Nunavut Territorial waters (Figure 3.1-1). The RSA encompasses the zone where project related vessels are reasonably likely to have a measureable effect and have the potential to act cumulatively with other projects.

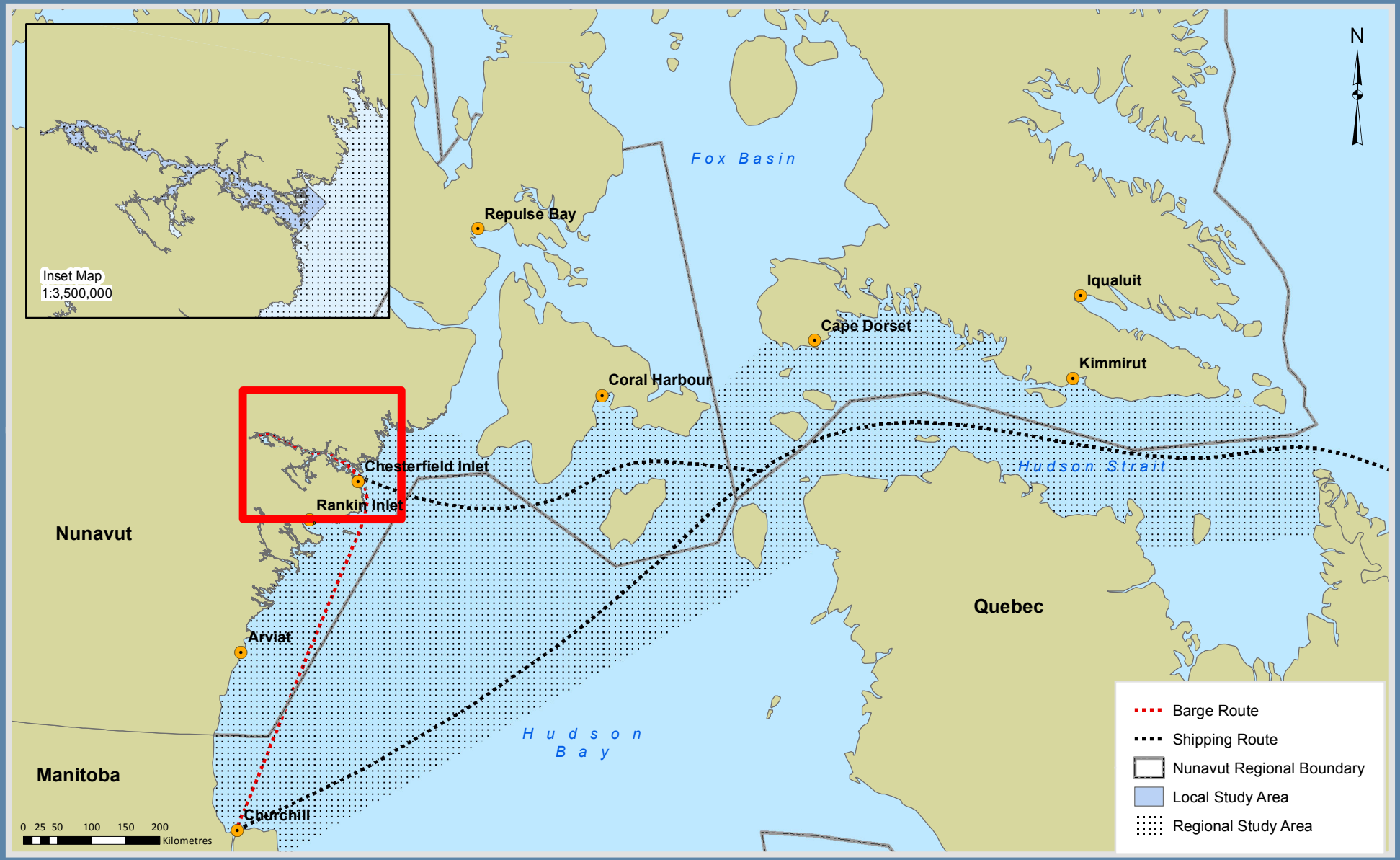

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FIGURE 3.1-1
MARINE ENVIRONMENTAL STUDY AREAS

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4 METHODS

Because the majority of the proposed project related marine transportation is expected to occur between Churchill, Chesterfield Inlet, and Baker Lake during the open water season only, the marine environment literature review and field surveys are primarily focused on the Chesterfield Inlet and Western Hudson Bay regions.

4.1 LITERATURE REVIEW

Standard literature search techniques were used to collect information on the marine environment in the LSA and RSA. The literature databases that were searched included those of:

- Federal Government agencies (e.g., Fisheries and Oceans Canada, Canadian Wildlife Service, Environment Canada);
- Government of Nunavut agencies (e.g., Department of Environment, Wildlife Research Group, Parks);
- Territorial research organizations and institutes (e.g., Nunavut Research Institute (NRI), Prince of Wales Northern Heritage Centre);
- Nunavut Wildlife Management Board (NWMB), Regional Wildlife Organizations (RWOs) and local Hunter and Trapper Organizations (HTOs);
- Universities and Colleges (e.g., ArcticNet, Canadian Arctic Shelf Exchange Study (CASES), Nunavut Arctic College, the Arctic Science and Technology Information System (ASTIS) database, International Polar Year and Arctic Institute of North America.

4.2 MARINE MAMMAL FIELD SURVEYS

4.2.1 Aerial Surveys

Information gathered on presence/absence, abundance and migration timing of marine mammals from the literature, expert knowledge and local input was used in the design of the 2008 and 2009 open-water field programs.

4.2.1.1 Aerial Survey Design – 2008

The 2008 marine mammal aerial survey was designed and optimized to determine encounter rates and spatial variability of marine mammal habitat use in and near Chesterfield Inlet. The survey program covered an area of 1,628 km^2 in Chesterfield Inlet and adjacent coastal and offshore regions (Figure 4.2-1). Coastal regions were considered to be 5 km or closer to shore. Areas greater than 5 km from shore were considered offshore regions. The objective of the

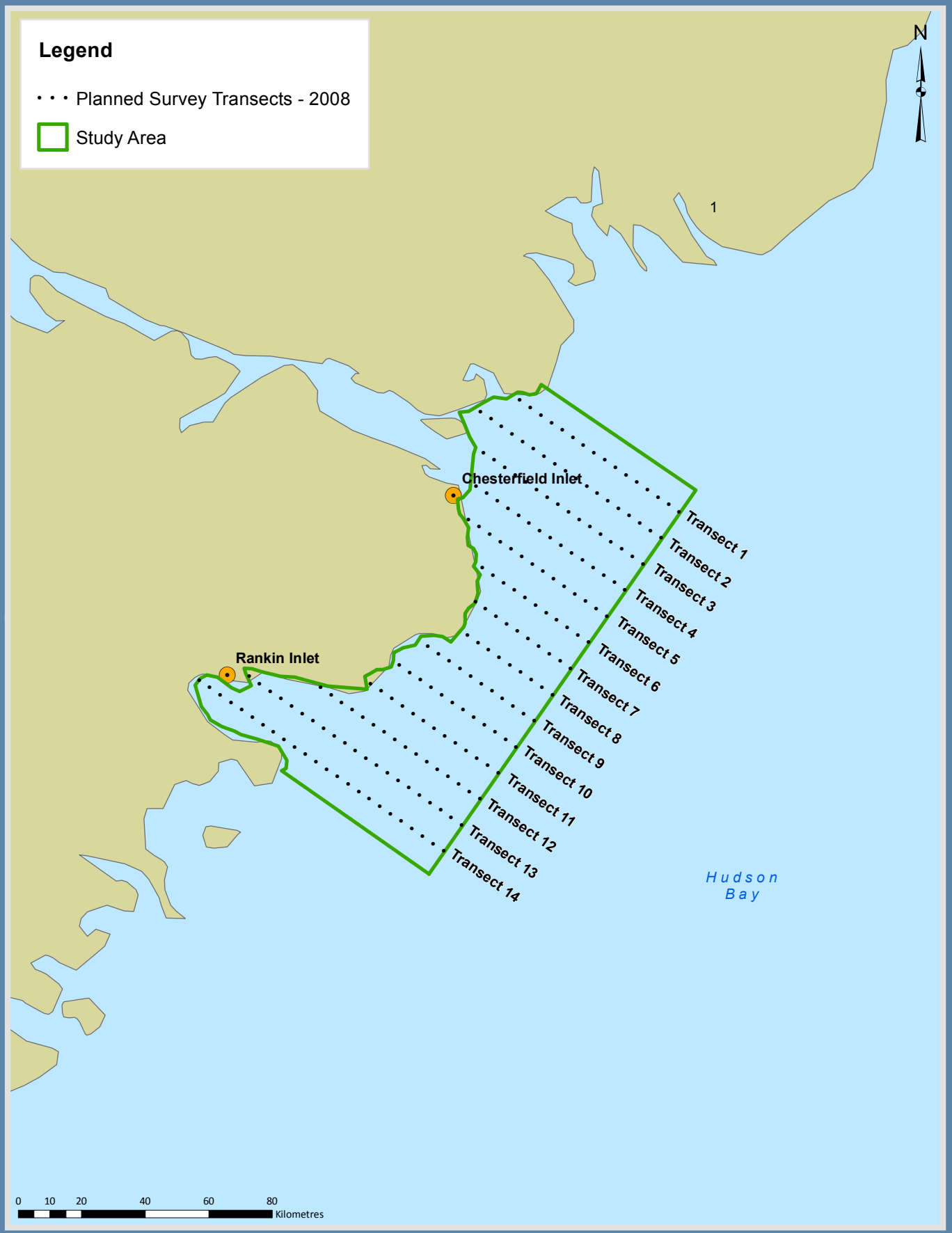
aerial survey was to describe marine mammal use of Chesterfield Inlet and adjacent areas during the open-water period.

A parallel transect strip survey design [Distance 5.0™ (Thomas *et al.* 2006)] was chosen to provide statistically meaningful data on the abundance and distribution of marine mammals within the study area. The coverage probability of the study area was designed to represent 20% of the total area, assuming a 1-km strip width (2-km strip width in total to account for both sides of the aircraft).

Fourteen evenly spaced (10 km) transects were delineated, orienting northwest to southeast and perpendicular to the shoreline (Figure 4.2-1). The location of the starting transect was randomly generated using Distance 5.0™ software. Transects ranged from 31 to 92 km in length (generated by the software) depending on the distance from shore required to cover the entire study area. The total length of all 14 planned transects combined was 737 km over an area of 1,629 km^2.

The survey was designed for replicate coverage of all 14 transects five times, over a five- to seven-day period (737 km of planned daily survey effort). Open-water surveys were planned to coincide with likely marine mammal presence in early to mid-September and to avoid limitations associated with weather delays in late-September and October.

Surveys were flown only when Beaufort Sea states were 0 (mirror smooth and glassy): 1 (small wavelets without crests); 2 (smooth wavelets with crests that do not break); or 3 (gentle breeze, large wavelets with crests that are beginning to break). In the event of inclement weather or sea states of greater than 3, the survey of off-shore transects was abandoned in favour of improved visibility along the shore.



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Data Sources: *Natural Resources Canada, Geobase®, Natural Topographic Database, Areva Resources Canada Inc.*

FIGURE 4.2-1
MARINE MAMMAL SURVEY AREA
AND PLANNED TRANSECTS
FOR THE 2008 AERIAL SURVEYS
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4.2.1.2 Aerial Survey Design – 2009

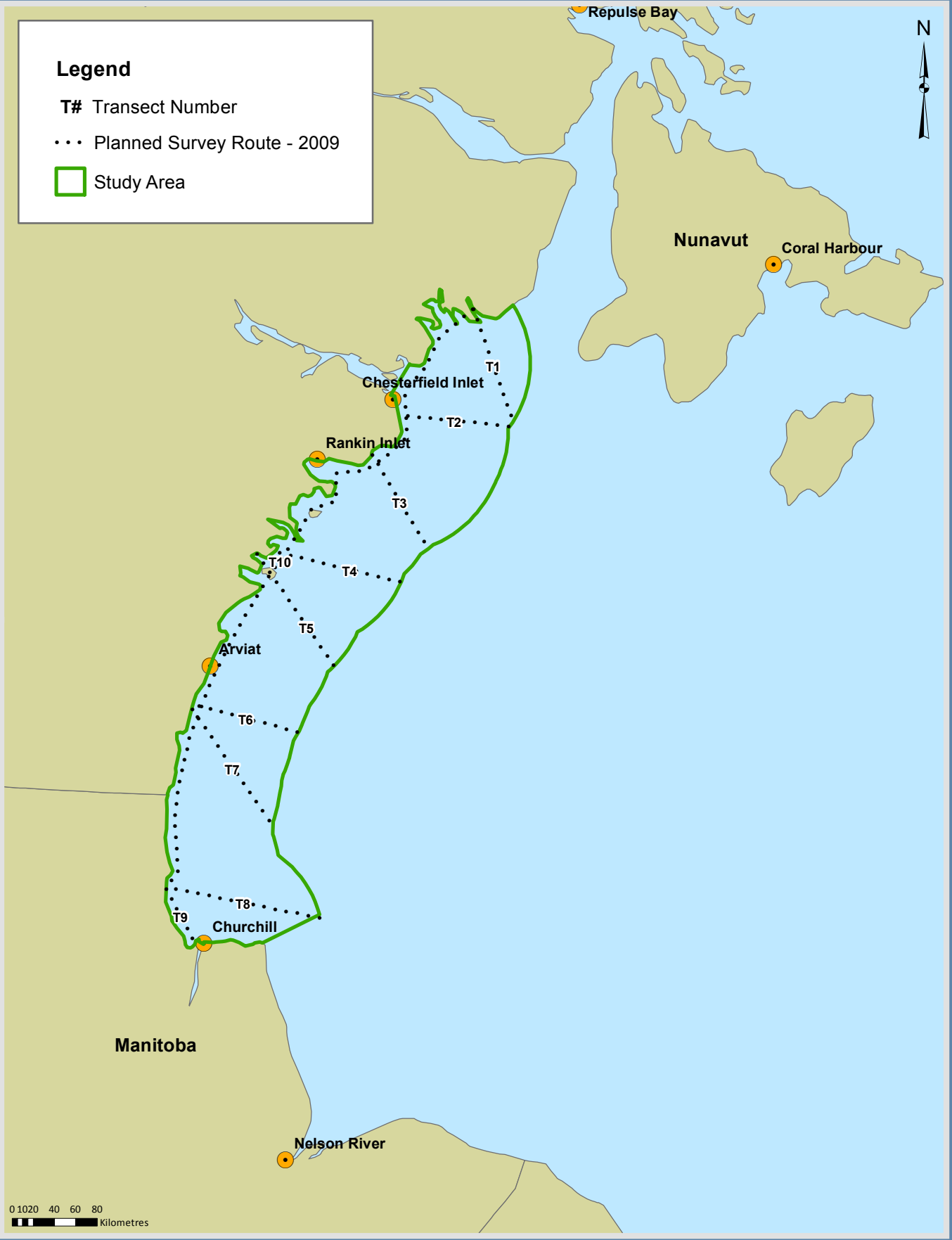
The main objective of the 2009 aerial survey program was to provide seasonal documentation of the distribution of marine mammals in the study area, which includes the shipping corridor between Churchill and Chesterfield Inlet. Portions of the regional study area were surveyed in 2009 to complement the 2008 survey and further describe large scale marine mammal use of Project shipping routes. The surveys covered 76,000 km^2 of the proposed vessel routes between Churchill and Chesterfield Inlet (Figure 4.2-2). Transects extended up to 100 km offshore to capture the extent of potential tug/barge routing.

A zigzag survey design was chosen to provide data on the offshore distribution of marine mammals within the study area. A separate design, which involved surveying a single transect adjacent and parallel to the coastline, was used to gather data on the coastal distribution of marine mammals. Percent coverage of the study area was designed to represent 6% of the total area, assuming a one-km strip width (two-km width in total to account for both sides of the aircraft).

Nine transects oriented diagonally across the study area were delineated (Figure 4.2-2). The location of the starting transect was randomly generated using Distance 5.0™ software. Planned transects ranged from 60 to 100 km in length. The total length of all transects, not including the coastal survey, was 1,600 km over an area of 76,000 km^2. The study was designed to replicate the survey coverage five times over a period of five days.

Surveys were timed to:

- Survey the study area immediately after ice breakup at the start of the open-water period (a period during which little is known about beluga presence/absence, abundance or distribution);
- Include periods of likely beluga whale presence in the summer and early fall to understand abundance and distribution within the study area; and
- Avoid limitations associated with inclement weather and high sea states in later September and October (as described in Section 4.2.1.1 above).



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Data Sources: *Natural Resources Canada, Geobase®, Natural Topographic Database, Areva Resources Canada Inc.*

FIGURE 4.2-2
MARINE MAMMAL STUDY AREA
AND PLANNED TRANSECTS
FOR THE 2009 AERIAL SURVEYS
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4.2.1.3 Equipment

A DeHavilland Twin Otter, specially outfitted with bubble windows, was used to conduct the surveys (Photo 4.2-1). Global positioning system (GPS) data were acquired via a Garmin 76Cx GPSMAP® handheld GPS receiver, placed on the dash of the aircraft. GPS track data were recorded every five seconds throughout the survey. GPS track points provided data that included input time, latitude, longitude and altitude with accuracy to within 3 m.

Photo 4.2-1: Twin Otter Aircraft Chartered for the Aerial Surveys

Each of the four observers (two primary and two secondary) had a digital wristwatch synchronized with the GPS unit, an Olympus© WS-331M digital voice recorder to record sightings and environmental data, and a Sunnto© inclinometer to record the angle of the sighting from the aircraft (thus allowing a calculation of lateral distance from the aircraft track-line).

Air speed was maintained at 185 km/hr while on transect. Altitude was maintained at 305 m (dependent on weather and visibility). Transect start and end points were programmed into the aircraft's navigation system prior to the start of the survey and flight position was determined by the pilot and co-pilot using the aircraft's GPS navigation system.

Onboard safety equipment included a portable Emergency Position Indicating Radio Beacon (EPIRB) attached to an 8-person automatically inflating life raft, an Emergency Locator

Transmitter (ELT) installed in the aircraft, a 21-person survival kit and Mustang® immersion suits for each survey crew member, each equipped with a personal EPIRB device.

4.2.1.4 Survey Crew

The survey crew was comprised of five individuals: two primary observers, two secondary observers (local assistants) and a survey navigator (crew lead). The two most experienced marine mammal observers (MMOs) on the aircraft typically occupied the primary observer positions (Photo 4.2-2). Primary observers sat in the forward right and left seats, and the environmental and sightings data they collected were used for analyses. Secondary observers sat in the rear right and left seats and independently recorded the same data as the primary observers. Their data were to be used as a back-up should the primary observer data be lost for any reason. The secondary data were also compared to those collected by the primary observers to identify any whales missed by the primary observers. Observers regularly took breaks (in between transects) to minimize fatigue and optimize visual survey quality.

A list of all the observers involved in the 2008 and 2009 aerial surveys is provided in Table 4.2-1.

Photo 4.2-2: Primary Observer (Owen McHugh) and Secondary Observer (Gary Ippiak) Scanning for Marine Mammals. AREVA representative Barry McCallum in third rear position.

Table 4.2-1: List of Aerial Survey Crew Members in 2008 and 2009

Year	Crew Lead	Primary Observers	Secondary Observers*
2008	Todd Goodsell	Janine Beckett Mark Fraker	Andre Tautu Ron Alikashuk Don Mimialik
2009	Ben Wheeler	Marina Winterbottom Owen McHugh	Gary Ippiak Don Mimialik

NOTE:
*Only two secondary observers were on board at a time

4.2.1.5 Data Collection – 2008

Primary observers concentrated the survey effort within 1 km of the aircraft (between approximately 20 and 70 degrees from the horizontal). Upon observation of a marine mammal, the species, the number of animals, and the behaviour of animal(s) were recorded with personal voice recorders. When a large aggregation of animals was spotted, or identification was not initially possible, the aircraft temporarily left the transect line in order to collect more information. If mammals were detected beyond the 1 km survey distance, primary observers measured and recorded the angle of inclination to each sighted animal (when the initial sighting location was perpendicular to the aircraft).

Environmental conditions were recorded (e.g. weather, sea state, visibility, and glare). Weather categories were described as clear, partly cloudy, overcast, fog, mist, light rain, moderate rain, heavy rain or snow. Sea state was estimated using a modified Beaufort Wind Force Chart. Observers estimated Beaufort wind force using this chart and correlated the wind speed to a corresponding sea state using a table summarizing the Beaufort Wind Force Scale and the corresponding Sea State Scale.

4.2.1.6 Data Collection – 2009

At the start of each flight, each observer was issued an inclinometer, wristwatch (synchronized with GPS), digital voice recorder and coding ‘cheat sheets’ (Appendix A).

While surveying, the observers were responsible for recording the following information:

1. **Environmental Conditions:** Recorded every two minutes and at the end of each transect:

    a) **Weather:** General comments on ambient conditions (e.g., cloud cover, presence of precipitation, fog, etc., as listed in Section 4.2.1.5 above);

    b) **Ice type and percent cover:** Ice presence/absence. Percentage of ice cover in field of view;

c) **Beaufort Wind Force:** Beaufort scale number (as described in Section 4.2.1.5 above);

d) **Glare:** Effect of glare on field of view (none, moderate or severe); and

e) **Sightability:** How easily a whale be sighted based on the interaction of factors listed above (excellent, good, moderately impaired, severely impaired or impossible).

Recording animal sightings was always the priority task; if sightings were frequent, observers were instructed to suspend recording of environmental conditions until fewer animals were seen.

2. **Sightings:** Information on a sighting was recorded the instant a marine mammal was spotted, but the *time* of the sighting was recorded when the animal was perpendicular to the aircraft. Critical information recorded was time, species, number of animals and inclinometer angles. When possible, additional details were also recorded:

    a) **Time:** Local time, based on the 24 hour clock, when a sighting was observed. Time of observations was linked with GPS data;

    b) **Species:** Common name of species observed;

    c) **Number:** Number of individuals in a group. Individuals were recorded as in a group if they were within 5–10 body lengths of each. If animals were farther apart, they were coded as separate sightings with a unique inclinometer angle;

    d) **Inclinometer angle:** Depression angle from the horizon to the centre of the group, taken when the marine mammal was perpendicular to the aircraft. One inclinometer reading was taken from the centre of a group (i.e., ranges of inclinometer readings were not recorded);

    e) **Sighting Category (On/Off Transect):** Sightings recorded along transects that were within the strip width markers on the aircraft windows were recorded as “ON” transect. If an animal was observed outside of these markers, it was considered as “OFF” transect.

Where possible, the following information was also collected for each sighting:

a) **Activity:** A collection of behaviours that indicated a given animal was working toward an overall goal; (e.g., feeding, resting, migrating, socializing);

b) **Behaviour:** Movements or biological processes in which an animal was engaged (e.g., blow, breach, dive, haul out);

c) **Heading (if travelling):** Direction of travel in relation to the aircraft;

d) **Speed (if travelling):** Relative speed of an animal's travel; and

e) **Age:** Apparent age class of the animal.

The MMOs also noted anecdotal observations, such as the presence of an ice edge, an oceanographic feature, a geographic feature and flocks of birds. The typical layout and equipment of an observing station is shown in Photo 4.2-3.

Photo 4.2-3: Typical Layout of an Observing Station: GPS Digital Synchronized Wristwatch, Coding "Cheat Sheet" and Delineation of Transect Boundaries

4.2.2 Vessel Reconnaissance Tour 2009

At community meetings on May 29, 2008 and July 16, 2009, the residents of Chesterfield Inlet proposed a vessel tour in Chesterfield Inlet to impart local knowledge of important hunting and fishing grounds in the area.

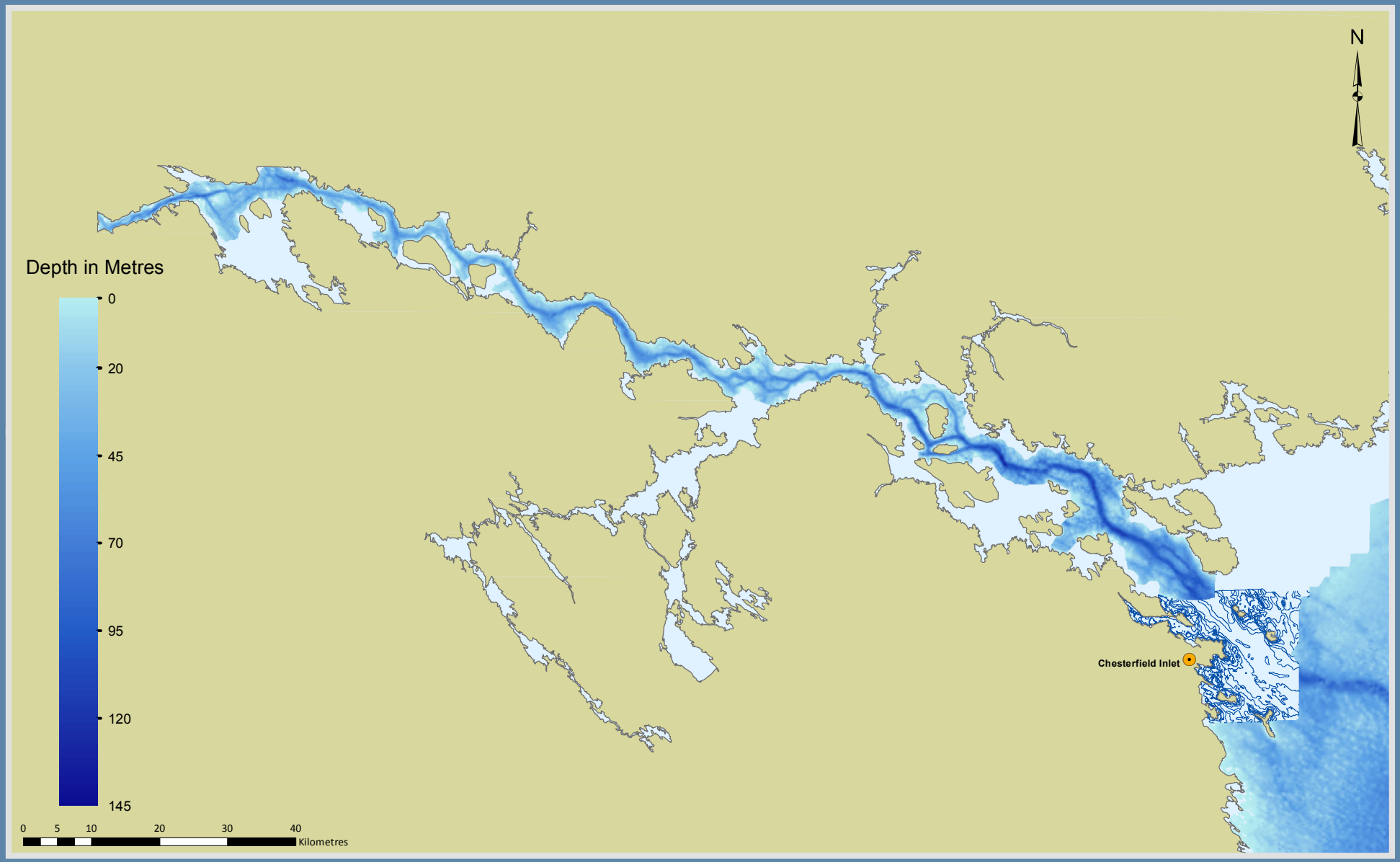
A boat was chartered from Leo and Don Mimialik on August 29, 2009. The survey route followed the north coast of Chesterfield Inlet for 40 to 50 km and then followed the south coast on return. Along the way, fishing cabins and popular hunting spots were highlighted. Opportunistic marine mammal sightings were recorded using a Garmin GPS. Leo and Don participated in an informal discussion regarding time and location of marine mammal hunting (e.g., beluga whale, seal, polar bear and walrus).

5 PHYSICAL AND BIOLOGICAL OCEANOGRAPHY

5.1 LITERATURE REVIEW

Chesterfield Narrows drains Baker Lake and empties into Chesterfield Inlet. A 200 km, salt-water tidal corridor, Chesterfield Inlet joins Hudson Bay with Baker Lake. Bathymetric charts are available for the Chesterfield Inlet area from the Canadian Hydrographic Service (station 5140). High resolution Bathymetric data (derived from multibeam sonar surveys) for Chesterfield Inlet was procured from TCarta Global Geospatial Data (Figure 5.1-1). Chesterfield Inlet experiences large semi-diurnal tides, which ranged in 2007 from 1.0 – 4.0 m (Government of Canada 2010). Northern coastal areas and estuaries in the vicinity of Chesterfield Inlet are characterized by clear waters and deep photic zones[1] that permit extensive growth of macroalgae (Schneider-Vieira *et al.* 1993).

[1] The part of the near-surface body of an ocean or lake that receives enough sunlight for photosynthesis to be possible.



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File: 1038926.04-020
Data Sources: *Natural Resources Canada, Geobase®, Natai Topographic Database, Areva Resources Canada Inc.*

FIGURE 5.1-1
BATHYMETRY OF CHESTERFIELD INLET

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5.1.1 Ice Cover

Experiencing a full cryogenic cycle, ice generally starts to form in Hudson Bay in late October and the bay usually becomes ice-free in early August. Studying the dates of ice freeze-up and breakup in Hudson Bay between 1971 and 2003, Gagnon and Gough (2005) report statistically significant trends toward earlier ice breakup in western and southern Hudson Bay and James Bay (magnitude range: -0.49 to -1.25 days per year) and later freeze-up in the northern and northeastern regions of Hudson Bay (magnitude range: 0.33 to 0.55 days per year).

The closest survey stations to Chesterfield Inlet, 62.0° N, 92.0° W and 63.0° N, 89.0° W, experience mean ice freeze-up on November 14 and November 13, respectively (Gagnon and Gough 2005) (Table 5.1-1). The closest station to Chesterfield Inlet where ice breakup was recorded, at 61.0° N, 89.0° W, experienced mean breakup on July 9. Two stations located further south in western Hudson Bay at 59.0° N, 92.0° W and 60.0° N, 92.0° W, were found to experience mean ice freeze-up later, on November 23 and November 21, and mean breakup later, on July 15 and July 10, respectively. Ice breakup in northwestern Hudson Bay is marginally earlier than that experienced further south in western Hudson Bay due to ice removal by strong prevailing northwesterly winds and ocean currents (Saucier *et al.* 2004; Gagnon and Gough 2005).

Table 5.1-1: Ice Freeze-up and Break-up Dates of Sea Ice for Stations Sampled in Western Hudson Bay between 1971 and 2003

Location	Station Number	Freeze-up (Julian days)		Break-up (Julian days)	
		Mean	S.D.	Mean	S.D.
59.0° N, 92.0° W	15	328 (Nov 23)	8.8	197 (Jul 15)	14.6
60.0° N, 92.0° W	20	326 (Nov 21)	8.6	192 (Jul 10)	17.2
61.0° N, 89.0° W	26	326 (Nov 21)	8.5	191 (Jul 9)	12.6
62.0° N, 92.0° W	30	319 (Nov 14)	9.5	–	–
63.0° N, 89.0° W	34	318 (Nov 13)	8.7	–	–

Source: Gagnon and Gough (2005)

Within the Hudson Bay, Hudson Strait and Foxe Basin region, Saucier *et al.* (2004) report that the maximum sea ice growth rates are found in a relatively large and persistent polynya[2] in northwestern Hudson Bay and in western Foxe Basin. Maximums of sea-ice cover and thickness however are found in eastern Foxe Basin and southern Hudson Bay, where sea-ice advection and ridging serves to accumulate the ice.

Climate change is predicted to decrease overall ice cover in the Arctic (Johannessen *et al.* 2004; Serreze *et al.* 2007) and has the potential to affect the ice regime within the Hudson Bay.

[2] An area of open water surrounded by sea ice.

Effects of climate change have the potential to cause increased ice melt earlier in the year, less winter ice cover, and a change in frequency of icebergs traveling through the Bay.

5.1.2 Sea Currents and Circulation

In western Hudson Bay, in accordance with the cyclonic circulation pattern of the bay, monthly mean currents are set generally to the south and east (Prinsenberg 1987; Saucier *et al.* 2004). Barotropic, semidiurnal tidal currents, up to 28 cm s-1 in amplitude, represent the majority of observable currents in the area. The presence of sea ice in western Hudson Bay, typically between November and July, causes a decrease in the heights and amplitudes of tidal currents, and an advance in their arrival when compared to open water (ice-free) conditions. Storm-driven, clockwise flowing, inertial currents may be as strong as tidal currents but are typically absent during the ice covered season. Daily averaged currents, with amplitudes of up to 25 cm s-1, are typically dominated by 5- to 6-day periodic motions driven by passing weather systems (Prinsenberg 1987).

For a location 190 km northeast of Churchill, at 60.00° N, 91.95° W, Prinsenberg (1987) reports monthly mean currents, consisting of wind-driven and density-driven currents, set predominantly to the south with speeds of up to 4 cm s-1. Seasonal variations in the amplitudes of mean currents occur in association with sea ice coverage.

Effects of climate change may have a profound impact on the regions currents by altering fresh water flux between the Arctic and Atlantic Oceans. An increase in low salinity water entering the Atlantic may reduce the formation of North Atlantic Deep Water—a process that is critically linked to global oceanic circulation (Rahmstorf 1999; Vellinga and Wood 2002). This has the potential to affect the currents and weather patterns of the entire Canadian Arctic, including the Hudson Bay. These warm temperatures may result in increased ice melt and subsequent elevation in water levels (Munk 2003).

5.1.3 Marine Phytoplankton and Ice Algae

Phytoplankton are photosynthesizing microscopic organisms, typically abundant in well-lit surface waters (termed the ‘euphotic zone’), which form the basis for the vast majority of marine food webs (food webs reliant on chemosynthesis are a notable exception). Phytoplankton are grazed on by zooplankton and benthic invertebrates, which in turn are consumed by fish and larger predators. Accounting for approximately half of all photosynthetic fixation of carbon on Earth, the primary productivity of phytoplankton provides valuable ecosystem functions including the maintenance of marine and atmospheric oxygen balances and the sequestration of carbon (Morel and Price 2003). The biomass and taxonomic composition of phytoplankton can be affected by environmental changes and have been widely used to examine effects of nutrient loading and metal pollution on ecosystems.

In the Arctic Ocean, phytoplankton primary productivity is limited by the long ice-covered season which reduces or, where thick enough, eliminates light availability for photosynthesis. Phytoplankton blooms, characterised by rapid increases in biomass and high cell concentrations, generally occur when the upper water column is nutrient rich and relatively

stable. Such conditions may occur in exposed areas in late April and May when light increases and low-salinity meltwater serves to stabilise the upper water column (Legendre *et al.* 1982). Between mid and late summer in Hudson Bay, occasional increases in stratification strength of the upper water column limits the flow of nutrients into the euphotic zone and causes a reduction in phytoplankton primary productivity (Ferland *et al.* 2011).

Despite a relatively low primary productivity when compared with that of more temperate waters, the Hudson Bay-James Bay system has a diverse microalgal community, comprising of over 495 taxa (Roff and Legendre 1986). Such high diversity, which is the reversal of a general trend, is well known but poorly understood. Assemblages of phytoplankton found in Hudson Bay, comprising primarily of marine diatoms and dinoflagellates, are reported to not differ significantly in species composition from those identified in Arctic and North Atlantic waters. The phytoplankton assemblages reported are a mixture of arctic, boreal and temperate forms (Roff and Legendre 1986). From marine water sampled from the plume at the mouth of Chesterfield Inlet the most common species of dinoflagellates were *Massartia rotundata*, *Peridinium pallidum* and *Peridinium pellucidum* (Anderson 1979; Anderson *et al.* 1981).

As part of the "CALANUS" expeditions of northern Hudson Bay and Hudson Strait, Harvey *et al.* (1997) found the most commonly occurring phytoplankters (100% occurrence) to include one very abundant unidentified flagellate, one prasinophyte *Pyramimonas* sp. and two cryptophytes. Centric and pennate diatoms, and dinoflagellates were the most abundant groups reported throughout the transect sample stations, although abundances of dinoflagellates was reported to increase near the mouth of James Bay. With the exception of dinoflagellates and small flagellates, the abundances of most phytoplankters were found to be inversely correlated to temperature, silicates and the strength of stratification within the euphotic zone (Harvey *et al.* 1997).

During the springtime, the bottom 1 to 5 cm of sea ice is typically colonized by dense populations of ice algae and free-floating phytoplankton are often present in high concentrations at the ice-water interface (Legendre *et al.* 1992). Ice algal biomass below first-year sea ice can be predicted for much of the Arctic by use of information on cumulative surface light and snow depth (Welch *et al.* 1991). Welch *et al.* (1991) measured ice algal chlorophyll *a* (Chl), production between March and May near Chesterfield Inlet, Nunavut, as an estimator of phytoplankton biomass. Ice algae biomass was found to be negatively associated with snow depth at any given date or location and reached a maximum of approximately 170 mg Chl m^{-2} in thin ice over deep water.

5.1.4 Marine Zooplankton

Zooplankton are heterotrophic organisms ranging in size from microscopic, single-celled, protozoa to large, multicellular, metazoans. Although predominantly transported by drifting in ambient currents, most zooplankton have a source of locomotion in order to escape predation. Zooplankton may feed on phytoplankton, bacterioplankton, detritus or cannibalistically on other zooplankton. Typically, zooplankton are found in the surface waters where there is an abundance of phytoplankton and other zooplankton. Falling detritus however (termed 'marine

snow') provides a food source for detritivorous zooplankton enabling abundances at greater depths. Due to their consumption of phytoplankton and other sources of primary production, zooplankton serve an ecologically important role in marine food webs as a conduit, packaging organic material for consumption by higher trophic levels. The vertical migrations of some zooplankton and zooplankton consumers in the water column also serve to restore sinking algal organic material back into the euphotic zone (Legendre *et al.* 1992).

There is a lack of information in the literature surrounding zooplankton dynamics in Hudson Bay. What literature there is primarily consists of information relating to eastern Hudson Bay and James Bay, brief taxonomic studies of occurrence and simple listings of specific groups of organisms *(Harvey et al.* 2001). Sampling a transect for zooplankton in Hudson Bay and Hudson Strait, Harvey *et al.* (2001) reported that the most commonly occurring (100% occurrence) zooplankters were the copepods *Calanus glacialis* and *Pseudocalanus* spp., the amphipod *Themisto libellula*, the chaetognath *Sagitta elegans*, and species from the phylum Cnidaria. *C. glacialis* and *Pseudocalanus* spp. were the most abundant species with reported densities of up to 26,769 individuals m^{-2} and 37,427 individuals m^{-2}, and mean densities of to 4,360 individuals m^{-2} and 12,477 individuals m^{-2}, respectively. Other commonly occurring taxa reported in Hudson Bay and Hudson Strait include other copepod species, molluscs, annelids, crustaceans, euphausiids, decapods and tunicates. Harvey *et al.* (2001) reported that zooplankton abundance was four times as high at sampling stations in the middle of Hudson Strait than at stations on the western side of Hudson Strait and in Hudson Bay. High abundances were associated with local hydrodynamic features which resulted in cooler and higher salinity mixed surface waters. Lower abundances of zooplankton were associated with warmer, lower salinity stratified surface waters.

Several amphipod and copepod species are known to graze on phytoplankton populations, including those of the diatom generas *Nitzschia* spp. and *Navicula* spp., present under sea ice and at ice edges in the Canadian High Arctic (Legendre *et al.* 1992). Siferd *et al.* (1997) investigated the seasonal distribution of sympagic[3] amphipods near Chesterfield Inlet and recorded several common species of amphipods including *Ischyrocerus anguipes, Pontogeneia inermis*, *Apherusa megalops* and *Weyprechtia pinguis.*

[3] An environment where water exists mostly as a solid.

6 MARINE FISH AND INVERTEBRATES

6.1 LITERATURE REVIEW

6.1.1 Marine Invertebrates

Limited research is available on the occurrence and abundance of marine invertebrates in Hudson Bay and much about their ecology, abundance and distribution is still unknown (Stewart and Lockhart 2005b). Present data indicates that at least 689 species of metazoan invertebrates and 25 species of urochordates occur in waters of the Hudson Bay marine ecosystem (Stewart and Lockhart 2005b). Few invertebrates inhabit the intertidal zone on a permanent basis, likely due to the scouring action of the winter ice (Stewart and Lockhart 2005b). The pelagic zone is characterized by comb jellies, arrow worms, copepods and amphipods, euphausids, and pelagic sea butterflies (Stewart and Lockhart 2005b).

The summary below includes major invertebrate groups that provide significant value either through their trophic importance in the food chain or as a harvested species by some local groups. While some small scale subsistence fishing occurs in Nunavut, there are currently no large-scale commercial fisheries in Hudson Bay due to the relatively low species abundance, long time to reach maturity, and high cost to harvest these organisms (Stewart and Lockhart 2005b).

6.1.1.1 Squid

The boreal armhook squid (*Gonatus fabricii*) is the most abundant squid found in marine waters of the Arctic and sub-Arctic of the North Atlantic (Bjorke 2001) and is found within Hudson Bay (Stewart and Lockhart 2005b). *G. fabricii* is short lived and fast growing (Frandsen and Wieland 2004). Bjorke (2001) suggests that the life span of *G. fabricii* does not likely exceed two years of age but Frandsen and Wieland (2004) report spawning occurring up to three years of age. The largest recorded specimen of *Gonatus fabricii* was 385 mm mantle length (Bjorke 2001). They are considered ecologically important due to their presence in the diets of fish, birds and mammals (Gaston *et al.* 1985; Gardiner and Dick 2010).

6.1.1.2 Bivalves

Several species of harvested bivalves are found within Hudson Bay including clams (*Mya truncata*), Icelandic scallops (*Chlamys islandica*), and blue mussels (*Mytilus edulis*) (Stewart and Lockhart 2005b).

Mya truncata are found buried in sandy or muddy benthic substrates (Aitken and Fournier 1993). They are most common in waters <50 m in depth (Aitken and Fournier 1993). Icelandic scallop are most common at depths of 20 to 60 m (Pedersen 1994). They are generally found on substrates consisting of shells, gravel, stones, rocks, and occasionally mud and are often in areas associated with strong tidal currents (Pedersen 1994). *Mytilus edulis* occur in both the intertidal and subtidal zones. They are sessile organisms, requiring hard substrate (e.g.,

bedrock, boulder, cobble, docks, and pilings) for attachment although they can also inhabit areas of sand or mud if there are hard objects (e.g., stones or other shells) within it to attach to (Newell 1989).

Bivalves are important prey for many fish, bird and mammal species in the Hudson Bay area (Stewart and Lockhart 2005b). *Mya truncata* are important prey of walrus and bearded seals (Mansfield 1958; Smith 1981) and it is estimated that a single walrus consumes 4,500 to 6,500 *M. truncata* per day (Welch and Martin-Bergmann 1990). *Mytilus edulis* are also an important prey species for various fish and seabird species (Stewart and Lockhart 2005b). Subsistence harvesting of *Mya truncata, Chlamys islandica* and *Mytilus edulis* occurs in the Belcher Islands (Stewart and Lockhart 2005b). An Icelandic scallop bed exists at the mouth of Chesterfield Inlet (Mercier *et al.* 1994).

6.1.1.3 Green Sea Urchin

The Green sea urchin (*Strongylocentrotus droebachiensis*) has a circumpolar distribution and is found along the coasts of Baffin Island, Foxe Basin, Hudson Strait and Foxe Channel (Atkinson and Wacasey 1989) as well as in Hudson Bay and James Bay (Stewart and Lockhart 2005b).

Strongylocentrotus droebachiensis commonly inhabit the low intertidal zone (Stewart and Lockhart 2005b) and prefer rocky benthic substrates (Himmelman 1986). Aggregations of green urchins are generally correlated with high abundances of macroalgae, their primary food (Himmelman 1986). *Strongylocentrotus droebachiensis* is perhaps the most common and abundant echinoderm in the James Bay and southeastern Hudson Bay (Clark 1922; Giroux 1989; Morin *et al.* 1991). *Strongylocentrotus droebachiensis* are commercially harvested in Eastern Canada and the Belcher Islands (Stewart and Lockhart 2005b).

6.1.2 Marine Fish

Shorelines around Chesterfield Inlet are typically composed of flat bedrock which transitions to subtidal cobble, gravel and sand. Intertidal habitat consists of sand and/or mudflat with a gently sloping grade dominated by moderately dense rockweed cover. The mid to low intertidal zones have low diversity of red seaweeds.

At least 49 species of fish occur in the marine ecosystem of Hudson Bay; 22 marine, nine mostly marine with occasional use of brackish water, one estuarine, nine anadromous, and eight mostly freshwater with occasional use of brackish water (Stewart and Lockhart 2005b). Very little is known throughout most of the Arctic regarding fish species occurrence and distribution. The absence of commercially exploitable resources in Hudson Bay as well as physical limitations (such as a short ice-free season) has likely restricted research efforts on fish populations in the region (Stewart and Lockhart 2005b). IQ has been limited mostly to observations from shallow nearshore waters and stomach contents of harvested fish (Stewart and Lockhart 2005b). Offshore marine fish resources are virtually unknown (Stewart and Lockhart 2005b). Despite a paucity of direct research on fish species occurrence and distribution, some of this information is available indirectly from studies of seabird diets (Gaston

et al. 2003). Although commercial fisheries are limited, subsistence harvest for a variety of species, such as Arctic char, can be substantial (Table 6.1-1).

Table 6.1-1: Estimated mean annual subsistence harvests of fishes by communities in RAA[1]

Community	Period	Cod	Sculpin	Arctic char
Arviat	1983 – 85	53	2	2643
Whale Cove	1982, 1984 – 5	–	–	3327
Rankin Inlet	1982 – 85	12	13	7361
Chesterfield Inlet	1983 – 85	–	–	237

NOTE:
[1] Table modified from (Stewart and Lockhart 2005a)

Several fish species of Baker Lake and Chesterfield Inlet play important roles in the ecological, economic and cultural health of the local communities. Arctic cod (*Boreogadus saida*), Arctic sculpin (*Myoxocephalus scorpioides*), Arctic char (*Salvelinus alpines*), fourhorn sculpin (*Triglopsis quadricornis*), banded gunnel (*Pholis fasciata*), and whitefish (*Coregonus nasus*) use sand and boulder benthic habitat around the mouth of Chesterfield Inlet.

No fish are listed under the Canadian *Species at Risk Act* (SARA) or designated by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as species of concern in Chesterfield Inlet and surrounding area. Arctic char, fourhorn sculpin and whitefish are listed under IUCN red list as a species of least concern (Table 6.1-2).

Table 6.1-2: Fish species status in the RSA[1]

Common Name	Scientific Name	Likely Found	Habitat Type	Conservation Status
Arctic cod	*Boreogadus saida*	Mouth of Chesterfield Inlet; Hudson Bay Coast	Demersal; anadromous; brackish; marine; 0 – 1,383 m	Not listed
Arctic sculpin	*Myoxocephalus scorpioides*	Mouth of Chesterfield Inlet; Hudson Bay Coast	Demersal; brackish; marine; 0 – 275 m; rocky bottoms among algae	Not listed
Arctic char	*Salvelinus alpinus*	Chersterfield Inlet; Hudson Bay	Benthopelagic; anadromous; brackish; marine; 30 – 70 m	IUCN Red List (Least Concern)
Fourhorn sculpin: marine form	*Triglopsis quadricornis* or *Myoxocephalus quadricornis*	Hudson Bay	Marine; 0 – 100 m	IUCN Red List (Least Concern)
Banded gunnel	*Pholis fasciata*	Mouth of Chesterfield Inlet,Hudson Bay	Demersal; marine; 0 – 94 m	Not listed
Broad whitefish	*Coregonus nasus*	Chersterfield Inlet; Hudson Bay	Demersal; anadromous ; brackish; marine	IUCN Red List (Least Concern)

NOTE:
[1] Table adapted from FishBase (2011, internet site)

Arctic char are the most abundant and dominant salmonid species throughout the Arctic; however they are not found much further south than 60°N due to competition from other species (Mercier *et al.* 1994). They can be both anadromous and landlocked. The anadromous char migrate out to Hudson Bay for summer feeding during ice break-up from mid-June to early July, and migrate back upstream from mid-August to mid-September to spend the winter in fresh water (Stewart and Lockhart 2005b). They spawn in late August to early October, preferring gravel substrate with sufficiently deep water to prevent the eggs from freezing and sufficient current to keep them clean (Stewart and Lockhart 2005b). After spawning, they will overwinter in the lake and migrate to the ocean to feed the following spring. While they are in the Bay during the summer they are known to feed on other marine fish including capelin (*Mallotus villosus*), sand lance (*Ammodytes americanus*), Arctic cod (*Boreogadus saida*) and Greenland cod (*Gadus ogac*) (Johnson 1989). In the Kivalliq region, they are harvested from the Thlewiaza River north to Daly Bay and into Chesterfield Inlet (Stewart and Lockhart 2005b).

Broad whitefish (*Coregonus nasus*) belongs to the second main group of anadromous fish in the Arctic, the coregonids (Stephenson and Hartwig 2010). They are known to occur in the Chesterfield Inlet area (FishBase 2011). Migration to spawning grounds in freshwater typically occurs in late July to early August (FishBase 2011).

Arctic cod are a small, pelagic cod species that play a key role in the Hudson Bay marine ecosystem. They are typically associated with ice cracks and edges and occur further inshore in late summer. They are widely distributed throughout the Bay where they support the diet of many other fishes, seals whales and marine birds (Stewart and Lockhart 2005b). They are occasionally taken for subsistence.

The banded gunnel is typically found inshore from the intertidal to 28 m at or near the bottom over rocky substrate. It is a prey item of Arctic cod, sculpins and seabirds (Stewart and Lockhart 2005b). The Arctic sculpin and fourhorn sculpin are eaten by larger fish and seabirds. Arctic sculpin is generally found over smooth or weedy bottoms from the intertidal to 110 m, while the fourhorn sculpin rarely occurs below 20 m and can be commonly found in tide pools and eelgrass beds (Stewart and Lockhart 2005b).

7 MARINE BIRDS

7.1 LITERATURE REVIEW

The most common species of waterbirds observed in Baker Lake and Chesterfield Inlet area are Canada goose, long-tailed duck, and common loon (Höhn 1969). Red-throated, arctic and yellow-billed loons have also been observed in the area as well as tundra swan (Höhn 1969). The Kivalliq region of Nunavut represents an important migratory, staging, moulting, and nesting area for white-fronted, snow, and Canada geese, sandhill crane, tundra swan, dunlin, golden-plover species, Baird's sandpiper, numerous gull species and arctic tern (Canadian Circumpolar Institute 1992).

The Important Bird Area (IBA) Program is an initiative between Bird Studies Canada, Nature Canada and BirdLife International for the international conservation of discrete sites that support threatened birds, large groups of birds, and birds restricted by range or by habitat. While a variety of migratory and non-migratory bird species may be found with the project area, no IBAs are identified within the LSA and eight sites with coastal and marine habitat components have been identified in or adjacent to the RSA (Bird Studies Canada (BSC) 2011 Internet site). Key marine habitat areas have been identified by the Canadian Wildlife Service (CWS) as areas that are essential to the welfare of various migratory bird species in Canada. The CWS established 16 bird sanctuaries in Canada to control and manage areas of importance for the protection of migratory birds, their nests and eggs. There are two migratory bird sanctuaries (MBS) with coastal habitat that fall within or are adjacent to the RSA. First, Harry Gibbons MBS situated in northern Hudson Bay on Southampton Island supports 10% of the world's Snow Goose population (IBI, internet site). Second, McConnell River MBS (Environment Canada 2011, internet site) is a large , primarily coastal marsh habitat for between 3-5% of the Arctic's breeding population of Snow Goose and Ross's Goose (IBI program, internet site). There three key marine bird habitat sites identified within or adjacent to the RSA (Mallory and Fontaine 2004).

Within the southern RSA at the Port of Churchill, Ross's gull is known to breed and use coastal habitat within this area. The species is nationally designated as Threatened by COSEWIC and listed in Schedule 1 of SARA. Ross's gull are more commonly seen in the Churchill area than anywhere else in Canada and represents only one of four breeding areas in the country (COSEWIC 2007). The last observation of Ross's Gull in the Churchill area was 4 individuals in 2005 (COSEWIC 2007). Nesting records were located inland but within 1 km from the Hudson Bay coastline, and individuals were also observed using coastline habitat in early August following the breeding season between early June and late July (Chartier and Cooke 1980).

The King Eider is given special designation by the Government of Nunavut. The King eider has not been assessed by COSEWIC but is ranked as Sensitive in Nunavut due to national declines, which are at least partially attributed to international subsistence harvest. An estimated 20,000 are taken per year in Alaska and western Canadian Arctic but no estimates are available for eastern Arctic (Sea Duck Joint Venture 2003, internet site). King eider populations breeding in

coastal areas of Hudson Bay are locally harvested at subsistence rates and commercially harvested (estimated at 20,000 individuals) during their wintering period in Greenland (Sea Duck Joint Venture 2003, internet site).

8 MARINE MAMMALS

8.1 LITERATURE REVIEW

Based on available information, nine marine mammal species inhabit northwestern Hudson Bay (Table 8.1-1). Of these species, three are considered common (beluga whale, ringed seal and polar bear) and six are considered rare or uncommon (bowhead whale, narwhal, bearded and harp seals, walrus and killer whale). A brief overview of conservation status, distribution and abundance of these nine marine mammal species within the study areas are provided in the following sections.

Table 8.1-1: Conservation Status of Marine Mammals Present in Western Hudson Bay and Chesterfield Inlet

Species	Scientific Name	*Species at Risk Act* (SARA) Schedule	Committee on Status of Endangered Species in Canada (COSEWIC) Status	Occurrence[4] in Western Hudson Bay
Beluga whale (Western Hudson Bay population)	*Delphinapterus leucas*	Not Listed	Special Concern	Common
Ringed seal	*Phoca hispida*	Not Listed	Not at risk	Common
Polar Bear	*Ursus maritimus*	Not Listed	Special Concern	Common
Bowhead Whale	*Balaena mysticetus*	Not Listed	Special Concern	Uncommon
Bearded Seal	*Erignathus barbatus*	Not Listed	Data Deficient	Uncommon
Harp Seal	*Phoca groenlandica*	Not Listed	Not Listed	Uncommon
Walrus	*Odobenus rosmarus*	Not Listed	Special Concern	Uncommon
Narwhal	*Monodon monoceros*	Not Listed	Special Concern	Rare
Killer Whale	*Orcinus orca*	Not Listed	Special Concern	Rare

8.1.1 Beluga Whale

The most recent population estimate for the western Hudson Bay population of beluga whales is 57,300 animals (95% C.L.: 37,700 – 87,100) (Richard 2005a). Site specific information of habitat use by beluga whales in Chesterfield Inlet (and western Hudson Bay) is limited.

After spring ice breakup in mid- to late June, western Hudson Bay belugas concentrate in the Churchill, Nelson and Seal River estuaries and increase in abundance until late July (Richard *et al.* 1990). Migration northward along the coast of Hudson Bay is believed to begin in late August or early September (COSEWIC 2004a). Satellite tag data shows the population moving towards wintering habitat in Hudson Strait; however, the routes taken between summering and wintering habitats are not well known. Belugas have been observed travelling north within the eastern portion of Chesterfield Inlet during the fall migration. Although few records of belugas in the

[4] As determined from IQ and available literature.

western portion of Chesterfield Inlet exist, the Baker Lake Hunters and Trappers Organization recorded the migration of five animals through Chesterfield Inlet into Baker Lake (Hunters and Trappers Association of Nunavut 1992).

Beluga whales are economically important to the Inuit of Nunavut and are hunted by 20 out of 28 communities (Priest and Usher 2004). Over the five-year period from 1996 to 2001, the total annual mean number of belugas taken through hunting was 1,339 for all of Nunavut, while annual rates of belugas harvested from the community of Chesterfield Inlet ranged from three (2001) to 31 (1996) (Priest and Usher 2004). Based on Inuit knowledge belugas are easier to hunt than other marine mammals because they are naive of humans and are often approached without fleeing (Richard 2001).

8.1.2 Bowhead Whale

Bowhead whales have a nearly circumpolar distribution in the northern hemisphere and are widespread in Nunavut. Based on their summer distribution, there are two stocks in the eastern Canadian Arctic: one that summers in northern Hudson Bay (around Repulse Bay and Frozen Strait) and Foxe Basin; and the other in Baffin Bay, Davis Strait and the waters of the Canadian High Arctic (Cosens *et al.* 2004; Wheeler and Gilbert 2007). Inuit from Repulse Bay report that they are concentrated at the floe edge in June, disperse after ice breakup and then gather inshore in August (NWMB 2000). A few sightings of bowhead whales were recorded in the 1980s at Arviat and in the Churchill River estuary but they are not common in southern Hudson Bay (Watts 1988 in Stewart and Lockhart 2005b).

The bowhead whale population is believed to have been increasing for decades and is likely still increasing in the absence of commercial whaling. This increase is supported by evidence from both IQ and science, with a current total abundance estimated at around 1,525 (95% CI: 333 – 6,990) for the Foxe Basin-Hudson Bay stock and 6,344 (95% CI: 3,119 – 12,906) for a single Eastern Canada-West Greenland population (COSEWIC 2009). During the most recent surveys of bowheads in north western Hudson Bay and Foxe Basin, approximately 270 whales were found, mainly north of Southampton Island in Foxe Basin, Fury and Hecla Strait (Cosens *et al.* 2004). It is assumed that bowheads over-winter in northern Hudson Bay, Hudson Strait and in central Davis Strait, southern Baffin Bay and west near Greenland (Dueck *et al.* 2006; Koski *et al.* 2006; Wheeler and Gilbert 2007).

8.1.3 Polar Bear

The range of the Western Hudson Bay and Foxe Basin sub-populations of polar bears overlaps spatially but not temporally with the proposed shipping route through Chesterfield Inlet and Hudson Bay.

During the open-water season, polar bears spend several months along the western coastline of Hudson Bay from Southampton Island to Churchill (COSEWIC 2008). The Western Hudson Bay sub-population tends to congregate on coastal capes and headlands between Cape Churchill and Arviat (Stirling *et al.* 1999). The Foxe Basin sub-population concentrates on the west and

northeast coasts of Southampton Island and along the coast of Wager Bay (north of Chesterfield Inlet) during the ice-free season when shipping activities are expected.

IQ data suggests that polar bear numbers are increasing in the Chesterfield Inlet area; however, the most recent estimate of the Western Hudson Bay sub-population indicates that overall abundance has declined from approximately 1,294 in 1987 to 935 in 2004 (COSEWIC 2008).

8.1.4 Narwhal

Two populations of narwhals have been recognized for the purpose of hunt management in Canada (Stewart and Lockhart 2005b). The tentative separation into Baffin Bay and Hudson Bay populations is based largely on summering distribution. Narwhals that summer in northwest Hudson Bay are believed to over-winter in eastern Hudson Strait (Richard 1991) and range over an area of roughly 250,000 km² (COSEWIC 2004b). The most recent population estimate, based on data from photographic aerial surveys in the Repulse Bay area between Roes Welcome Sound and Lyon Inlet, estimated the narwhal population at 1,780 animals (90% CI = 1212 – 2492) in 2000 (Stewart and Lockhart 2005b).

The seasonal movement patterns of the Hudson Bay narwhals are not well known. In the spring, they likely migrate westward from wintering grounds in eastern Hudson Strait (Richard 1991), traveling offshore through Hudson Strait and Foxe Channel until they reach the floe edge east of Repulse Bay in late June (Stewart and Lockhart 2005b). During the summer months, narwhals inhabit Hudson Bay, preferring coastal areas that offer deep water and shelter from the wind (COSEWIC 2004b). They tend to concentrate in the waters surrounding Southampton Island, with the largest aggregations found in Repulse Bay, Frozen Strait, western Foxe Channel and Lyon Inlet (Richard 1991). Whales from this population also spend the summer in Wager Bay and Duke of York Bay, although typically in smaller numbers (Stewart and Lockhart 2005b). Narwhal generally remain at their summering grounds until late August or early September, at which point they travel south eastward out of the area through Frozen Strait, following the east coast of Southampton Island.

In Hudson Bay, they are rarely seen west of Southampton Island or along the west coast of Hudson Bay, unless they are avoiding predation by killer whales (COSEWIC 2004b). Based on available data, narwhals are not expected to be common in or around Chesterfield Inlet. One narwhal was caught by a hunter between 1997 and 1998 in Whale Cove (south of Chesterfield Inlet) (DFO 1998) and three carcasses have been found along the Ontario coast of Hudson Bay (COSEWIC 2004b).

8.1.5 Killer Whale

Killer whales are known to inhabit arctic waters; however, there are no population estimates for killer whales in Nunavut. Their presence in Hudson Bay has been increasing since the mid-1900s, before which they were not reported in the area (Reeves and Mitchell 1988). They are seen infrequently and in small numbers in northern Hudson Bay, and south along the Kivalliq coast to Churchill. The community of Chesterfield Inlet reported seeing a pod of seven killer whales in August 2008, while the community of Arviat observed a group of approximately 30

killer whales at Sentry Island a few years ago. Inuit of Nunavut presently do not harvest killer whales.

8.1.6 Atlantic Walrus

Some of the most southerly populations of Atlantic walrus are now found in southeast Hudson Bay and James Bay, though walruses are more common and abundant in northwest Hudson Bay, Hudson Strait and Foxe Basin (Mansfield and St. Aubin 1991). Four distinct stocks of Atlantic walrus have been identified in Canadian waters (Outridge *et al.* 2003). Two of these, the South and East Hudson Bay Stock and the Hudson Bay-Davis Strait Stock, are known to occur in the regional study area (Stewart and Lockhart 2005b). The Northern Hudson Bay-Davis Strait population is distributed over an area of roughly 385,000 km^2 from Arviat, north and east through Hudson Strait, to Clyde River on the east coast of Baffin Island (Stewart 2002). The Hudson Bay-Davis Strait Stock may consist of separate sub-stocks that inhabit northern Hudson Bay, Hudson Strait, and Davis Strait. Inuit have observed differences in body size and tusk length that are consistent with these separations, suggesting that Chesterfield Inlet and Repulse Bay may not share the same walrus populations (Stewart and Lockhart 2005b).

In western Hudson Bay, walruses occur south to Churchill yet become increasingly numerous moving north along the coast. They often occur in areas of shallow, open water, which support an abundant clam community for foraging. During the summer they prefer to haul out on low, rocky shores with steep subtidal zones. Walruses are generally absent near Chesterfield Inlet in summer, but do over-winter in the Chesterfield Inlet-Roes Welcome Sound area and are found on the other side of the inlet in the spring (Stewart and Lockhart 2005b). They occur in Wager Bay when ice is minimal and Inuit indicate that they prefer areas with strong current. Walruses are common in the Repulse Bay area, but are seen less often when ice concentration remains high during the summer.

Walruses traditionally provide important staples in the subsistence economy of the eastern Canadian Arctic (COSEWIC 2006). Many (18 out of 28) communities in Nunavut hunt walrus (Priest and Usher 2004). Over a five-year period, from 1996 to 2001, the total number of walruses harvested near Chesterfield Inlet ranged between one and four animals annually (Priest and Usher 2004). During a series of interviews to collect IQ, residents of Chesterfield Inlet indicated they typically hunt walrus north of Chesterfield Inlet near Depot Island and Daley Bay (AREVA 2009).

8.1.7 Ringed Seal

The ringed seal is the most common and abundant species of seal in Hudson Bay, where it is resident year-round. Estimates of ringed seal populations are based mainly on aerial surveys conducted during the peak haulout and moulting period from late May to early July. Smith (1975) conducted an aerial survey of Hudson Bay between Churchill and Chesterfield Inlet, and estimated that there were 455,000 ringed seals in Hudson Bay—including Roes Welcome Sound. More recently, aerial systematic strip transect surveys extending from the Nelson River estuary to Rankin Inlet estimated 38,340 (SE = 3640) ringed seals in 1994 and 140,880 (SE = 8100) ringed seals in 1995 (Lunn *et al.* 1997). These estimates are likely conservative because

they are based on the number of seals hauled out on the ice and were not corrected for seals that were submerged. The total population of the area may be twice as large (Stirling and Øritsland 1995).

In spring, the highest densities of breeding adults occur on stable, landfast ice in areas with good snow cover, whereas non-breeders tend to be found at the floe edge or in the moving pack ice (Stewart and Lockhart 2005b). Their ability to maintain breathing holes in ice enables them to occupy areas of Nunavut that are inaccessible to other marine mammals during the colder seasons.

8.1.8 Bearded Seal

Bearded seals are found along almost all coastal areas of Nunavut year-round (Gilchrist and Robertson 2000). They have a wide, yet patchy, distribution and a relatively low density; they are considerably less abundant than ringed seals (Stewart and Lockhart 2005b).

Aerial systematic strip transect surveys were conducted north from the Nelson River estuary to Rankin Inlet to derive population estimates. In 1994, the bearded seal population was estimated at 12,290 (SE = 2,520) while in 1995, it was estimated at 1,980 (SE = 560) (Lunn *et al.* 1997).

Bearded seals prefer areas of moving pack ice and open water, and may move between coastal and offshore areas in response to changing ice conditions (Stewart and Lockhart 2005b). Aggregations of bearded seals are most likely to occur during the winter months prior to ice breakup and during early summer when the availability of ice pans for haulout is limited. During the open-water period, they will enter estuaries and haulout on land, sometimes in the company of harbour seals (Stewart and Lockhart 2005b). The Arctic Marine Proceedings held in 1994 suggest that bearded seals are likely to be present throughout coastal areas in Hudson Bay and Chesterfield Inlet (Freshwater Institute 1994).

8.1.9 Harp Seal

The most recent aerial survey of the northwest Atlantic harp seal population was conducted in 2004 by DFO, and resulted in an estimate of 5.82 million individuals; however, there are no estimates for the population within Nunavut (DFO 2005). The northwest Atlantic harp seal population is concentrated (upwards of 20,000 individuals) in Lancaster, Eclipse and Jones Sounds, and at the head of Cumberland Sound and Frobisher Bay (Freshwater Institute 1994). A small number of harp seals seasonally migrate into Hudson Bay, occurring south to Arviat in the west and the Belcher Islands in the east (Richard 2001). Harp seals are less common in Hudson Bay than ringed or bearded seals (DFO 2005).

Local residents of Nunavut hunt harp seals for food and fur (Richard 2001). About half the communities (18 out of 28) in Nunavut hunt harp seal (Priest and Usher 2004). Over a five year period (1996 – 2001), a total of 24 harp seals were harvested from Chesterfield Inlet (Priest and Usher 2004), confirming the presence of this species in the region.

8.2 AERIAL SURVEY RESULTS – 2008

8.2.1 Overview

Aerial surveys were conducted over five days in 2008. The raw survey data can be found in Appendix B, and daily and overall effort, environmental conditions and sightings are summarized here.

The five surveys comprised a total of 3,868 km of linear survey over 17.51 hours Survey effort over offshore transects was impeded by poor conditions (sea state >4) during a portion of three survey dates (September 12, 13, and 15). Poor conditions (precipitation, low ceiling, high winds) grounded the aircraft on September 14. Sea state is a key factor that affects the ability to detect marine mammals during aerial surveys (Buckland *et al.* 2001). Sea state conditions were generally better near the shoreline and within Chesterfield Inlet over all days, compared to surveys conducted in offshore areas. Survey design was adapted due to frequently high sea state offshore, as well as to incorporate feedback on beluga whale habitat from local wildlife advisors. As a result, survey effort was greatest within Chesterfield Inlet (42% of total survey effort), followed by survey of offshore transects (34% of total survey effort) and survey of the shoreline between Rankin Inlet and Chesterfield Inlet (23% of total survey effort).

8.2.2 Daily Reports

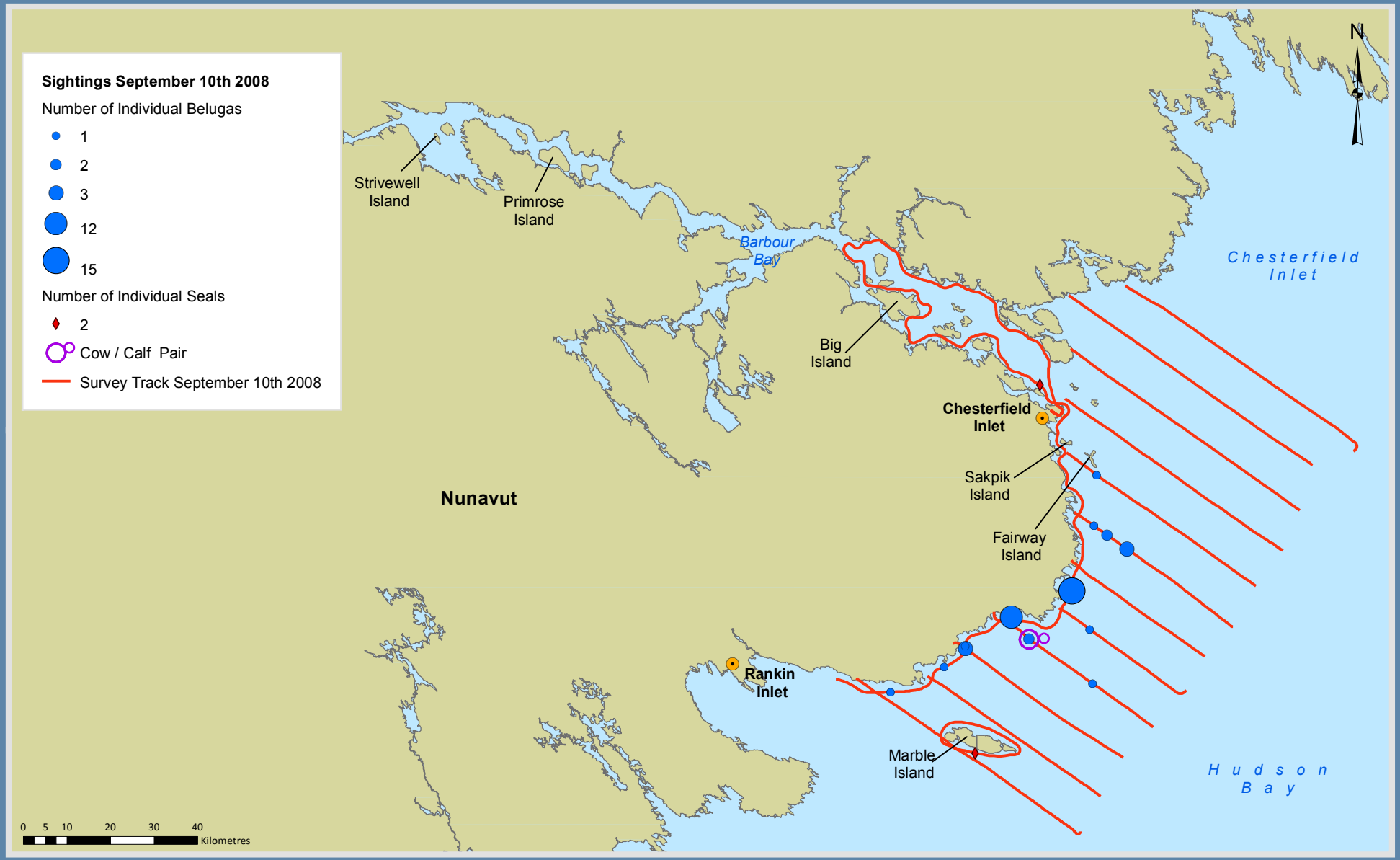
September 10, 2008

To maximize survey effort and airplane availability, the shoreline between Rankin Inlet and Chesterfield Inlet was surveyed en route to the community of Chesterfield Inlet for refuelling and to pick up secondary observers. Approximately half of Chesterfield Inlet was surveyed. Favourable conditions offshore allowed completion of offshore Transects 1 through 12 for a total effort of 805 km. The shoreline of Marble Island, located between offshore Transects 11 and 12, was surveyed after an undocumented report of killer whales in the area the week prior.

Weather varied between overcast with mixed cloud and sun throughout the day. Observation conditions ranged from good to excellent, with a sea state of less than 3, relatively calm winds and marginal glare throughout the day.

A total of 44 beluga whales were observed amongst 13 separate sightings. Photo 8.2-1 shows five adult belugas within a group of 15 animals sighted along the shoreline between Rankin Inlet and Chesterfield Inlet. Observed whales were swimming in one of two directions (north or east). This included one cow/calf pair sighted offshore (approximately 30 km) on Transect 9 (Figure 8.2-1). Two seals were observed over two independent sightings, one in the nearshore area of Marble Island and the second nearshore of Chesterfield Inlet.

Photo 8.2-1: Beluga Whales Sighted Near Shore between Rankin Inlet and Chesterfield Inlet on September 10, 2008



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Creator: SS
Date: 12/01/2009 Scale: 1:1,250,000
File: 1038926.04-019
Data Sources: *Natural Resources Canada, Geobase®, Natai Topographic Database, Areva Resources Canada Inc.*

FIGURE 8.2-1
SURVEY EFFORT SEPTEMBER 10 2008
MARINE MAMMAL SURVEYS

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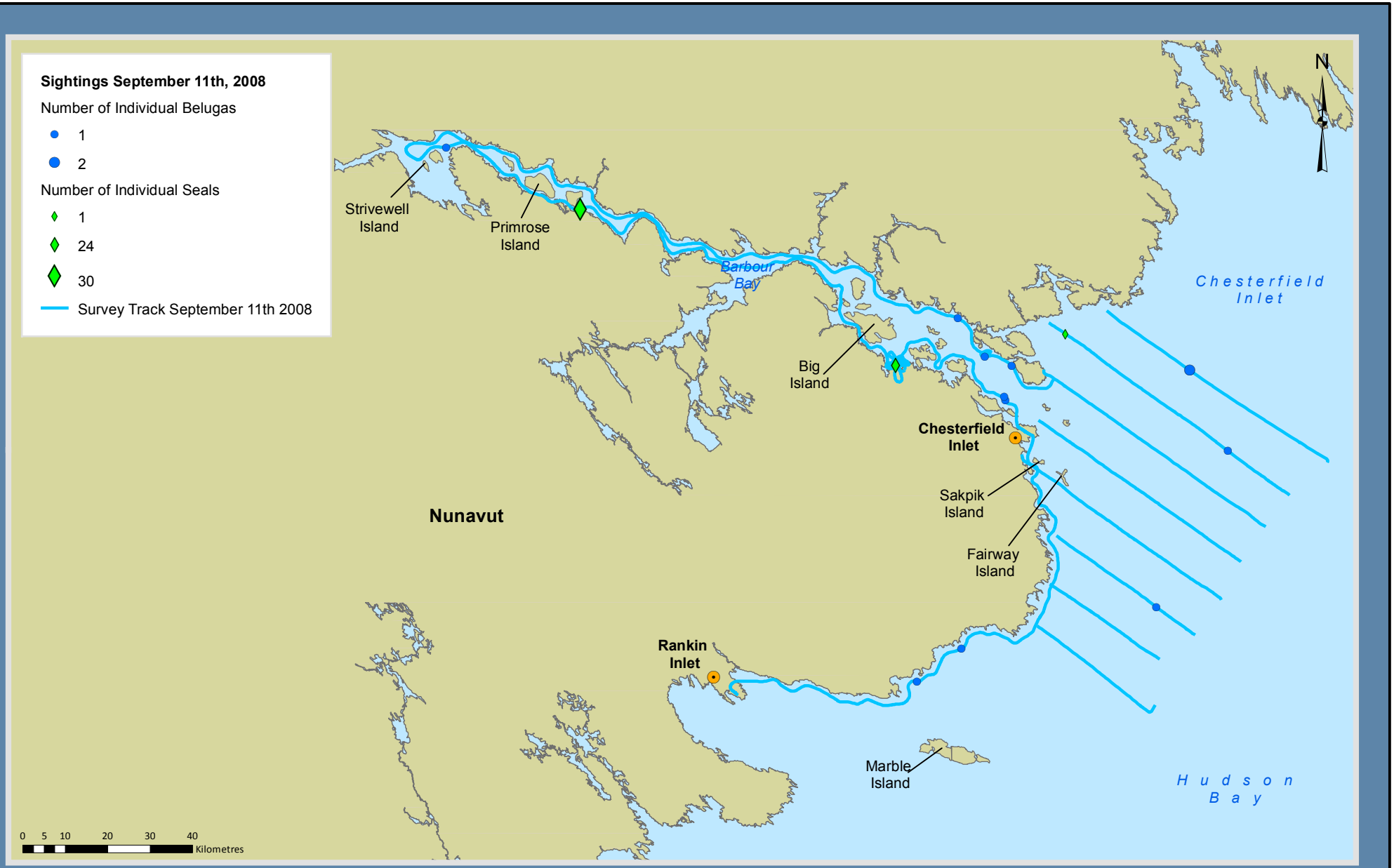
September 11, 2008

Similar to the surveys conducted on September 10, a coastal survey was first conducted between Rankin Inlet and Chesterfield Inlet. Poor visibility and unfavourable sea state conditions precluded earlier surveys of Transects 1 to 14. Consequently, Chesterfield Inlet itself was surveyed. The survey of Chesterfield Inlet included a westward leg along the southern shore, and an eastward leg along the northern shore (Figure 8.2-2). After Chesterfield Inlet was surveyed, offshore Transects 1 through 8 were surveyed for a total survey effort of 977 km.

Weather varied throughout the day and between regions (offshore and inlet) from clear skies to rain. Visibility was generally good, with recorded sea states of between 1 and 3.

A total of 12 belugas were observed over 11 separate sightings and 55 seals were observed during three sightings (Table 6.2-3). This included a group of 24 seals that was observed approximately 2 km from the south shore of Chesterfield Inlet, east of Big Island. Observed behaviours of beluga whales included swimming, diving and milling. Photo 8.2-2 shows three whales swimming north, approximately 20 km offshore along Transect 1.



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Creator: SS
Date: 12/01/2009 Scale: 1:1,250,000
File: 1038926.04-020
Data Sources: *Natural Resources Canada, Geobase®, Natai Topographic Database, Areva Resources Canada Inc.*

FIGURE 8.2-2
SURVEY EFFORT SEPTEMBER 11 2008
MARINE MAMMAL SURVEYS

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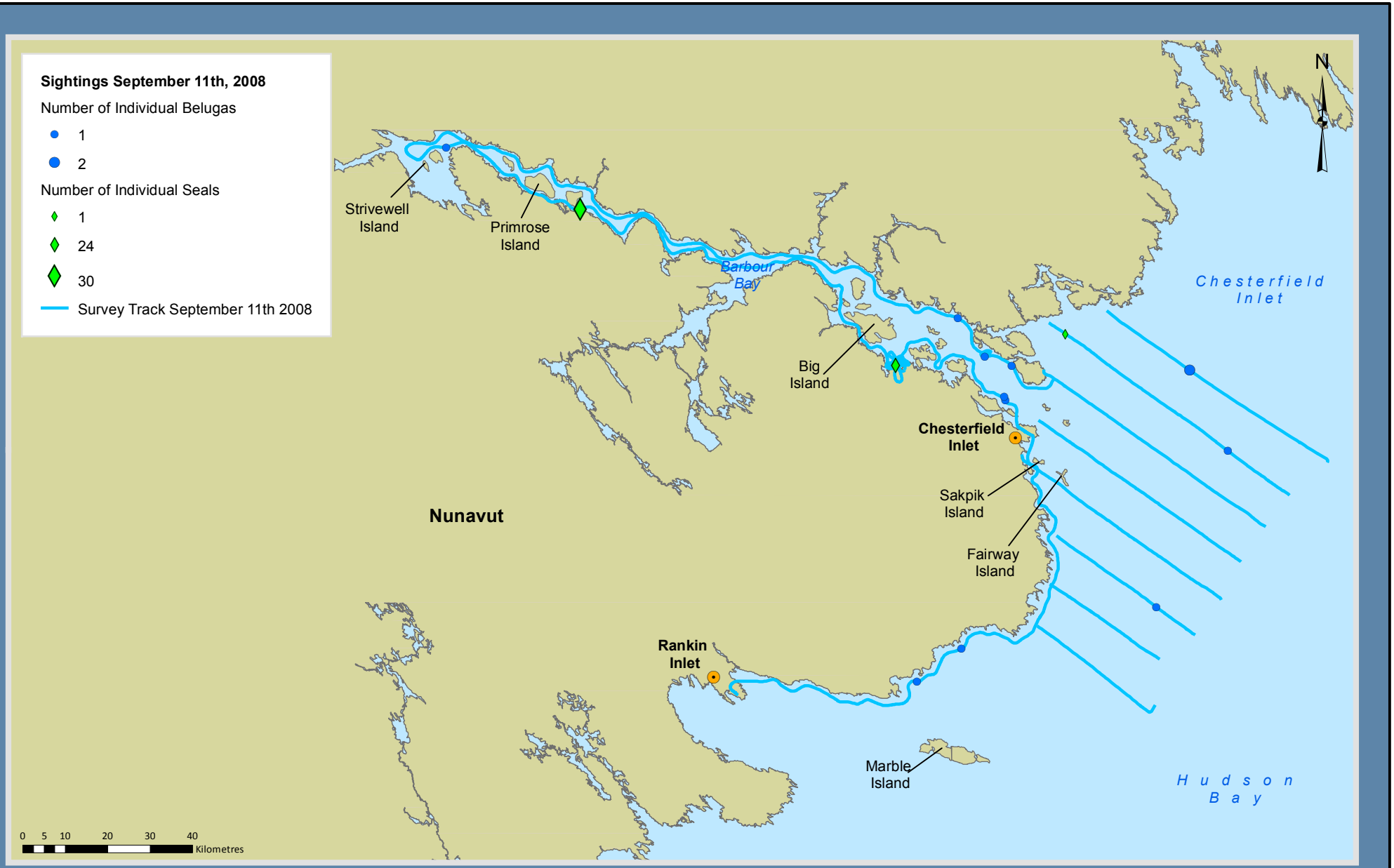
Photo 8.2-2: Beluga Whales Sighted Offshore between Rankin Inlet and Chesterfield Inlet on September 11, 2008

September 12, 2008

As with prior surveys, the coastal region between Rankin Inlet and Chesterfield Inlet was surveyed first. Due to high offshore winds and in response to input from the local wildlife observers, the survey design was altered to focus on Chesterfield Inlet itself. Following the survey of Chesterfield Inlet (south and north shore), attempts were made to survey Transects 1 and 2 (Figure 8.2-3). The remaining Transects (3 to 14) could not be surveyed due to the reduced visibility associated with wave states of greater than or equal to a Beaufort State 4. The coastal region between Chesterfield Inlet and Rankin Inlet was surveyed again (during the return to base). Total survey effort was 842 km.

Weather conditions during the day's survey varied from clear to overcast skies with a sea state of up to 3 along the shoreline and of greater than 4 offshore. Only two belugas were observed (in two separate sightings). One sighting occurred along the shoreline between Chesterfield Inlet and Rankin Inlet in an area known as the 'Baker forelands'. The other beluga was observed along the north shore of Chesterfield Inlet (Figure 8.2-3). A group of 24 unidentified seals was sighted approximately 3 km from the north shore of Chesterfield Inlet (Figure 8.2-3). Seals were observed quickly swimming towards land. Attempts to obtain further information (e.g., through photo-identification) were unsuccessful.



Projection: NAD 1983 UTM Zone 15N
Creator: SS
Date: 12/01/2009 Scale: 1:1,250,000
File: 1038926.04-020
Data Sources: *Natural Resources Canada, Geobase®, Natai Topographic Database, Areva Resources Canada Inc.*

FIGURE 8.2-2
SURVEY EFFORT SEPTEMBER 11 2008
MARINE MAMMAL SURVEYS

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September 13, 2008

As with prior surveys, the coastal region between Rankin and Chesterfield Inlet was surveyed first. The southern and northern coasts of Chesterfield Inlet were then surveyed (using the same flight path as the previous day). Upon completion of the survey of Chesterfield Inlet, offshore Transect 1 was completed; however, further survey of offshore transects was abandoned due to increasing winds and sea states. The remainder of the survey captured coastal regions between Rankin Inlet and Chesterfield Inlet, with a focus on Sakpik and Fairway islands, the Baker forelands and the outlet of the Josephine River (total effort of 768 km; Figure 8.2-4). A local wildlife advisor (Andre Tautu) reported the harvest of a single beluga on the shoreline near Finger Point (Baker forelands) during the week of September 1, 2008.

Conditions were overcast without precipitation throughout the day and with winds increasing in the afternoon. Two beluga sightings of one individual each were made, both along shore between Rankin Inlet and Chesterfield Inlet adjacent to the Baker forelands (Figure 8.2-4). No other marine mammals were observed.

Projection: NAD 1983 UTM Zone 15N
Creator: SS
Date: 12/01/2009 Scale: 1:1,250,000
File: 1038926.04-022
Data Sources: *Natural Resources Canada, Geobase®, Natai Topographic Database, Areva Resources Canada Inc.*

FIGURE 8.2-4
SURVEY EFFORT SEPTEMBER 13 2008
MARINE MAMMAL SURVEYS

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September 15, 2008

Initial coastal surveys and offshore surveys were not possible due to limited visibility and/or weather. The survey was, therefore, restricted to coastal regions near Sakpik, Fairway and Marble Islands and the north coast of Chesterfield Inlet (total of 477 km).

Weather conditions varied, but were generally overcast with high winds. Beaufort Sea state ranged from 2 to 5.

Two single belugas were observed during two independent sightings, both near the coast between Rankin and Chesterfield Inlet. One beluga was observed near the Baker forelands and the other approximately 15 km north (Figure 8.2-5). No other marine mammals were observed.

Projection: NAD 1983 UTM Zone 15N
Creator: SS
Date: 12/01/2009 Scale: 1:1,250,000
File: 1038926.04-023
Data Sources: *Natural Resources Canada, Geobase®, Natai Topographic Database, Areva Resources Canada Inc.*

FIGURE 8.2-5
SURVEY EFFORT SEPTEMBER 15 2008
MARINE MAMMAL SURVEYS

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8.2.3 Summary of Marine Mammal Sightings

Marine mammals were sighted every day and included only beluga whales and seals (likely harp or ringed seals; Table 8.2-1). All pinnipeds have been grouped because of the difficulty in identifying species from the air.

Over five survey days, a total of 62 beluga whales were observed (during 30 separate sightings) and 81 seals were observed (during six separate sightings; Table 8.2-1).

The majority of sightings (80%) and number of beluga whales observed (93%) occurred during the first two days of the survey (Table 8.2-1). Seals were not sighted during the last two days of the survey (Table 8.2-1).

Table 8.2-1: Marine Mammals Sightings and Number of Individuals Observed by Transect and Region on Each Day, September 10 – 15, 2008

Date	Flight, Transect Number or Area Name	Region	Time on Transect (min)	Beluga (sighting)	Beluga (# of animals)	Seal (# of sightings)	Seal (# of animals)
Sept 10, 2008	Coastline RI to CI	shoreline	43	3	3	1	1
	1	offshore	20	0	0	0	0
	2	offshore	21	0	0	0	0
	3	offshore	19	0	0	0	0
	4	offshore	19	0	0	0	0
	5	offshore	18	1	1	0	0
	6	offshore	14	3	6	0	0
	7	offshore	11	0	0	0	0
	b/w 7 and 8	shoreline	-	1	15	0	0
	8	offshore	11	1	1	0	0
	b/w 8 and 9	offshore	3	1	12	0	0
	9	offshore	13	2*	3	0	0
	10	offshore	16	1	3	0	0
	11	offshore	15	0	0	0	0
	12	offshore	19	0	0	0	0
	Marble Island	shoreline	13	0	0	1	1
Total for Sept 10, 2008			**255**	**13**	**44**	**2**	**2**
Sept 11, 2008	RI to CI	shoreline	32	2	2	0	0
	RI – CI / Chesterfield Inlet	shoreline	61	6	6	1	30
	Off transect: circling group of animals	shoreline	21	0	0	1	24
	1 (shoreline from CI)	shoreline	20	1	2	0	0

Date	Flight, Transect Number or Area Name	Region	Time on Transect (min)	Beluga (sighting)	Beluga (# of animals)	Seal (# of sightings)	Seal (# of animals)
	2	offshore	22	1	1	1	1
	3	offshore	19	0	0	0	0
	4	offshore	18	0	0	0	0
	6	offshore	13	1	1	0	0
	7	offshore	10	0	0	0	0
	8	offshore	10	0	0	0	0
Total for Sept 11, 2008			**226**	**11**	**12**	**3**	**55**
Sept 12, 2008	Coastline RI – CI	shoreline	46	0	0	0	0
	CI	Chesterfield Inlet	120	1	1	0	0
	Off CI transect: circling for group of animals	shoreline	10	0	0	1	24
	1	offshore	16	0	0	0	0
	2	offshore	19	0	0	0	0
	Shoreline CI – RI	shoreline	24	1	1	0	0
Total for Sept 12, 2008			**235**	**2**	**2**	**1**	**24**
Sept 13, 2008	Coastline: RI – CI	shoreline	36	0	0	0	0
	CI – length of the Inlet	chesterfield inlet	127	0	0	0	0
	1	offshore	13	0	0	0	0
	Coastline: CI – RI	shoreline	41	1	1	0	0
	Off transect: Circling Sakpik and Fairway Islands	shoreline	33	1	1	0	0
Total for Sept 13, 2008			**250**	**2**	**2**	**0**	**0**
Sept 15	Coastline: RI – CI	Chesterfield Inlet	85	2	2	0	0
Total for Sept 15			**85**	**2**	**2**	**0**	**0**
TOTAL			**1,051**	**30**	**62**	**6**	**81**

NOTE:
* Includes one sighting of a cow/calf pair

Survey effort of the coastal region resulted in 34 belugas being observed during 17 individual sighting events over 1,083 km of track-line surveyed (Table 8.2-2). These data translate to 1.57 sightings per 100 km and 3.14 whales per 100 km. Within the coastal survey region (i.e., 5 km or closer to shore), 32 seals were observed during three sighting events, corresponding to 0.28 sightings per 100 km and 2.95 seals per 100 km (Table 8.2-3). Of the 32 seals observed in the coastal region, 30 were counted during one of the three sightings.

A total of 25 belugas were observed offshore (i.e., greater than 5 km from shore) during 10 separate sighting events over 1,225 km of track-line surveyed (Table 8.2-2). This corresponded to 0.82 beluga sightings per 100 km and 2.04 whales per 100 km (Table 8.2-2). Within the offshore survey region, one seal was observed during one sighting event, representing 0.08 sightings and seals per 100 km (Table 8.2.3). The individual seal was observed approximately eight kilometres offshore, north of Chesterfield Inlet. No other pinnipeds were observed in the offshore region.

Within Chesterfield Inlet, three belugas were observed during three individual sighting events over 1,560 km of track-line surveyed. This corresponded to 0.19 beluga sightings and individuals per 100 km (Table 8.2-2). Two groups containing 24 seals each were observed on consecutive days in separate locations within Chesterfield Inlet (Tables 8.2-1 and 8.3-3). The first sighting occurred on September 11 adjacent to the south shore of the inlet and the second sighting occurred on September 12 on the north side of Chesterfield Inlet. These sightings were made approximately 20 km apart and could be of the same group. When combined, this corresponded to 0.13 seal sightings per 100 km and 3.08 individuals per 100 km surveyed (Table 8.2-3); however, actual densities are likely lower if possible resightings are considered.

In total, 62 belugas were sighted during 30 sightings over 3,868 km of survey track-line survey. This corresponded to 0.78 sightings per 100 km and 1.60 whales per 100 km (Table 8.2-2).

Amongst the three general regions surveyed (coastal, offshore and Chesterfield Inlet) within the study area, encounter rates of beluga whales were greatest coastally (1.57 sightings per 100 km and 3.14 belugas per 100 km), compared to offshore areas (0.82 sightings per 100 km and 2.04 belugas per 100 km) or Chesterfield Inlet (0.19 sightings and individuals per 100 km) (Table 8.2-2).

Table 8.2-2: Beluga Whale Encounter Rates per 100 km by Survey Regions, September 10 – 15, 2008

Survey Region	Number of Sightings	Number of Belugas	Survey Distance km	Sightings per 100 km	Belugas per 100 km
Coastal	17	34	1083	1.57	3.14
Offshore	10	25	1225	0.82	2.04
Chesterfield Inlet	3	3	1560	0.19	0.19
TOTAL	**30**	**62**	**3,868**	**0.78**	**1.60**

In total, 81 seals were sighted during six sightings over 3,868 km of survey track-line resulting in 0.16 sightings per 100 km and 2.09 seals per 100 km.

Amongst the three general regions surveyed (coastal, offshore and Chesterfield Inlet) within the study area, the number of pinnipeds sighted per 100 km was greatest coastally (0.28 sightings per 100 km), followed by Chesterfield Inlet (0.13 sightings per 100 km) and the offshore area (0.08 per 100 km) (Table 8.2-3). However, the number of seals per 100 km

was greatest within Chesterfield Inlet (3.08 seals per 100 km), followed by coastal (2.95 seals per 100 km) and offshore areas (0.08 seals per 100 km) (Table 8.2-3).

Table 8.2-3: Pinniped (Seal) Encounter Rates per 100 km by Survey Regions, September 10 – 15, 2008

Survey Region	Number of Sightings	Number of Seals	Survey Distance km	Sightings per 100 km	Seals per 100 km
Coastal	3	32	1083	0.28	2.95
Offshore	1	1	1225	0.08	0.08
Chesterfield Inlet	2	48	1560	0.13	3.08
TOTAL	**6**	**81**	**3,868**	**0.16**	**2.09**

8.3 AERIAL SURVEY RESULTS – 2009

8.3.1 Overview

Aerial surveys were conducted in early summer (July 29 – 30, 2009) and early fall (August 31 – September 3, 2009) in an attempt to capture seasonal changes in marine mammal distribution and abundance within the study area. The summer (July) surveys were timed to assess the study area immediately after ice breakup, as relatively little is known about beluga presence, abundance or distribution at the start of the open-water period. The fall (late August/early September) surveys were timed to gain a better understanding of beluga abundance and distribution during their northward migration to over-wintering habitat.

In total, 7,035 km of track-line was flown across four survey days, including 2,922 km of coastline and 4,113 km of offshore transects (Tables 8.3-1 and 8.3-2). Transects reached up to 100 km offshore in order to capture the extent of potential tug/barge routing. All sighting details can be found in Appendix C.

Table 8.3-1: Summary of Coastal Survey Details for July 29 – 31, 2009 and August 31 – September 3, 2009

	Date	# km Flown	Total Flight Time	Conditions	Overall Sightability
Coastal Transects	July 29, 2009	651	2.8 hours	Mixed sun and cloud; brief periods of rain; ice along Transects 7/8	Good to excellent
	July 30, 2009	529	1.8 hours	Mixed cloud; periods of light rain; ice along Transects 7/8	Good
	July 31, 2009	–	Grounded	Fog; low ceiling	Impossible
	August 31, 2009	828	3.6 hours	Clear and calm south of Rankin; severe sun glare along Transects 7/8; low ceiling and fog north of Rankin	Good
	September 1, 2009	–	Grounded	Wind warning	–
	September 2, 2009	–	Grounded	Wind warning	–
	September 3, 2009	914	4.6 hours	Severe sun glare south of Rankin; low-lying fog north of Rankin and offshore	Moderately impaired

Table 8.3-2: Summary of Offshore Survey Details for July 29 – 31, 2009 and August 31 – September 3, 2009

	Date	# km Flown	Time of flights	Conditions	Overall Sightability
Offshore Transects	July 29, 2009	1409	7.8 hours	Mixed sun and cloud; brief periods of rain; ice along Transects 7/8	Good to excellent
	July 30, 2009	1326	6.9 hours	Mixed cloud; periods of light rain; ice along Transects 7/8	Good
	July 31, 2009	–	Grounded	Fog; low ceiling	Impossible
	August 31, 2009	1069	4.5 hours	Clear and calm south of Rankin; severe sun glare along Transects 7/8; low ceiling and fog north of Rankin	Good
	September 1, 2009	–	Grounded	Wind warning	–
	September 2, 2009	–	Grounded	Wind warning	–
	September 3, 2009	309	2.4 hours	Severe sun glare south of Rankin; low-lying fog north of Rankin and offshore	Moderately impaired

8.3.2 Daily Reports

July 29, 2009

A total of 2,060 km were flown over 10.6 hours on July 29, 2009 (Tables 8.3-1 and 8.3-2). The ability to detect marine mammals was ranked as good to excellent throughout the day. Short periods of reduced sightability, resulting from sun glare (<1 hour along Transects 3, 5 and the coast) and light rain (<0.5 hours along Transect 7), were also recorded. Weather varied between overcast with mixed cloud and sun throughout the day. Some sea ice was encountered in the south-eastern region of the study area, just north of Churchill, along Transects 7 and 8; observations continued over the ice. The ice type was mostly brash, with some larger pans and small-medium floes, and ranged from 1/10 to 9/10 in cover.

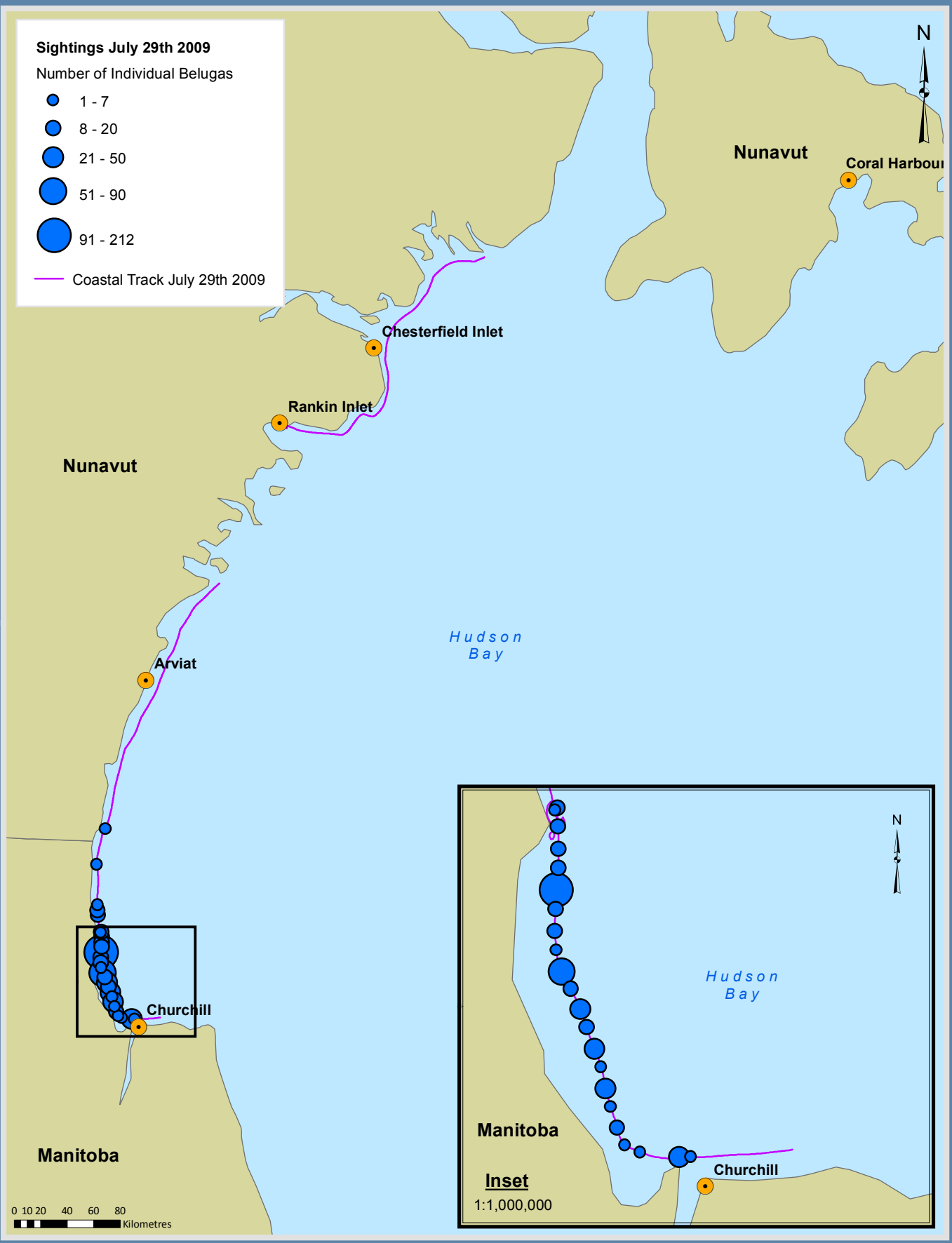
A total of 952 beluga whales were observed amongst 123 sightings from all transects flown (Figure 8.3-1). Sightings of beluga whales were most frequent in and around the Churchill River estuary, where the whales were densely congregated. Eighteen cow/calf pair sightings were observed. The northern-most beluga whale sighting occurred between Arviat and Churchill near the Manitoba/Nunavut border. Observed activities included feeding, travelling and socializing, and behaviours included swimming, diving and milling.

A total of 554 beluga whales were observed on the coastal survey, across 84 sightings (Figure 8.3-1). In contrast, 398 beluga whales amongst 39 sightings were observed along the coastal portion of the offshore transects (on section of track-line from Churchill which overlaps with the coastal area) (Figure 8.3-2). However, all of these sightings were documented along Transects 8 and 9, which spanned the Churchill River estuary. No whales were observed offshore, nor were any viewed on Transects 1 through 7.

Eleven seals were observed from six sightings (Figures 8.3-3 and 8.3-4), including one sighting of six individuals hauled out on a rocky island just off the coast between Arviat and Churchill (Appendix C). Three sightings were recorded north of Chesterfield Inlet, including an offshore sighting of a single seal. Seal species were not identified.

A group of approximately 20 walrus was observed hauled out on one of the larger ice floes (Figure 8.3-4).

A total of 16 polar bears were observed over two separate sightings (Figures 8.3-3 and 8.3-4). One sighting of 15 individuals, including cubs, was made on a rocky coastal headland just north of Churchill. Bears were observed feeding on a beluga carcass. Two passes over the spit were flown to maximize observations and to take photographs (Photo 8.3-1). A single polar bear was also seen swimming north of Churchill (Figure 8.3-4).



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File: 1038926.04-001
Data Sources: *Natural Resources Canada, Geobase®, Natural Topographic Database, Areva Resources Canada Inc.*

FIGURE 8.3-1
COASTAL SURVEY EFFORT AND
BELUGA SIGHTINGS
FOR JULY 29, 2009
KIGGAVIK PROJECT - EIS

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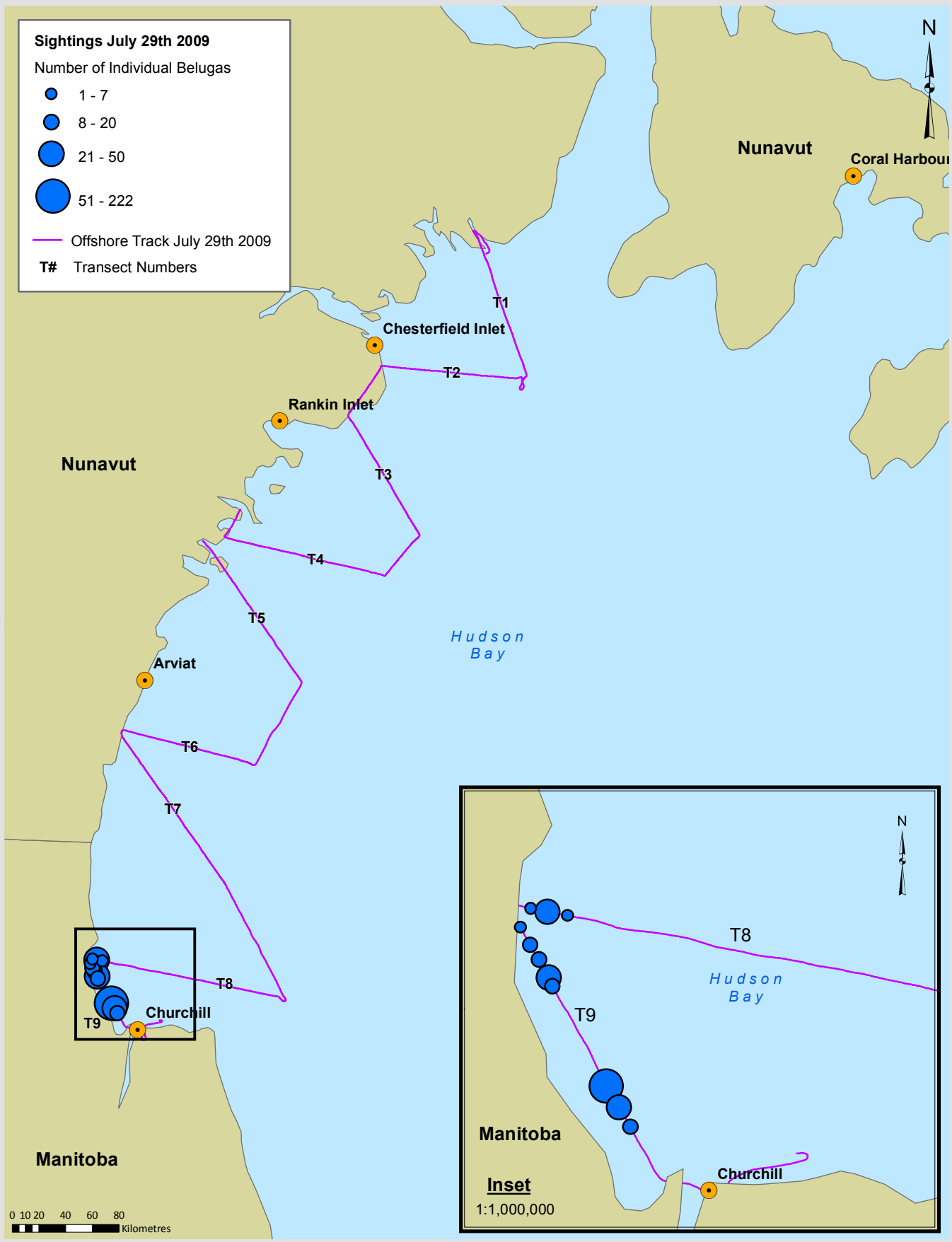

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File: 1038926.04-002
Data Sources: *Natural Resources Canada, Geobase®, Natural Topographic Database, Areva Resources Canada Inc.*

FIGURE 8.3-2
OFFSHORE SURVEY EFFORT AND BELUGA SIGHTINGS FOR JULY 29, 2009
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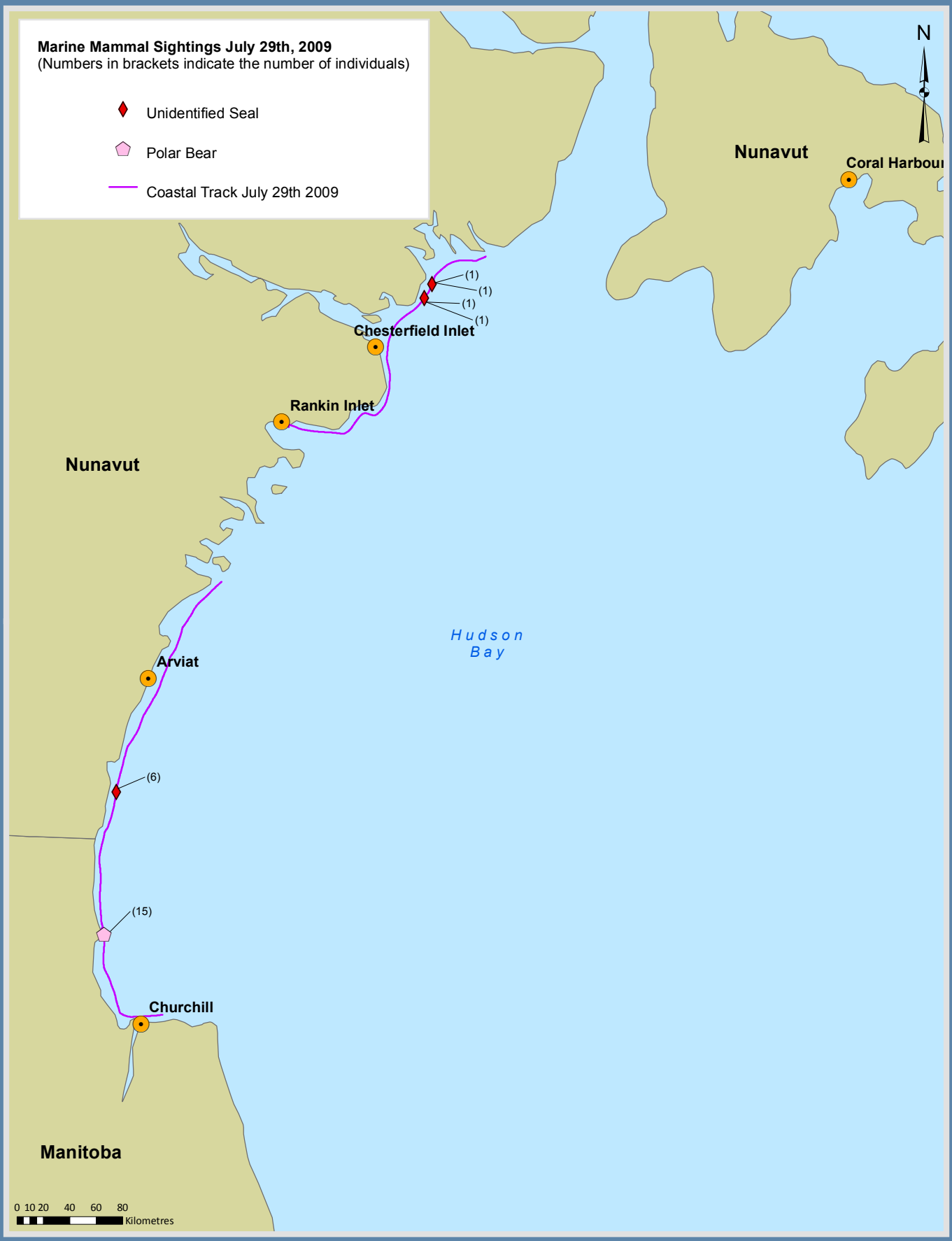

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Creator: SS
Date: 12/04/2009 Scale: 1:4,000,000
File: 1038926.04-003
Data Sources: *Natural Resources Canada, Geobase®, Natural Topographic Database, Areva Resources Canada Inc.*

FIGURE 8.3-3
COASTAL SURVEY EFFORT AND
OTHER MARINE MAMMAL SIGHTINGS
FOR JULY 29, 2009
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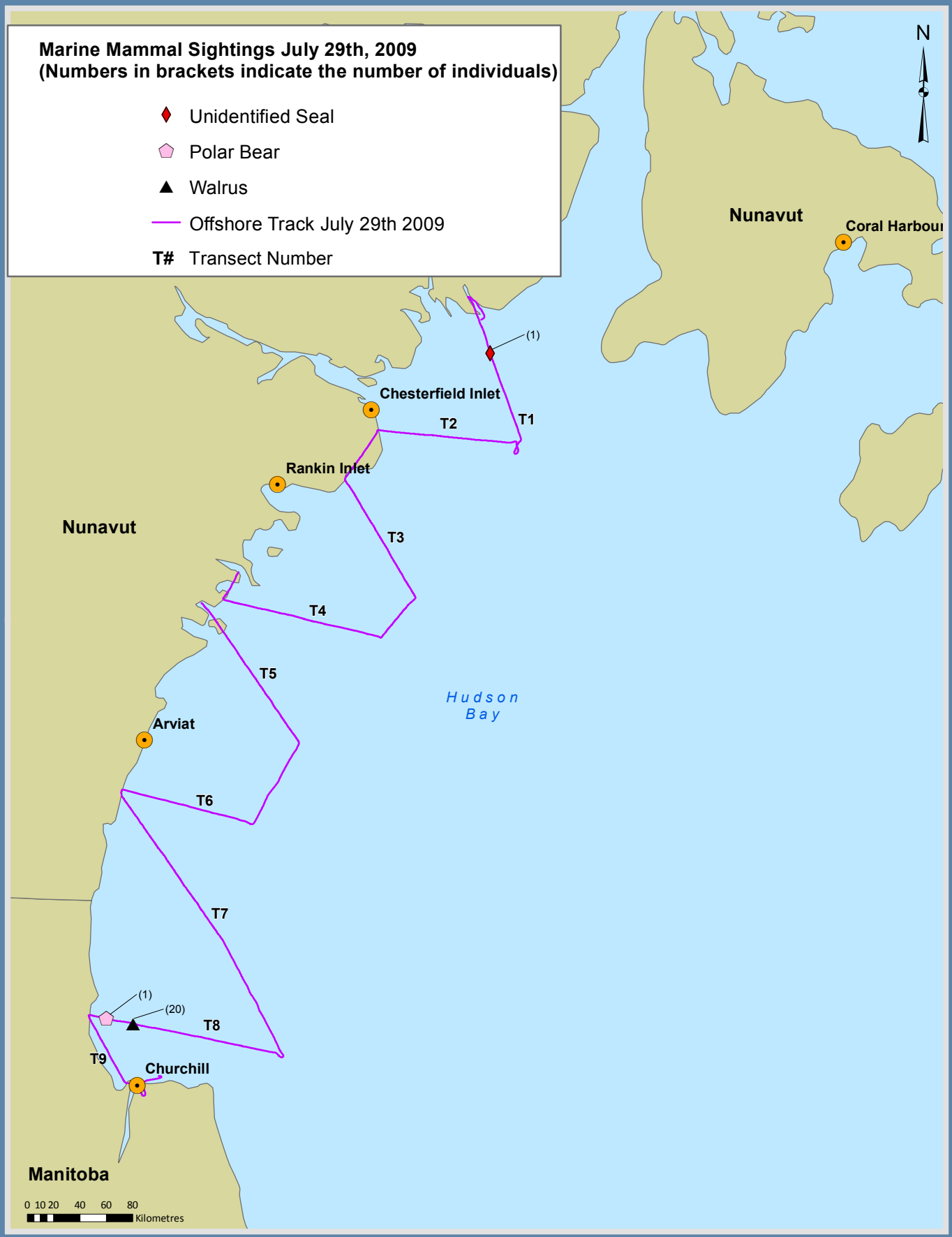

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File: 1038926.04-004
Data Sources: *Natural Resources Canada, Geobase®, Natural Topographic Database, Areva Resources Canada Inc.*

FIGURE 8.3-4
OFFSHORE SURVEY EFFORT AND
OTHER MARINE MAMMAL SIGHTINGS
FOR JULY 29, 2009
KIGGAVIK PROJECT - EIS

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Photo 8.3-1: Group of Polar Bears Sighted on a Rocky Headland in between Churchill and Arviat on July 29, 2009

July 30, 2009

Favourable conditions offshore allowed the completion of all offshore transects and the coastal survey on July 30, 2009. A total of 1,855 km were flown over 8.7 hours. The ability to detect marine mammals was ranked as good throughout the day. Short periods of reduced sightability, resulting from fog and light rain (less than two hours along Transects 3 to 5 and the coast), were also recorded. Weather was predominantly overcast throughout the day. Some sea ice was encountered in the south-eastern region of the study area, just north of Churchill, along Transects 7 and 8; observations continued over the ice. The ice type was mostly brash and ranged from 1/10 to 4/10 in cover.

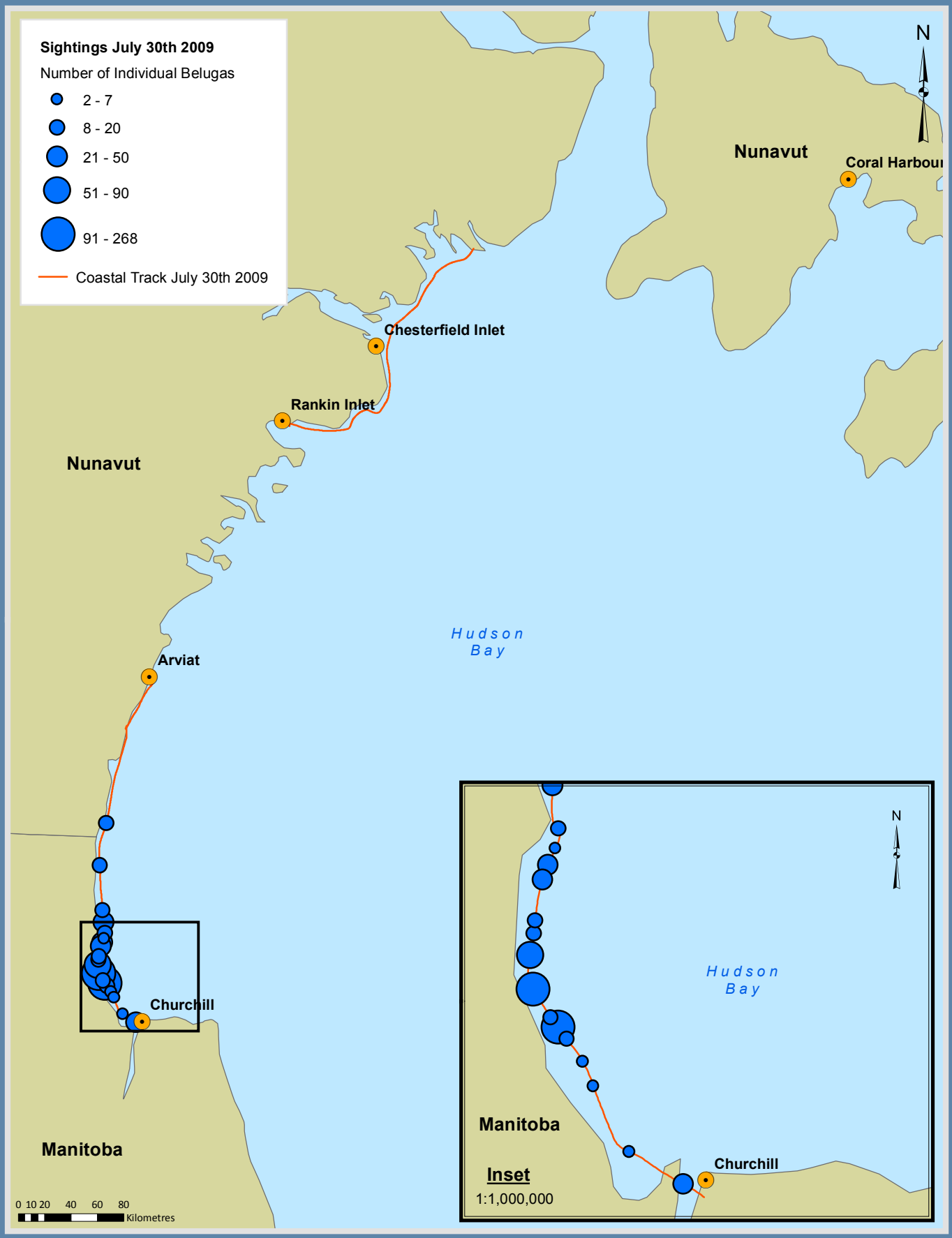
A total of 1,177 beluga whales were observed amongst 139 separate sightings. Again, sightings were most frequent in and around the Churchill River estuary where the whales were densely congregated. At least twenty cow/calf pair sightings were observed. The northern-most sighting was observed offshore between Rankin Inlet and Arviat along Transect 4. Observed activities included feeding, travelling and resting, and behaviours included swimming, diving and milling.

A total of 715 whales were observed on the coastal survey, across 58 sightings (Figure 8.3-5). In contrast, 462 whales were observed amongst 81 sightings along the coastal portion of the

offshore transects (i.e., Transects 8 and 9, which span the Churchill River estuary) (Figure 8.3-6). Photo 8.3-2 shows three adult and one sub-adult belugas sighted along the coast between Arviat and Churchill.

Twenty seals were observed over seven independent sightings (Figures 8.3-7 and 8.3-8), including one sighting of seven individuals hauled out onshore north of Chesterfield Inlet. Three sightings were made offshore, including two along Transect 6 and one while transiting between Transects 7 and 8. Again, no species were identified.

One polar bear was observed swimming just off the coast between Arviat and Churchill, with no ice present in the field of view (Figure 8.3-7).



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Creator: SS
Date: 12/04/2009 Scale: 1:4,000,000
File: 1038926.04-005
Data Sources: *Natural Resources Canada, Geobase®, Natural Topographic Database, Areva Resources Canada Inc.*

FIGURE 8.3-5
COASTAL SURVEY EFFORT AND BELUGA SIGHTINGS FOR JULY 30, 2009
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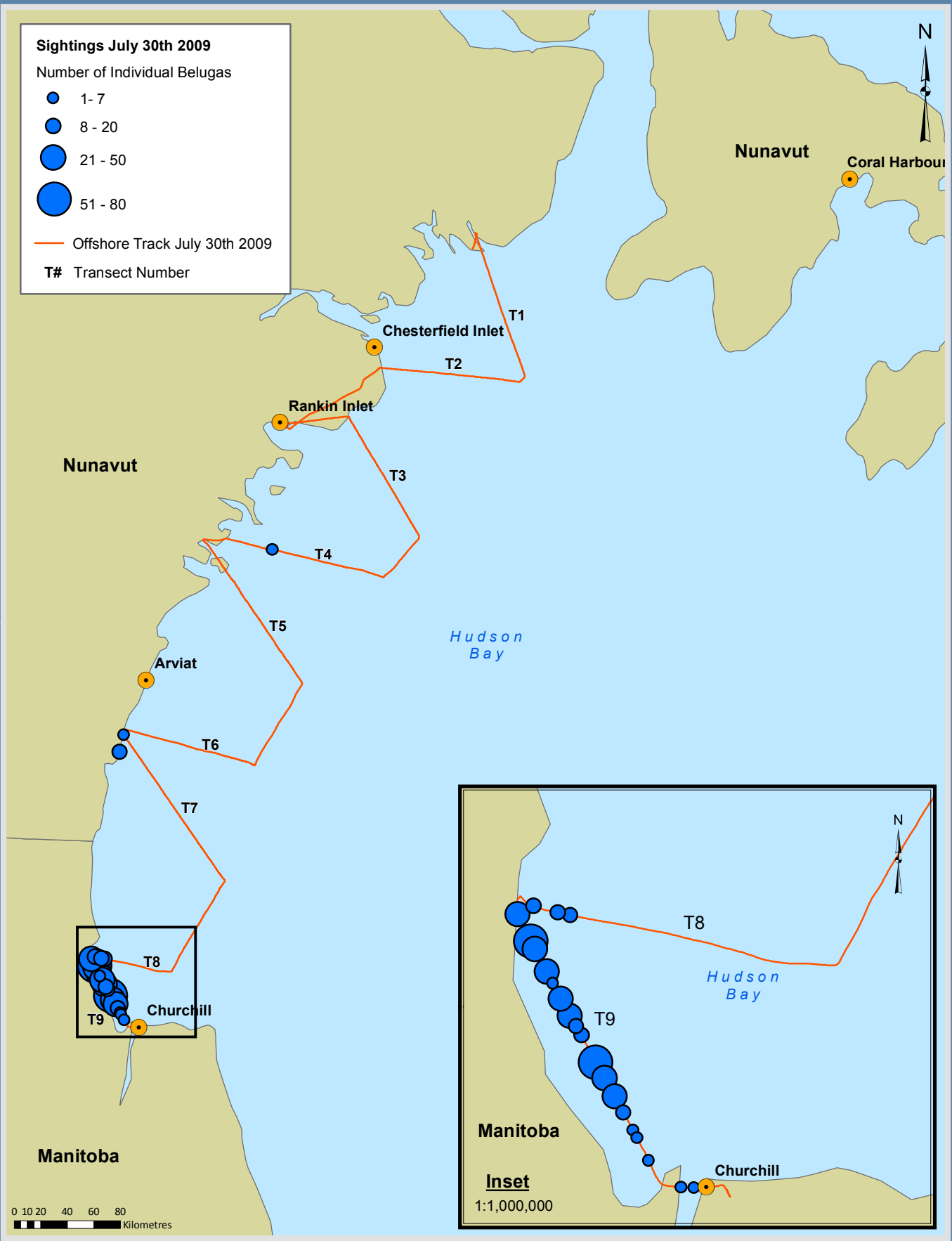

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Creator: SS
Date: 12/04/2009 Scale: 1:4,000,000
File: 1038926.04-006
Data Sources: *Natural Resources Canada, Geobase®, Natural Topographic Database, Areva Resources Canada Inc.*

FIGURE 8.3-6
OFFSHORE SURVEY EFFORT AND BELUGA SIGHTINGS FOR JULY 30, 2009
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Photo 8.3-2: Three Adult and one Sub-adult Belugas Sighted in the Churchill River Estuary on July 30, 2009

Projection: NAD 1983 UTM Zone 15N
Creator: SS
Date: 12/04/2009 Scale: 1:4,000,000
File: 1038926-007
Data Sources: *Natural Resources Canada, Geobase®, Natural Topographic Database, Areva Resources Canada Inc.*

FIGURE 8.3-7
COASTAL SURVEY EFFORT AND
OTHER MARINE MAMMAL SIGHTINGS
FOR JULY 30, 2009
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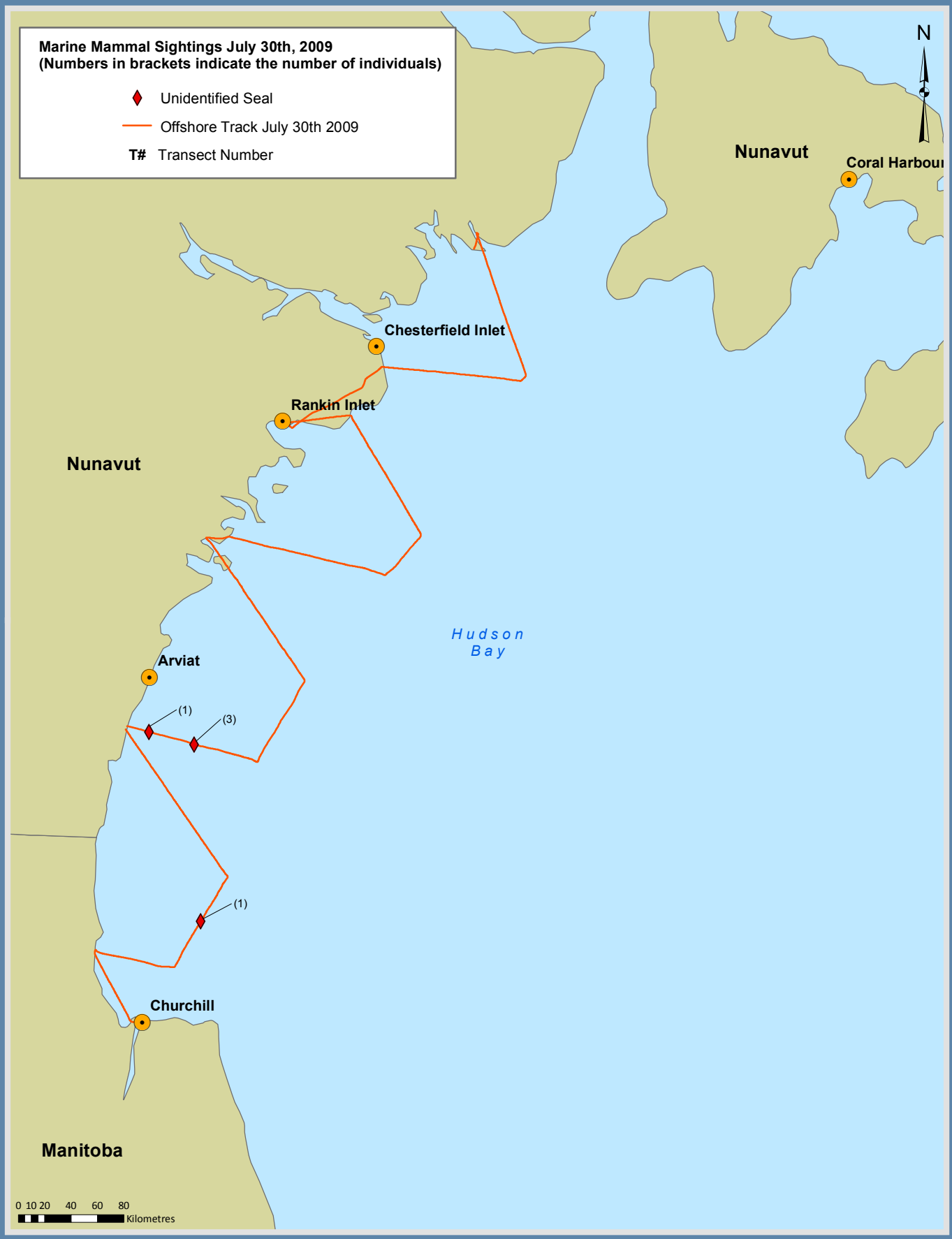

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Creator: SS
Date: 12/04/2009 Scale: 1:4,000,000
File: 1038926.04-008
Data Sources: *Natural Resources Canada, Geobase®, Natural Topographic Database, Areva Resources Canada Inc.*

FIGURE 8.3-8
OFFSHORE SURVEY EFFORT AND
OTHER MARINE MAMMAL SIGHTINGS
FOR JULY 30, 2009
KIGGAVIK PROJECT - EIS

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August 31, 2009

A total of 1,897 km were flown over 8.1 hours on August 31, 2009. The ability to detect marine mammals was characterized as good overall, with clear weather and calm sea states throughout much of the day. Relatively long periods of reduced sightability, resulting from sun glare (approximately three hours along Transects 7 to 8 and the coast south of Arviat) and fog (less than 0.5 hours along the coast near Rankin Inlet), were also recorded. No sea ice was encountered. Due to low ceilings and fog north of Rankin Inlet, the southern Transects (5 to 9) were flown first and after a refuelling stop in Churchill, the coast was flown to Waypoint 8, and Transects 3 and 4 were completed. Due to time restrictions, Transects 1 and 2 were not surveyed.

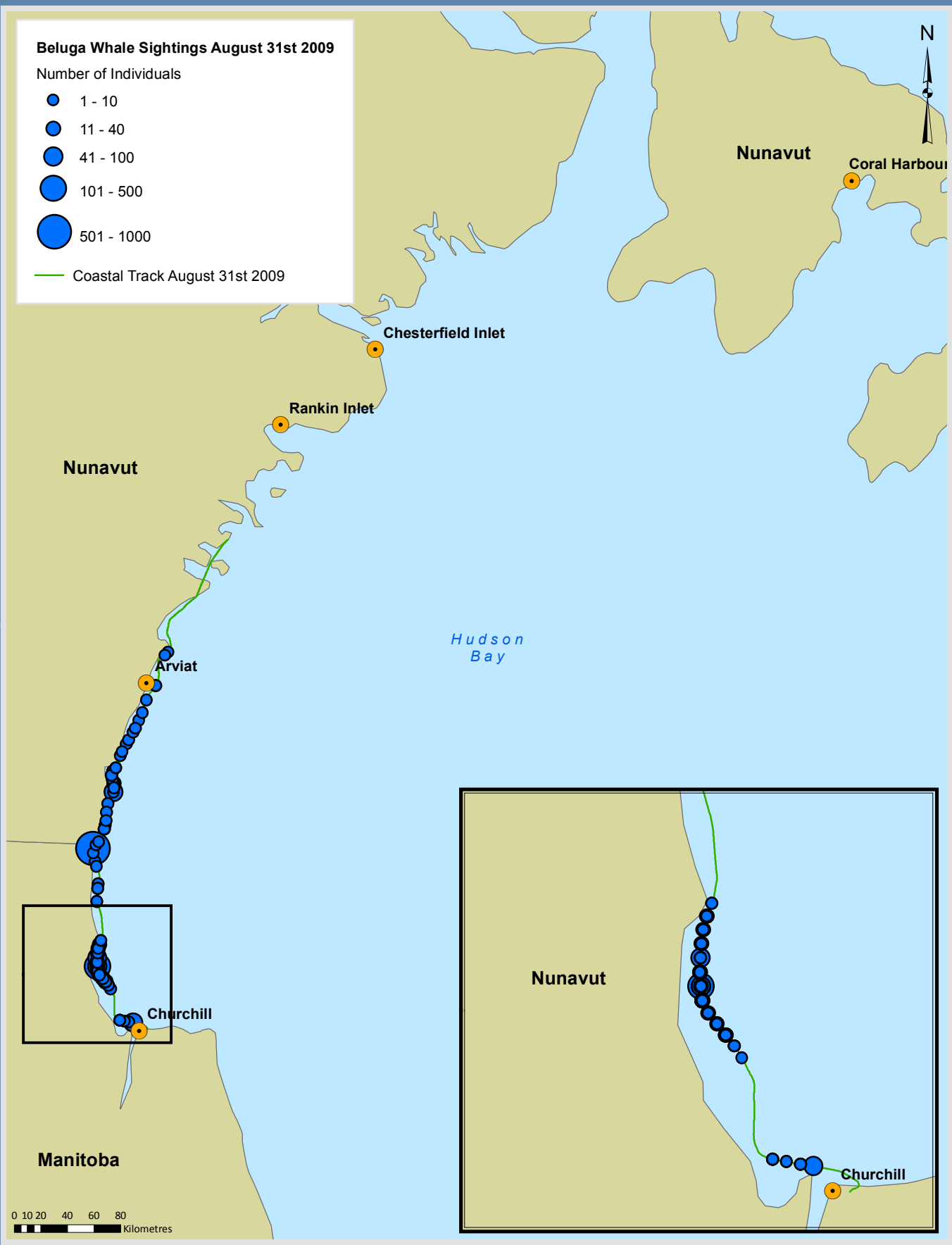
A total of 3,867 whales were observed over 273 sightings. Sightings included documentation of a “superpod”, comprised of approximately 1,000 whales (Photo 8.3-3). Similar to the summer surveys conducted in July, the vast majority of whales were observed congregating in the relative vicinity of the Churchill River estuary. At least thirty two cow/calf sightings were documented. Observed activities included moulting, travelling and resting, while behaviours included milling, swimming and diving. Many whales appeared skittish and dove beneath the surface in response to the noise generated by the plane.

A total of 1,381 whales were observed on the coastal survey across 192 sightings (Figure 8.3-9), while 2,486 whales were observed on the offshore transects amongst 81 sightings (Figure 8.3-10). Similar to the surveys conducted in July, all of these sightings were documented along Transects 8 and 9, spanning the Churchill River Estuary. No whales were observed offshore, nor were any viewed in Transects 1 through 7.

Seventeen seals were observed over 14 sightings (Figures 8.3-11 and 8.3-12), including four harp seals, four ringed seals and nine unidentified seals. The most common behaviour documented was surfacing.

Two polar bears were counted on the coastal survey, each as a separate sighting (Figures 8.3-11). In both instances, the bears were swimming in relatively shallow water close to shore.

Photo 8.3-3: Superpod of Belugas Sighted Along Coast North of Churchill on August 31, 2009



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Creator: SS
Date: 12/04/2009 Scale: 1:4,000,000
File: 1038926.04-009
Data Sources: *Natural Resources Canada, Geobase®, Natural Topographic Database, Areva Resources Canada Inc.*

FIGURE 8.3-9
COASTAL SURVEY EFFORT AND
BELUGA SIGHTINGS
FOR AUGUST 31, 2009
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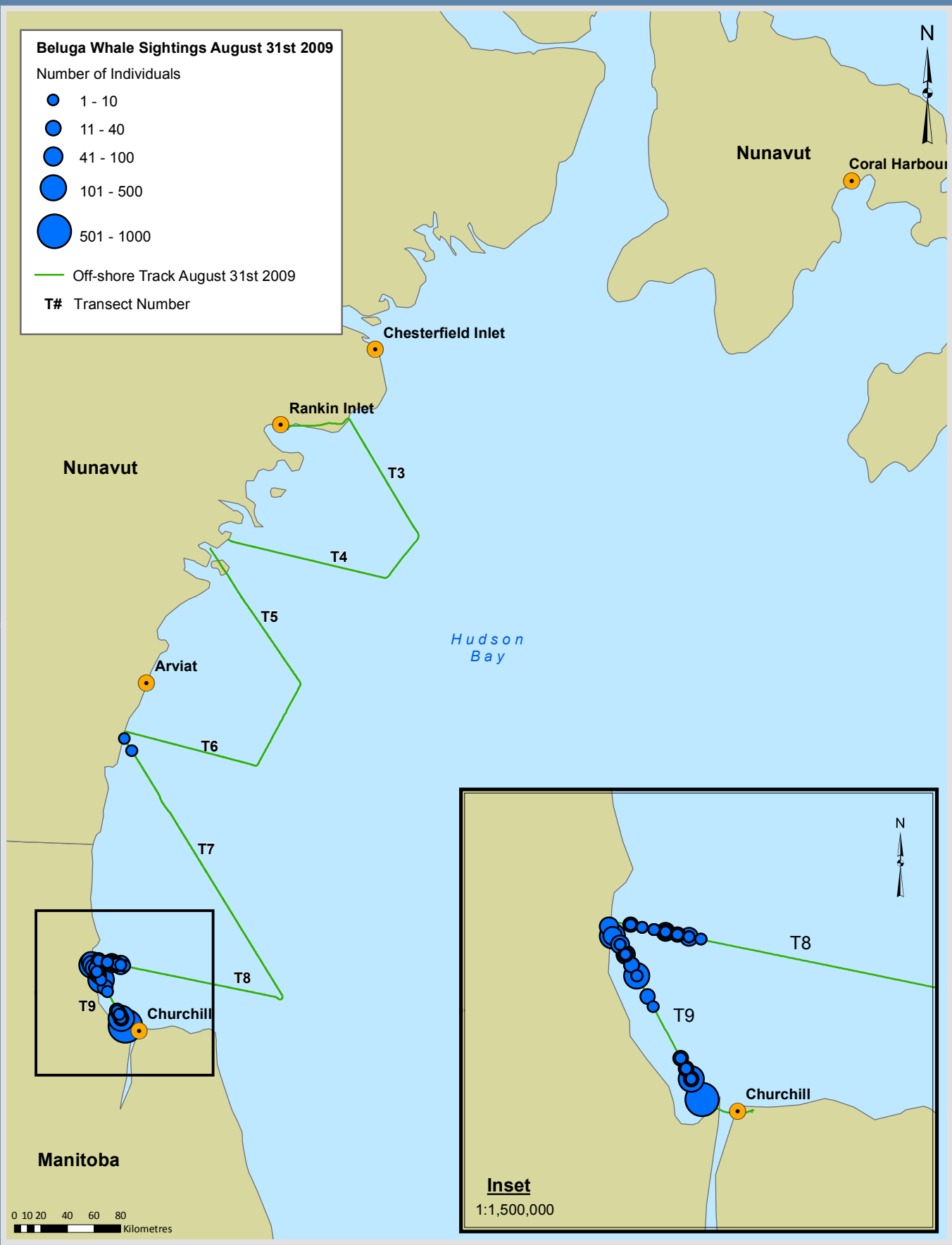

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File: 1038926.04-010
Data Sources: *Natural Resources Canada, Geobase®, Natural Topographic Database, Areva Resources Canada Inc.*

FIGURE 8.3-10
OFFSHORE SURVEY EFFORT AND BELUGA SIGHTINGS FOR AUGUST 31, 2009
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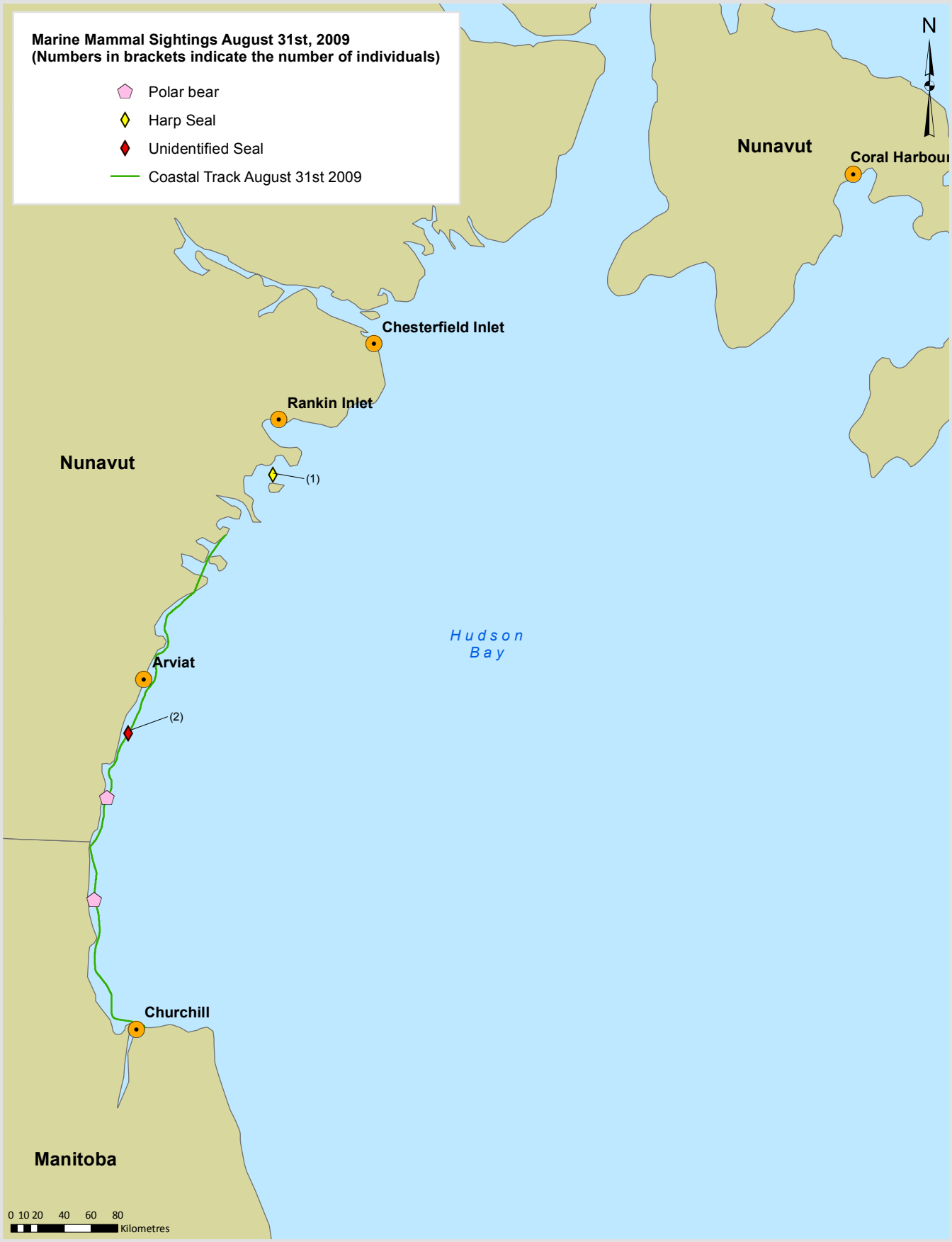

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Date: 12/04/2009 Scale: 1:4,000,000
File: 1038926.04-011
Data Sources: *Natural Resources Canada, Geobase®, Natural Topographic Database, Areva Resources Canada Inc.*

FIGURE 8.3-11
COASTAL SURVEY EFFORT AND
OTHER MARINE MAMMAL SIGHTINGS
FOR AUGUST 31, 2009
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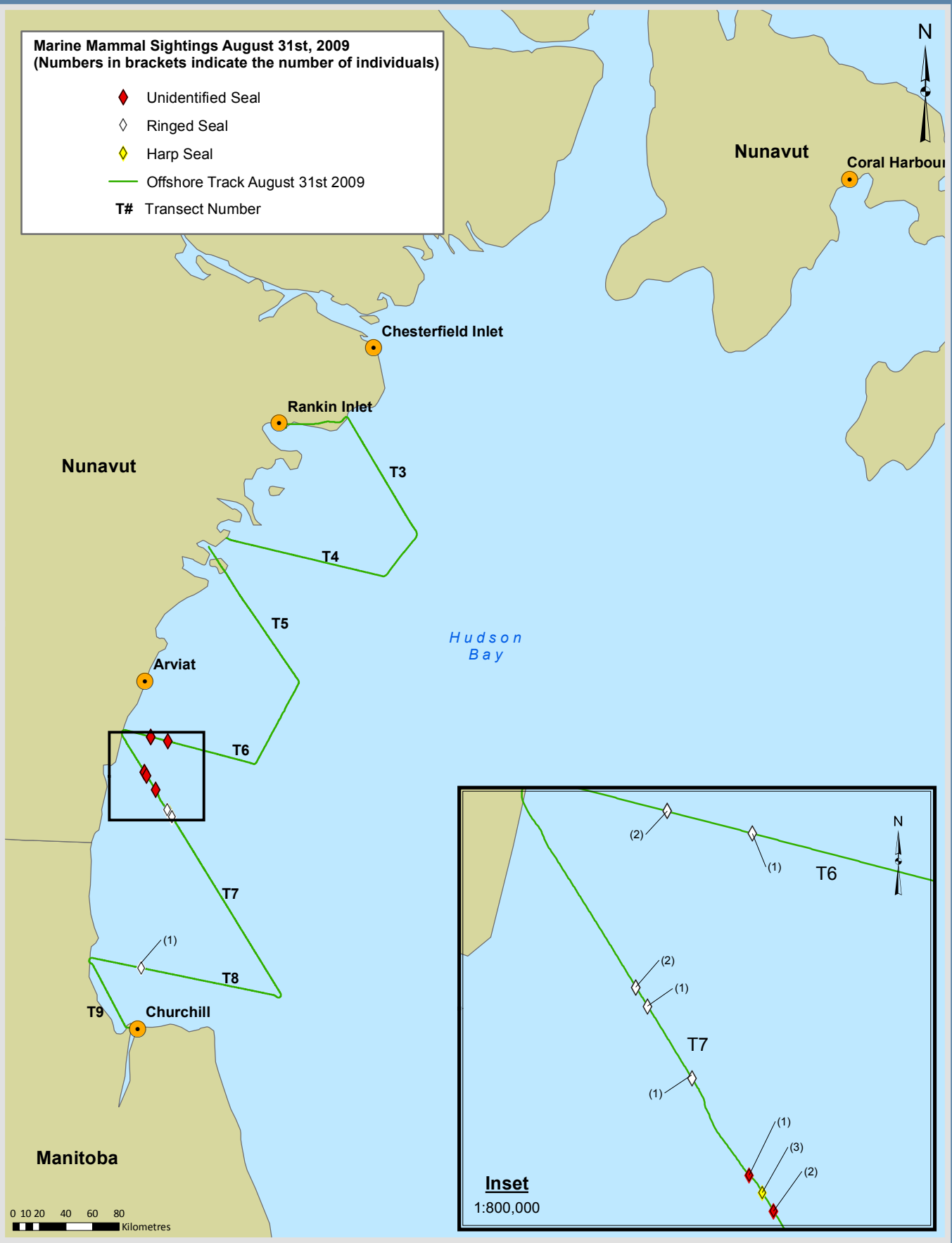

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Date: 12/04/2009 Scale: 1:4,000,000
File: 1038926.04-012
Data Sources: *Natural Resources Canada, Geobase®, Natural Topographic Database, Areva Resources Canada Inc.*

FIGURE 8.3-12
OFFSHORE SURVEY EFFORT AND
OTHER MARINE MAMMAL SIGHTINGS
FOR AUGUST 31, 2009
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September 3, 2009

A total of 1,223 km were flown over seven hours of flight time on September 3, 2009. Overall, the ability to detect marine mammals was ranked as moderately impaired during the survey. Due to low ceilings and fog north of Rankin Inlet, the coast down to Churchill was surveyed first. After a refuelling stop, the northern portion of the coast (between Rankin Inlet and Chesterfield Inlet) was surveyed. Offshore Transects 1 and 2 were then completed, since they had not been surveyed the previous day. Transect 9 was also surveys but other planned offshore transects could not be completed. Though sea states were calm throughout much of the day, relatively long periods of reduced sightability, resulting from sun glare (approximately three hours along the coast from Rankin to Churchill), were recorded. Fog hindered sightability along the coast north of Rankin Inlet and along Transects 1 to 2, for approximately two hours. No sea ice was encountered. It is difficult to evaluate exactly how these factors influenced the ability of the observers to detect marine mammals on that day. However, as indicated below, sighting numbers were high (second highest of all survey days) which suggests that observers we able to adequately detect marine mammals in most areas, or at least where they were abundant. Sightings in areas where sightability was poorer were likely underestimated relative to days and areas where sightability was high. A detailed analysis of sighting rates as a function of environmental conditions was beyond the scope of this study.

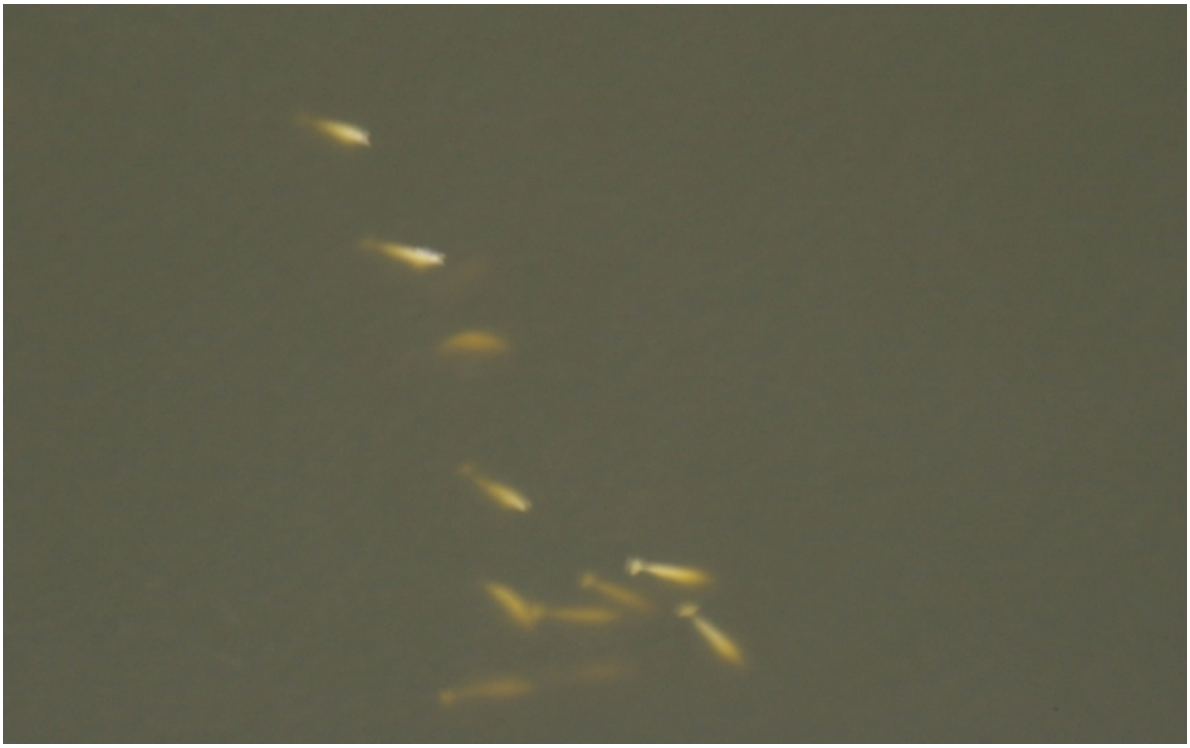
A total of 1,131 belugas were counted over 228 separate sightings. While there was still a high density of whales in the Churchill River Estuary, the numbers appeared fewer than three days previous. This may be linked to a two-day windstorm, which caused substantial turbidity in the estuary, greatly reducing sightability owing to murky, muddy water (Photo 8.3-4). There were at least 39 cow/calf pair sightings made. A greater proportion of whales were observed outside of the delta, many travelling north of Chesterfield Inlet. Approximately 70 whales, representing 9% of the sightings on this day, were observed along the coast north of Rankin Inlet, suggesting the northward migration was underway.

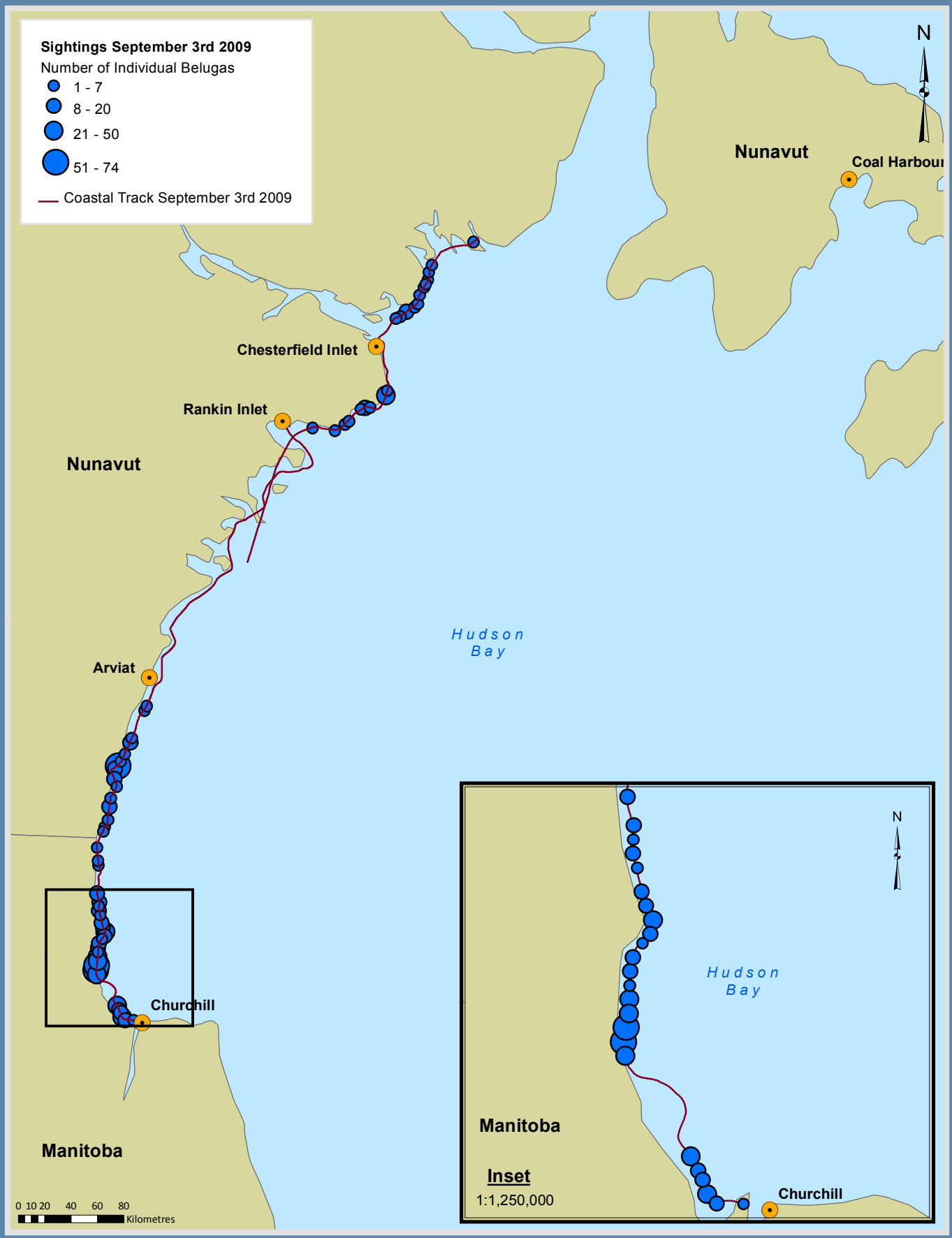
A total of 731 whales were observed on the coastal survey across 167 sightings (Figure 8.3-13). A total of 400 belugas were observed across 61 sightings along the offshore track, though the vast majority of these sightings were along the coastal portion of the transects. One sighting of three whales was also observed greater than 5 km offshore on Transect 2 (Figure 8.3-14).

There was one sighting of two seals swimming on the coastal survey between Arviat and Churchill (Figure 8.3-15).

Three polar bears were observed over two sightings, one on the coastal route between Arviat and Churchill and two north of Chesterfield Inlet on Transect 1 (Figures 8.3-15 and 8.3-16). In both instances, the bears were on a coastal headland and appeared to be startled by the plane.

Photo 8.3-4: Group of Belugas Observed in the Murky Waters of the Churchill River Estuary after a two-day Windstorm on September 3, 2009





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File: 1038926.04-013
Data Sources: *Natural Resources Canada, Geobase®, Natural Topographic Database, Areva Resources Canada Inc.*

FIGURE 8.3-13
COASTAL SURVEY EFFORT AND
BELUGA SIGHTINGS
FOR SEPTEMBER 3, 2009
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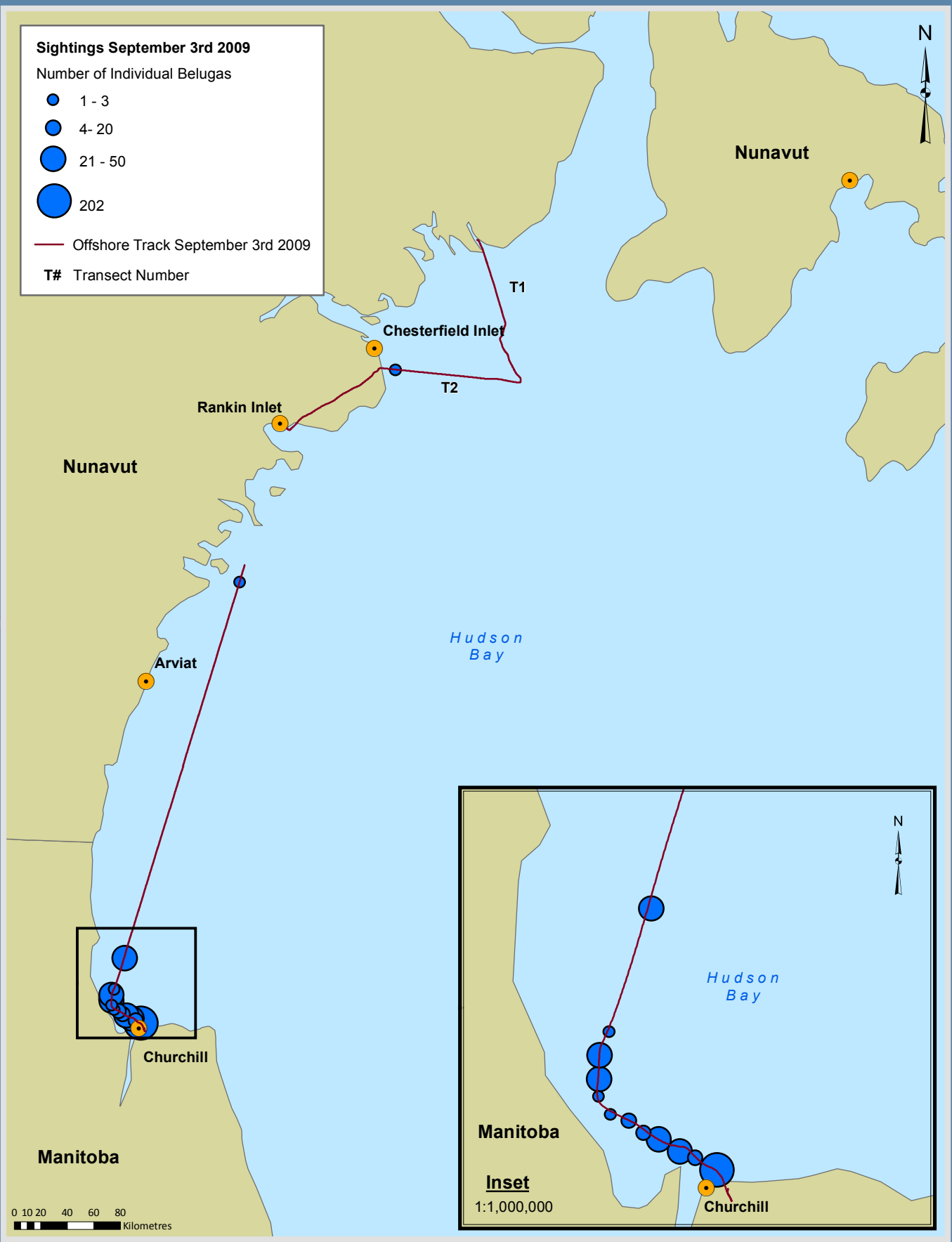

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Date: 12/04/2009 Scale: 1:4,000,000
File: 1038926.04-014
Data Sources: *Natural Resources Canada, Geobase®, Natural Topographic Database, Areva Resources Canada Inc.*

FIGURE 8.3-14
OFFSHORE SURVEY EFFORT AND BELUGA SIGHTINGS FOR SEPTEMBER 3, 2009
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Projection: NAD 1983 UTM Zone 15N
Creator: SS
Date: 12/04/2009 Scale: 1:4,000,000
File: 1038926.04-015
Data Sources: *Natural Resources Canada, Geobase®, Natural Topographic Database, Areva Resources Canada Inc.*

FIGURE 8.3-15
COASTAL SURVEY EFFORT AND
OTHER MARINE MAMMAL SIGHTINGS
FOR SEPTEMBER 3, 2009
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Projection: NAD 1983 UTM Zone 15N
Creator: SS
Date: 12/04/2009 Scale: 1:4,000,000
File: 1038926.04-016
Data Sources: *Natural Resources Canada, Geobase®, Natural Topographic Database, Areva Resources Canada Inc.*

FIGURE 8.3-16
OFFSHORE SURVEY EFFORT AND
OTHER MARINE MAMMAL SIGHTINGS
FOR SEPTEMBER 3, 2009
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8.3.3 Summary of Marine Mammal Sightings

Marine mammals, including beluga, pinnipeds (i.e., seals and walruses) and polar bears were sighted on every survey day.

Over four days of surveying, a total of 7,127 beluga whales were observed over 763 separate sightings; 50 seals across 28 sightings; 20 walrus from one sighting; and 22 polar bears across seven sightings (Table 8.3-3).

Table 8.3-3: Summary of Sightings and Number of Marine Mammals Observed per Day, July 29 – 31 and August 31 – September 3, 2009

Day	Beluga (# of sightings)	Beluga (# of animals)	Pinniped (# of sightings)	Pinniped (# of animals)	Polar Bear (# of sightings)	Polar Bear (# of animals)
July 29, 2009	123	952[1]	7[5]	31	2	16
July 30, 2009	139	1177[2]	7	20	1	1
July 31, 2009	N/A	N/A	N/A	N/A	N/A	N/A
August 31, 2009	273	3867[3]	14	17	2	2
September 1, 2009	N/A	N/A	N/A	N/A	N/A	N/A
September 2, 2009	N/A	N/A	N/A	N/A	N/A	N/A
September 3, 2009	228	1131[4]	1	2	2	3
TOTAL	**763**	**7,127**	**29**	**70**	**7**	**22**

NOTES:
[1] Includes 18 cow/calf pairs
[2] Includes at least 20 cow/calf pairs
[3] Includes at least 32 cow/calf pairs
[4] Includes at least 39 cow/calf pairs
[5] Includes 1 sighting of 20 walrus

In total, 7,127 belugas were detected during 763 separate sighting events over 7,035 km of track-line surveyed. Overall, proportion and the encounter rates of beluga whale sightings were much greater on the coastal surveys (66% of sightings or 17 sightings per 100 km and 115 individuals per 100 km) than on offshore surveys (34% of sightings or six sightings per 100 km and 91 individuals per 100 km) (Table 8.3-4). However, the whales were almost exclusively coastally associated; only one sighting of three whales was made at greater than 5 km offshore, along Transect 4 on the July 30, 2009 survey (Figure 8.3-6). While these metrics give an idea of encounter rates throughout the study area, they fail to capture the clumped distribution of whales, which is centred on the Churchill estuary.

A total of 102 whales (1.3%) were observed north of Rankin Inlet over the course of the surveys, 70% of which were sighted during the September 3, 2009 survey alone.

Table 8.3-4: Beluga Whale Encounter Rates per 100 km by Survey Region, July 29 – 30 and August 31 – September 3, 2009

Survey Region	Number of Sightings	Number of Belugas	Survey Distance km	Sightings per 100 km	Belugas per 100 km
Coastal	501	3381	2922	17	115
Offshore	262	3746	4113	6	91
TOTAL	**763**	**7,127**	**7,035**	**11**	**101**

In total, 22 polar bears were documented across seven separate sighting events over 7,035 km of track-line surveyed (Table 8.3-5). The majority of polar bears were observed on coastal headlands (95%), indicating a strong coastal association. Seventy-one percent of these sightings (86% of individuals) occurred during the coastal survey and 29% (or 14% of individuals) along the offshore transects; however, like belugas, two of the three bears documented on the offshore transects were actually observed along the coastal portion. Encounter rates were higher on the coastal surveys (0.17 sightings or 0.65 polar bears per 100 km) than the offshore surveys (0.05 sightings or 0.07 polar bears per 100 km). A lone bear was spotted offshore swimming in the residual brash ice northeast of Churchill during the July 29 survey.

Table 8.3-5: Polar Bear Encounter Rates per 100 km by Survey Region, July 29 – 30 and August 31 – September 3, 2009

Survey Region	Number of Sightings	Number of Polar Bears	Survey Distance km	Sightings per 100 km	Polar Bears per 100 km
Coastal	5	19	2922	0.17	0.65
Offshore	2	3	4113	0.05	0.07
TOTAL	**7**	**22**	**7,035**	**0.10**	**0.31**

In total, 70 pinnipeds were observed during 29 separate sighting events over 7,035 km of track-line surveyed. Pinnipeds were observed both coastally and offshore, with 41% of the sightings (42% of individuals) documented on the coastal survey and 59% (57% of individuals) on the offshore transects. Again, many of the sightings on the offshore transects were actually made in the coastal region. Walrus (one herd of 20 individuals) were observed exclusively offshore and associated with residual ice floes northeast of Churchill. This resulted in a similar overall pinniped encounter rate in coastal and offshore areas (0.41 sightings and about 1 pinniped per 100 km) (Table 8.3-6). However, when the walrus sighting was excluded from all pinnipeds, the encounter rate was higher in coastal (0.41 sightings and 1 seal per 100 km) than offshore areas (0.38 sightings and 0.48 individuals per 100 km).

Table 8.3-6: Pinniped Encounter Rates per 100 km by Survey Region, July 29 – 30 and August 31 – September 3, 2009

Survey Region	Number of Sightings	Number of Pinnipeds	Survey Distance km	Pinniped Sightings per 100 km	Pinnipeds per 100 km	Seal Sightings per 100 km	Seals per 100 km
Coastal	12	30	2922	0.41	1.00	0.41	1.00
Offshore	17	40	4113	0.41	0.97	0.38	0.48
TOTAL	**29**	**70**	**7,035**	**0.41**	**1.00**	**0.40**	**0.71**

8.4 VESSEL RECONNAISSANCE TOUR 2009

8.4.1 Description of Tour

As recommended by the residents of Chesterfield Inlet, a vessel tour was conducted to capture IQ on important hunting and fishing grounds in the area (Photo 8.4-1). The duration of the tour was 10 hours, from 08:00 until 18:00. The route was essentially a large loop, first travelling the north coast of the Inlet and returning along the south (Figure 8.4-1). Along the way, fishing cabins and popular hunting spots were pointed out by Leo and Don Mimialik. A series of informal questions were asked to both Leo and Don, relating to the timing and location of hunting of various marine mammals, such as beluga, seal, polar bear and walrus. Additionally, all marine mammal sightings were recorded using a Garmin GPS (Figure 8.4-1).

Photo 8.4-1: Leo and Don Mimialik on the Vessel Reconnaissance Tour August 29, 2009

8.4.2 Information Collected

Belugas are mostly hunted in the Baker forelands, in late August/early September. Leo Mimialik mentioned reports of beluga entering Chesterfield Inlet in early-mid August 2009 (Figure 8.4-1); several boats attempted to harvest belugas, but were unsuccessful.

Beluga used to swim into the harbour at Chesterfield Inlet, but this happens more seldom now, likely because of increased boat traffic. Often, they will pass through the harbour at night.

Ringed seals are the most common seal species in the Inlet. They are hunted everywhere, but especially near the islands in the Inlet, such as Ellis Island and Big Island. Seals are often present at Daley Bay. They are hunted for both consumption and for their skins.

Harp seals are abundant in the Inlet until about October. They are hunted mostly for fur, to be used in mitts and mukluks. They are not popular to eat, as the flavour of the meat is extremely strong.

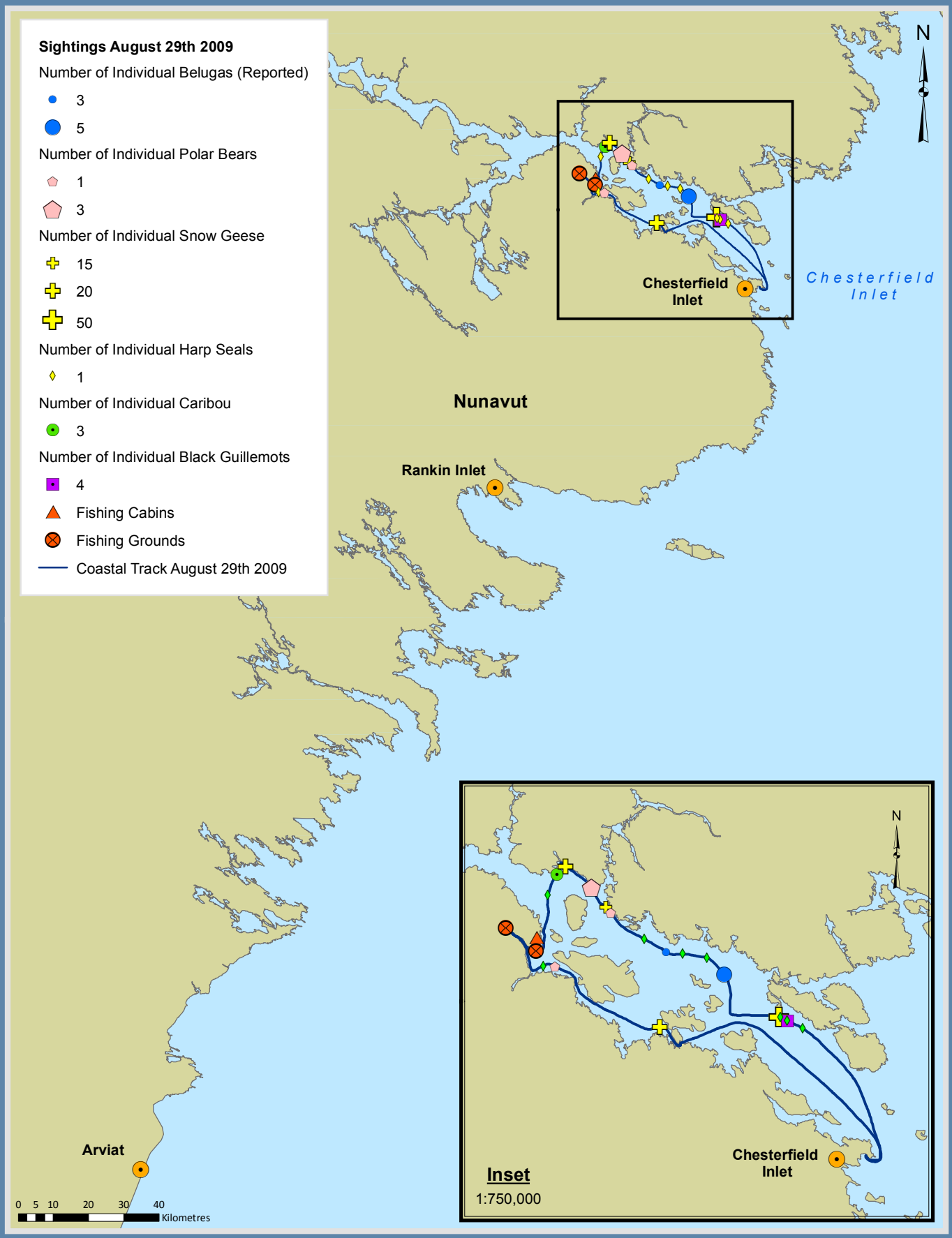
Polar bears are now more common in the Chesterfield Inlet region than in the past, particularly in coastal areas; encounters with bears have increased over the last few years, especially around the garbage dump and hunting cabins.

A few people hunt polar bears for pelts and meat, typically in the spring. The bears have dens around Wager Bay in the winter.

Walrus hunting is not as popular as it used to be. Walrus are typically hunted in the spring, after ice breakup. They are hunted north of Chesterfield Inlet, around Daley Bay and Depot Island.

Family fishing cabins dot the landscape of Chesterfield Inlet, predominantly on the south side of the Inlet. Fishing for river-run char occurs in Steep Bank Bay, mostly using gill nets.

Bird nesting grounds are found on the islands in the mouth of the Inlet, such as Promise Island. Canada geese and snow geese are typically hunted in the spring when they are fat.



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File: 1038926.04-017
Data Sources: *Natural Resources Canada, Geobase®, Natural Topographic Database, Areva Resources Canada Inc.*

FIGURE 8.4-1
VESSEL RECONNAISSANCE TOUR OF CHESTERFIELD INLET
AUGUST 29, 2009
KIGGAVIK PROJECT - EIS

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8.5 DISCUSSION

Integration of available scientific literature, IQ and results from Nunami Stantec aerial surveys indicates that marine mammals present in the waters and/or ice habitats along the proposed Project vessel routes include beluga whales, seals, walruses and polar bears.

Lack of bowhead whale and/or narwhal sightings during both the 2008 and 2009 surveys suggests that these species are rare in the study area. Literature and IQ confirm that preferred habitat for both species appears to lie north of the study area, around Repulse Bay and Foxe Basin (COSEWIC 2004b; AREVA 2009; COSEWIC 2009). Killer whales live at all latitudes and sporadically migrate into Hudson Bay in the summer (Stewart and Lockhart 2005b); while several sightings of pods of killer whales have been reported by Inuit communities over the past few years, they were not observed during either the 2008 or 2009 aerial surveys.

Walruses and ringed seals are year-round residents of Hudson Bay, while harp seals are seasonal visitors to the region. In congruence with both the literature and IQ, results from the aerial surveys suggest that ringed and harp seals are the most common pinnipeds in the study area (Stewart and Lockhart 2005b; AREVA 2009). Survey results indicate that walruses, while not common, are present in southwestern Hudson Bay; information found in literature and IQ lend support to these observations and affirm walruses are more abundant in areas north of Chesterfield Inlet (Born *et al.* 1995; AREVA 2009).

Observations taken during the Nunami Stantec field surveys complement information presented in both the literature and IQ. All sources indicate polar bears frequent coastal areas along Western Hudson Bay in the summer, and are most common in the area between Arviat and Churchill (COSEWIC 2008; AREVA 2009).

Results from the aerial surveys indicate that, belugas are the most common and abundant cetacean species in Hudson Bay. Other researchers corroborate these findings, believing that aggregations of belugas summering in the estuaries of the Nelson, Churchill and Seal rivers in July and August to be some of the largest known in the world (Richard 2005b). Consequently, beluga whales will be the predominant focus of the discussion below.

8.5.1 Beluga Whale

Beluga whales are an important cultural and ecological species in Nunavut (Fisheries and Oceans Canada (DFO 2000). Members of the Aqigiq Hunters and Trappers Organisation (HTO) and the Chesterfield Inlet Council relate that beluga whales are the most abundant and culturally important marine mammal species in the Chesterfield Inlet area. Belugas are generally hunted along the coast in the summer and are harvested up to 35 km offshore (Riewe 1992).

The range of the Western Hudson Bay beluga population overlaps with the proposed vessel route. However, it is possible that Churchill area belugas from Western Hudson Bay represent a distinct population centered on the Churchill River; genetic findings to date seem to support

these further divisions (de March and Postma 2003). This hypothesis is also supported by IQ collected by AREVA, which recognizes two herds of belugas in Western Hudson Bay, one that migrates north from Churchill and another that migrates south from Foxe Basin (AREVA 2009).

8.5.1.1 Encounter Rates

Results from the field surveys indicate that beluga whales are the most commonly sighted marine mammal in Western Hudson Bay. The relative abundance of beluga whales calculated in 2008 was lower than that found by other researchers (Gosselin 2005) and is approximately 60 times lower than that calculated in 2009. The 2008 surveys were flown in mid-September, and it is possible that the majority of the whales had already migrated northward past the Chesterfield Inlet region by that time. More belugas appeared to have been sighted in coastal regions surveyed south of Chesterfield Inlet on the first day of the aerial survey (September 10, 2008) than on subsequent days which may indicate the tail end of migration. The coastal aerial surveys conducted in early September 2009 seemed to also indicate signs of northward beluga migration past Chesterfield Inlet at that time. Anecdotal information collected on the Vessel Tour also confirmed that belugas travelled past the Chesterfield Inlet in late August 2009. Aerial surveys in 2009 covered a much larger study area and were timed to capture peak beluga presence in the Churchill River estuary.

Richard (2005b) estimated 57,300 (95% C.L.: 37,700-87,100) belugas in Western Hudson Bay. Sightings data from the 2009 aerial survey were generally consistent with the literature and confirmed the presence of thousands of whales densely aggregated in southwestern Hudson Bay, predominantly in the area between Arviat and Churchill; however, the aerial survey program was not designed to derive a population estimate, and therefore, any conclusions related to population size are not possible.

8.5.1.2 Distribution

The summer distribution of the Western Hudson Bay beluga population centers in the coastal waters of Manitoba, with the largest aggregations occurring in the estuaries of the Seal, Churchill and Nelson Rivers (Richard 2005b). St. Aubin *et al.* (1990) have shown that the occupation of warm, less saline waters of estuaries is related to the annual moult and is connected with significant hormonal changes that are associated with new skin growth. Additionally, the use of estuarine habitats by females may be related to calving (Harwood and Smith 2002).

Both the literature and IQ suggest that aggregation of belugas near the coast may also be attributed to the presence of killer whales (Richard 2005b). There are many Inuit reports of belugas and narwhals hugging the shoreline when killer whales are present in an area. During interviews conducted in Chesterfield Inlet, one Elder said the Foxe Basin herd behaves as if something is chasing it, such as killer whales, while another Elder believes that beluga will go up Chesterfield Inlet if there are killer whales (AREVA 2009). It has recently been shown that it does not take a large number of killer whales to cause a noticeable reduction in a marine mammal population (Williams *et al.* 2004). Therefore, belugas may have adapted to seek shelter in shallow waters at times when there is no pack ice in which to hide from killer whales

(Richard 2005b). While no killer whales were observed during either the 2008 or 2009 survey, the coastal nature of the 2008 beluga sightings may be linked to the presence of killer whales, as a pod of orcas was reported by Chesterfield Inlet residents a week prior to the surveys.

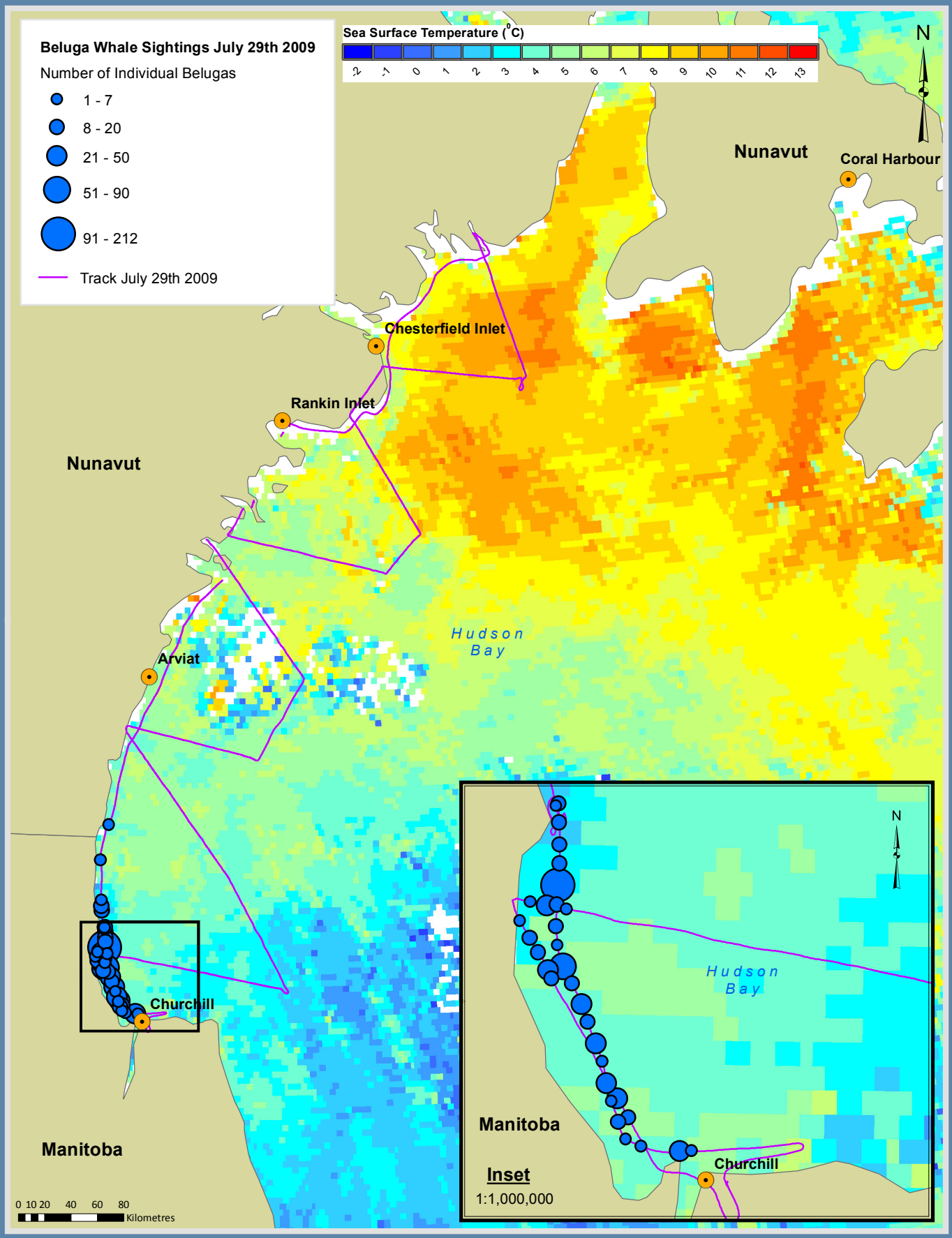
Scientific literature, IQ and field surveys conducted by Nunami Stantec all substantiate that belugas are clustered in the Churchill River estuary from mid-June (immediately following spring ice breakup) until the end of August or early September; their numbers are greatest from late July through mid-August (COSEWIC 2004a). Most whales leave the estuary and move northward along the Kivalliq coast in late August or early September (Sergeant 1973). This is supported by Inuit traditional knowledge and the fact that southern Kivalliq communities hunt belugas earlier in the season (July – August) than do those to the north (August-September) (Gamble 1988).

It is postulated that environmental variables play an important role in triggering the beluga whale migration. Satellite imagery of sea surface temperatures and chlorophyll *a* concentrations was obtained in an attempt to establish a correlation between changes in these variables and the start of the beluga migration (Figures 8.5-1 to 8.5-6). The white grid cells in these figures represent areas where data are deficient, since cloud cover had blocked the satellites from obtaining a proper reading. Figures 8.5-2, 8.5-5 and 8.5-6 indicate that the shallow waters of the Churchill River estuary are extremely productive relative to deeper, offshore waters. This is supported by the literature, where limited data suggest that productivity in Hudson Bay appears to be greatest in coastal waters, particularly in embayments and estuaries, where there is periodic entrainment or upwelling of deeper, nutrient-rich water (Stewart and Lockhart 2005b). During the summer, primary productivity appears to be greater inshore than offshore. Evaluation of Figures 8.5-2, 8.5-5 and 8.5-6 suggests that areas of clumped beluga distribution coincide with regions of high primary productivity.

Additionally, sea surface temperature (SST) may also play a role in migration timing. Sergeant (1973) suggested most whales begin to travel north along the west coast of Hudson Bay in late August or early September, when the weather begins to get stormy. Results from the 2009 field season appear to loosely support this claim. Surveys were grounded on September 1 and 2 due to high winds and stormy weather; and when they recommenced on September 3, as predicted in the literature, more whales were observed travelling northward along the coast than on previous survey days. Figures 8.5-3 and 8.5-4 depict a slight drop in SST between August 31 and September 3, 2009. It is possible that the storm event, and corresponding change in temperature, served as an environmental cue, prompting the belugas to begin their northward migration.

Results from the 2008 field season are also generally consistent with available literature. Surveys were conducted around Chesterfield Inlet in mid-September (i.e., Sept. 10 to 15), and the low number of whales observed (62) suggests that the bulk of the migration had already passed and that whales were en route to their over-wintering habitat. Information provided by the Aqigiq Hunters and Trappers Organization in early September revealed that belugas migrated through the Chesterfield Inlet region as early as late August 2008.

The locations of the sightings during both the 2008 and 2009 aerial survey programs suggest that coastal regions provide more regular beluga whale summering habitat than offshore regions. However, contrary to results from the 2009 surveys, radio-tagging studies conducted in 2003 showed that some beluga moved north of Churchill later in the season, in mid-September or early October, and travelled offshore from the Kivalliq Coast or across central Hudson Bay. They passed south of Southampton Island in mid- to late October, and all three of the animals whose tags were still transmitting in November continued east, reaching Hudson Strait and northern Ungava Bay by late November (Richard 2005b). Results from the 2008 field season seem to support these data. During the surveys conducted in mid-September, a total of 25 belugas were observed offshore over ten separate sighting events (33% of sightings and 40% of individuals). In contrast, during the 2009 aerial surveys, conducted in late July and late August respectively, there was only one offshore sighting of 3 whales on July 30. It is plausible that the surveys, which ended on September 3, were flown too early to capture this later offshore migration. The uncertainty surrounding offshore beluga distribution and abundance in Western Hudson Bay remains a considerable data gap. Additional aerial survey effort farther offshore and later in the season (i.e. October) were not possible due to plane availability and cost limitations. Such surveys may help resolve some of these issues.



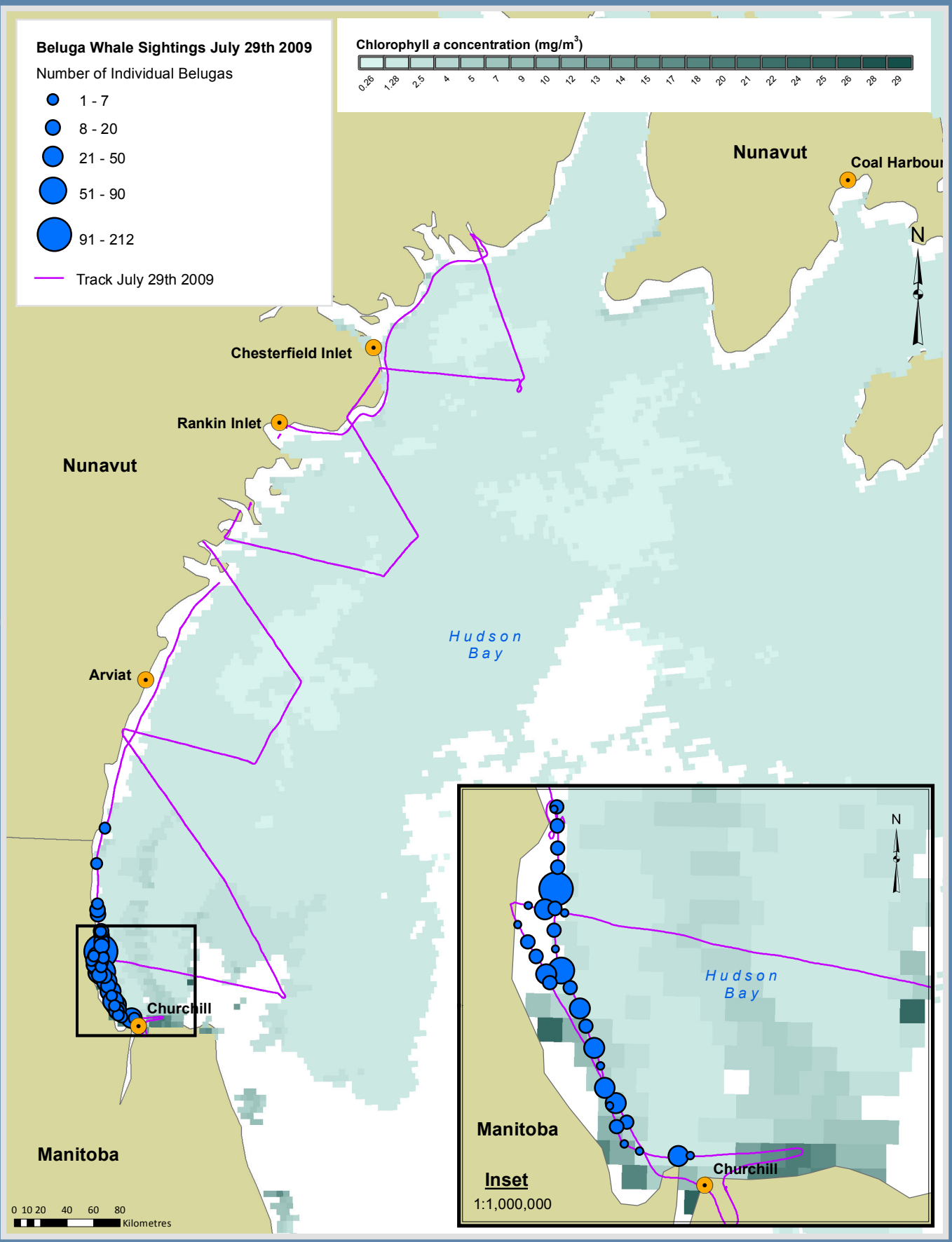
Projection: NAD 1983 UTM Zone 15N
Creator: SS
Date: 12/04/2009 Scale: 1:4,000,000
File: 1038926.04-025
Data Sources: *Natural Resources Canada, Geobase®, Natural Topographic Database, Areva Resources Canada Inc.*

FIGURE 8.5-1
WEEKLY MEAN SURFACE TEMPERATURE
AND BELUGA WHALE SIGHTINGS
FOR JULY 29, 2009
KIGGAVIK PROJECT - EIS

Stantec

AREVA

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



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Creator: SS
Date: 12/04/2009 Scale: 1:4,000,000
File: 1038926.04-024
Data Sources: *Natural Resources Canada, Geobase®, Natural Topographic Database, Areva Resources Canada Inc.*

FIGURE 8.5-2
DAILY CHLOROPHYLL *a* CONCENTRATIONS
AND BELUGA WHALE SIGHTINGS
FOR JULY 29, 2009
KIGGAVIK PROJECT - EIS

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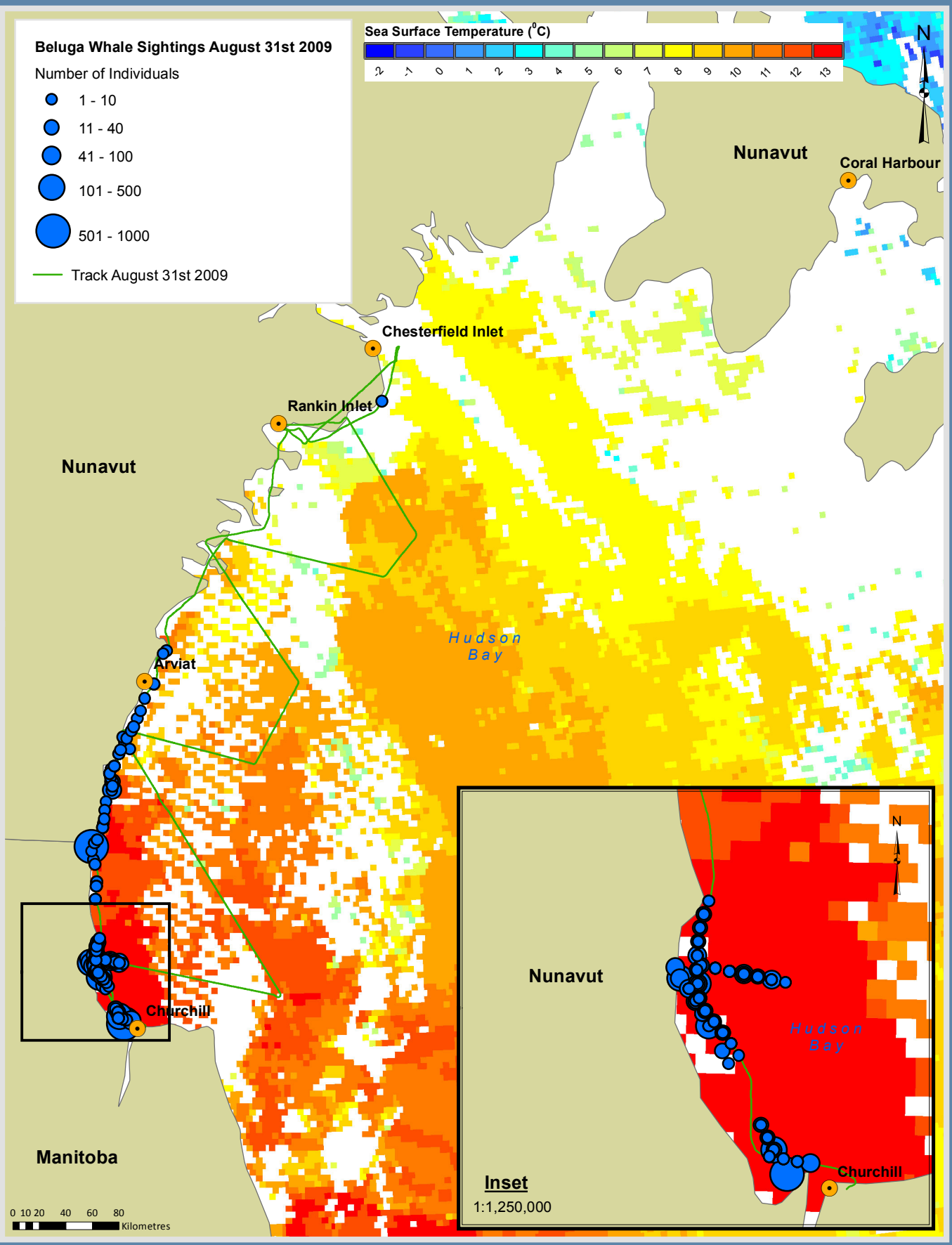
AREVA

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



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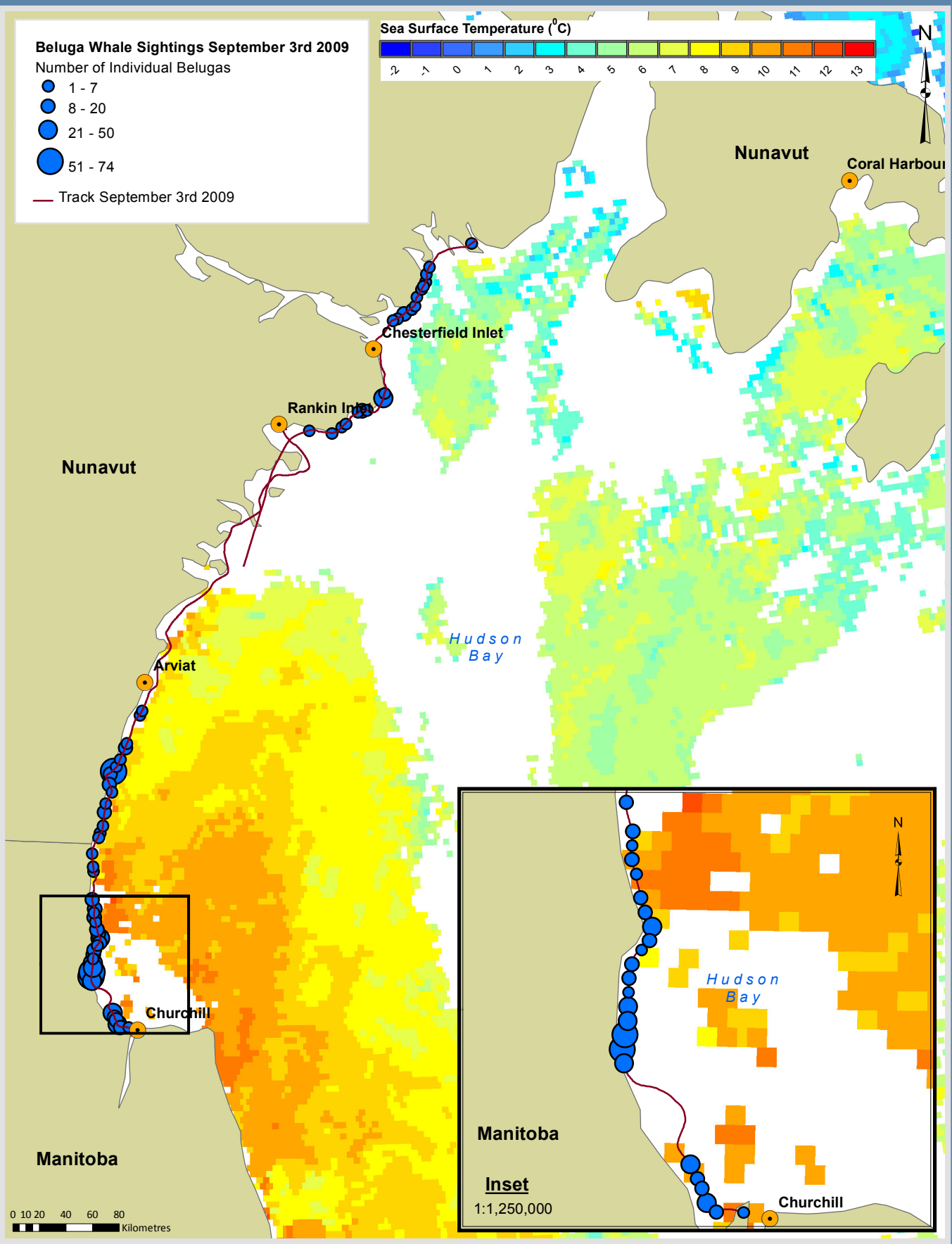
Creator: SS
Date: 12/04/2009 Scale: 1:4,000,000
File: 1038926.04-027
Data Sources: *Natural Resources Canada, Geobase®, Natural Topographic Database, Areva Resources Canada Inc.*

FIGURE 8.5-3
DAILY SEA SURFACE TEMPERATURE
AND BELUGA WHALE SIGHTINGS
FOR AUGUST 31, 2009
KIGGAVIK PROJECT - EIS

Stantec

AREVA

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



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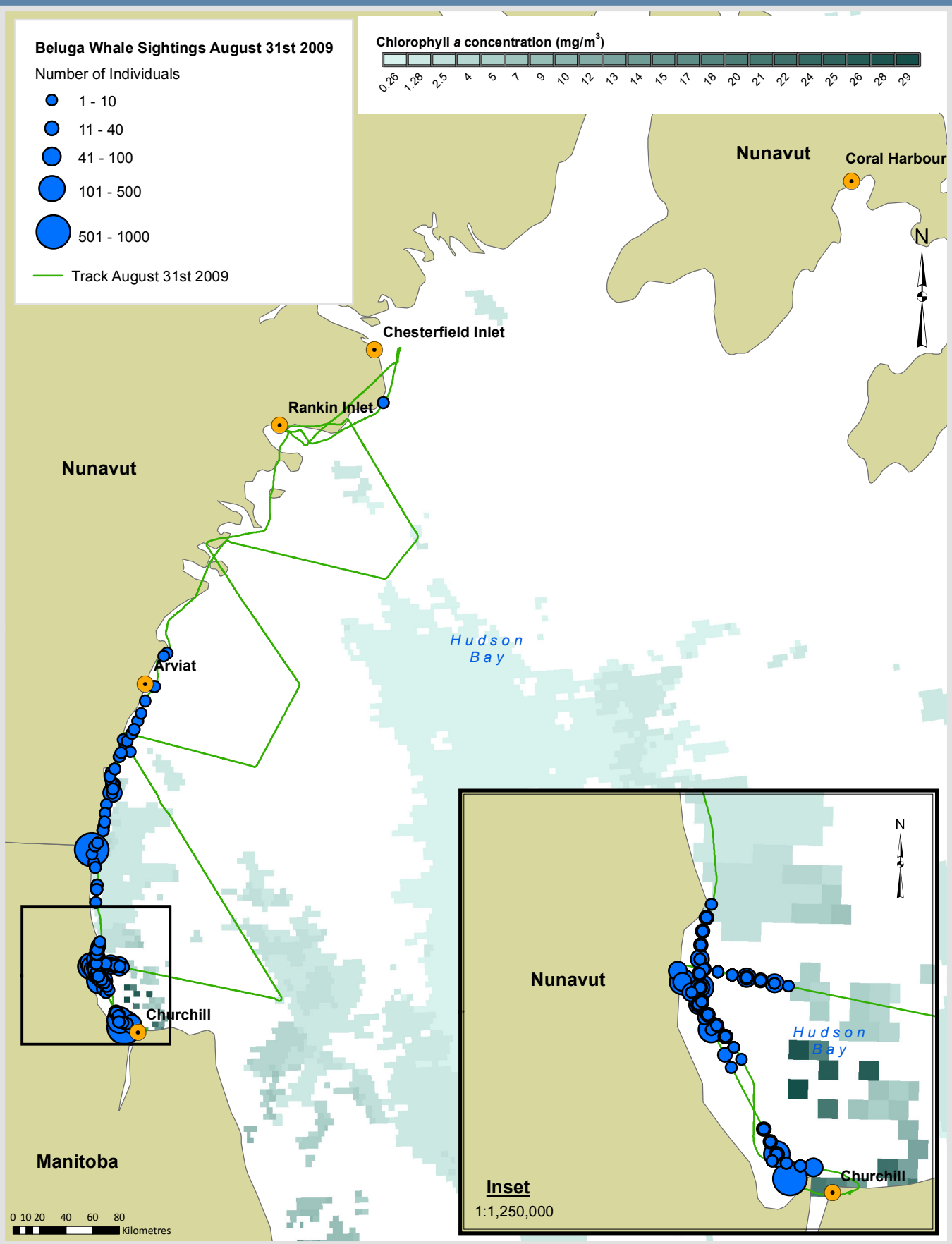
Creator: SS
Date: 12/04/2009 Scale: 1:4,000,000
File: 1038926.04-028
Data Sources: *Natural Resources Canada, Geobase®, Natural Topographic Database, Areva Resources Canada Inc.*

FIGURE 8.5-4
DAILY SEA SURFACE TEMPERATURE
AND BELUGA SIGHTINGS
FOR SEPTEMBER 3, 2009
KIGGAVIK PROJECT - EIS

Stantec

AREVA

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



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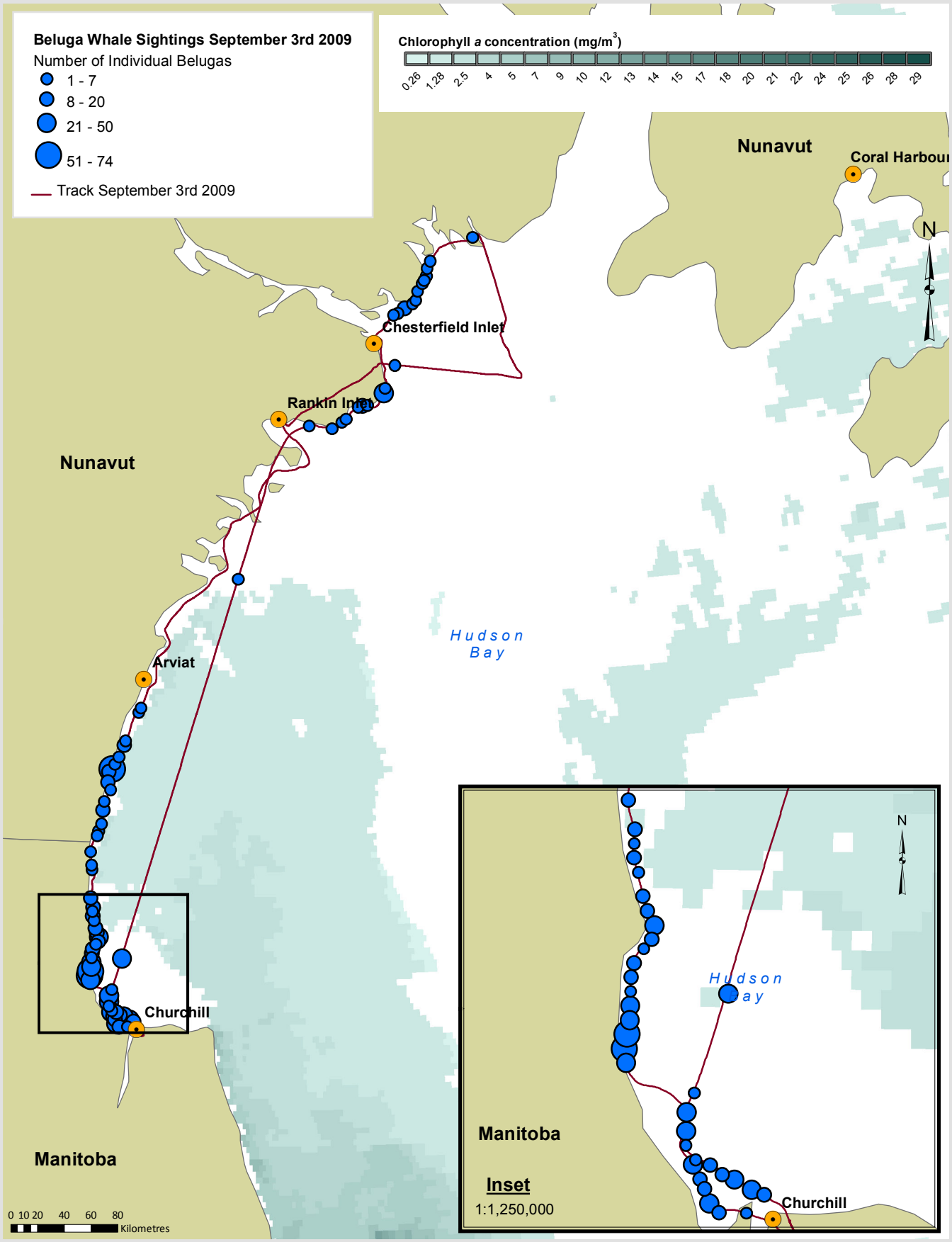
Creator: SS
Date: 12/04/2009 Scale: 1:4,000,000
File: 1038926.04-026
Data Sources: *Natural Resources Canada, Geobase®, Natural Topographic Database, Areva Resources Canada Inc.*

FIGURE 8.5-5
DAILY CHLOROPHYLL *a* CONCENTRATIONS
AND BELUGA WHALE SIGHTINGS
FOR AUGUST 31, 2009
KIGGAVIK PROJECT - EIS

Stantec

AREVA

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



Projection: NAD 1983 UTM Zone 15N
Creator: SS
Date: 12/04/2009 Scale: 1:4,000,000
File: 1038926.04-029
Data Sources: *Natural Resources Canada, Geobase®, Natural Topographic Database, Areva Resources Canada Inc.*

FIGURE 8.5-6
DAILY CHLOROPHYLL *a* CONCENTRATION
AND BELUGA WHALE SIGHTINGS
FOR SEPTEMBER 3, 2009
KIGGAVIK PROJECT - EIS

Stantec

AREVA

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

8.5.2 Polar Bear

The range of polar bears in Canada has been divided into 13 sub-populations (COSEWIC 2008). Bears from two of these sub-populations—Western Hudson Bay and Foxe Basin—are likely found within the study area. The study area primarily includes the range of the Western Hudson Bay sub-population and is at the southern edge of the Foxe Basin sub-population. There is some mixing of sub-populations on the sea ice during the winter and spring; however, the degree of interbreeding between sub-populations is unknown (Stewart and Lockhart 2005b). The bears sighted in the 2009 surveys almost certainly belong to the Western Hudson Bay sub-population based on distribution.

8.5.2.1 Encounter Rates

No bears were observed during the 2008 surveys, whereas 22 bears were observed during the 2009 surveys. IQ data suggest that polar bear numbers are increasing in the Chesterfield Inlet area; however, the most recent estimate of the Western Hudson Bay sub-population indicates that the overall abundance has declined from approximately 1,294 in 1987 to 935 in 2004 (COSEWIC 2008).

8.5.2.2 Distribution

The most important factor affecting the seasonal distribution and movement of polar bears is the seasonal variation in sea ice conditions (Stewart and Lockhart 2005b). It is reported in both the literature and IQ that annual ice melt generally forces bears ashore from mid-July through late August; and results from the 2009 survey are consistent with these observations, as the vast majority of bears were sighted along the shoreline. Further, the bears seem to come ashore in the same areas and show long-term site fidelity (Stirling *et al.* 2004).

In the fall, there is a gradual northward movement of the Western Hudson Bay polar bears along the south coast of Hudson Bay, as they gather to await the formation of new sea ice in November. Some bears tagged in the Churchill region move northward along the Kivalliq Coast as far as Chesterfield Inlet (Stirling *et al.* 1999). The movements of 41 adult female bears tagged at Churchill between 1991 and 1998 suggest that bears may concentrate in the area between Cape Churchill and Arviat. This is corroborated by results from the 2009 aerial surveys, as most polar bear sightings occurred in this region, including one sighting of 15 bears.

8.5.3 Pinnipeds

Pinnipeds surveyed included seals and walruses. Aerial surveys conducted in both 2008 and 2009 were designed primarily to detect cetaceans, and consequently, confident identification of seals was not always possible. Local knowledge and available harvest data suggest individuals categorized as ‘unidentified’ were most likely ringed or harp seals which are the most common seals in the area (AREVA 2009). Walruses were identified from the surveys.

8.5.3.1 Encounter Rates

Our surveys were not designed to adequately detect and identify pinnipeds in water. However, all seal sightings made were recorded. Aerial surveys designed for pinnipeds are generally conducted when there is ice and animals are more easily counted. Aerial survey results seem to concur with literature and IQ, which report seals to be common in the study area. Lunn *et al.* (1997) reported densities ranging from near 0 where ice cover was minimal to over 2 seals per km^2 where ice cover was dense in the area south of Rankin Inlet. These encounter rates cannot be directly compared to our results due to differences in methodologies, timing and areas covered but do indicate the presence of ringed and bearded seals in the area. Encounter rates calculated in 2008 were approximately two-fold higher than those calculated in 2009.

Walrus sightings were not common, which concurred with literature findings that suggest walruses had been more common and numerous along the west coast of Hudson Bay between Arviat and Chesterfield Inlet in the past (Born *et al.* 1995).

8.5.3.2 Distribution

The ringed seal is the most common and abundant species of seal in Hudson Bay, where it is resident year-round and occurs at virtually any depth (Stewart and Lockhart 2005b). During both the 2008 and 2009 survey programs, seal sightings were predominantly documented close to shore, though several offshore sightings were also noted. This is consistent with the literature, which suggests that, during the open-water season, seals of all ages are typically found nearshore (Stewart and Lockhart 2005b).

Harp seals are seasonal migrants in western Hudson Bay, present from ice breakup in June until just before freeze-up in early October. As recently as the 1970s, harp seal were rare along the Kivalliq coast south of Rankin Inlet; however, with the increase in the Atlantic population, the species may be reoccupying its former range (Stewart and Lockhart 2005b). During the 2009 vessel survey, 13 harp seal sightings were documented in Chesterfield Inlet on August 29, 2009.

Some of the most southerly populations of Atlantic walrus are found in Hudson Bay, though sightings around Churchill are rare (Stewart and Lockhart 2005b). During the July 29, 2009 aerial survey, a herd of approximately 20 walruses was observed, hauled out offshore of Churchill on residual brash ice. Some walruses remain at the ice edge or in the pack ice over the winter, while others move northeast into Hudson Strait.

8.5.4 Bowhead Whale

No bowhead whales were observed during the 2008 or 2009 aerial surveys, suggesting that waters south of Chesterfield Inlet are not prime bowhead whale habitat. This seemingly contradicts the literature, which denoted the study area as pre-commercial bowhead whale habitat and identified it currently as potentially suitable bowhead habitat (Wheeler and Gilbert 2007). The historical presence of a large population of bowhead suggests that there is an area of high productivity in northwestern Hudson Bay, though its existence has not yet been proven.

Additionally, Inuit elders interviewed for bowhead information denoted the study area as bowhead whale habitat (NWMB 2000).

Historically, bowhead whales were abundant in northwestern Hudson Bay from mid-May to mid-September. A favourite area for hunting them was the vicinity of Whale Point, north of the mouth of Chesterfield Inlet (Cosens and Innes 2000). A few bowhead whales have been harvested in recent years by Inuit north of the study area, around Repulse Bay (COSEWIC 2009). The lack of bowhead sightings in 2008 and 2009 is consistent with survey results over the same area in 1995 (Cosens and Innes 2000), and suggests that bowhead whales are not common in this area.

8.5.5 Killer Whale

Little is known about the movements or biology of killer whales in Hudson Bay. No killer whales were observed in 2008 or 2009, indicating that they are not frequent visitors to the region. However, residents of Chesterfield Inlet have reported sightings of killer whales in the summer of 2008. Additionally, in a private meeting held on July 30, 2009, members of the Arviat HTO reported seeing a pod of approximately 30 orcas about four years previously off Sentry Island, northeast of Arviat.

Further consultation with residents may yield more information pertaining to specific locations, numbers of animals and apparent behaviours. Several Nunavut communities are reporting increases in abundance and presence of killer whales.

8.5.6 Narwhal

No narwhals were observed during the 2008 or 2009 aerial surveys. This concurs with both the literature and IQ, which identify narwhal habitat primarily north of the study area, in the waters surrounding Southampton Island (e.g., Repulse Bay and Foxe Channel) (Stewart and Lockhart 2005b). Sightings of narwhals to the south, near Arviat, are unusual and have generally been attributed to the presence of killer whales (Stewart and Lockhart 2005b).

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9 SUMMARY

This report has been prepared to describe baseline marine environment conditions for AREVA's proposed uranium mine in the Kivalliq region of Nunavut and support the environmental assessment of potential effects of the Project on the marine environment. Literature reviews were conducted for existing information on marine mammals, birds, fish, invertebrates and sea ice and currents in the RSA. Field surveys were conducted in 2008 and 2009 to complement existing data on marine mammals in the study area. The study was successful in collecting available literature, Inuit IQ and field data to better understand temporal and spatial variability in marine mammal abundance and distribution in relation to the study area.

Integration of available scientific literature, IQ and results from Nunami Stantec aerial surveys indicates that marine mammals present in the waters and/or ice habitats along the proposed Project vessel routes include beluga whales, seals, walruses and polar bears.

The lack of bowhead whale, killer whale and/or narwhal sightings during both the 2008 and 2009 surveys suggests that these species are rare in the study area. Literature and IQ confirm that the preferred habitat for these species appears to lie north of the study area, around Repulse Bay and Foxe Basin. Killer whales live at all latitudes and sporadically migrate into Hudson Bay in the summer (Stewart and Lockhart 2005b); while a number of sightings of orca pods have been reported by Inuit communities over the past few years, they were not observed during either the 2008 or 2009 aerial surveys.

Walruses and ringed seals are year-round residents of Hudson Bay, while harp seals are seasonal visitors to the region. In agreement with both the literature and IQ, results from the aerial surveys suggest that ringed and harp seals are the most common pinnipeds in the study area. Survey results indicate that walruses, while not common, are present in southwestern Hudson Bay; information found in the literature and IQ lend support to these observations and affirm that walruses are more abundant in areas north of Chesterfield Inlet.

Observations during Nunami Stantec field surveys complement information presented in both the literature and IQ. All sources indicate that polar bears frequent coastal areas along Western Hudson Bay in the summer, and are most common in the area between Arviat and Churchill.

Results from the aerial surveys indicate that belugas are the most common and abundant cetacean species in Hudson Bay. Other researchers corroborate these findings, reporting aggregations of belugas summering in the estuaries of the Nelson, Churchill and Seal rivers in July and August to be some of the largest known in the world (Richard 2005b). Overall, belugas tended to be observed mainly in coastal areas both in the 2008 and 2009 surveys. This apparent distribution may have been affected by environmental factors (e.g., SST, chlorophyll *a* or food availability) which are dependent on seasonal changes likely driving annual migration.

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ATTACHMENT A

Aerial Survey Cheat Sheet

AERIAL SURVEY CHEAT SHEET

Time	Hours, minutes and seconds
Record Type	Sighting, time period, start transect, end transect

Environmental	
Weather	Clear, partly cloudy, overcast, fog, mist, light rain, moderate rain, heavy rain, snow
Ice	% cover (in 10% intervals)
Beaufort Force	Glassy (0); ripples (1); small wavelets (2); smooth wavelets (3); small whitecaps (4); moderate waves, some spray (5)
Glare	None, moderate or severe
Sightability	Excellent, good, moderately impaired, severely impaired, impossible

Sightings	
Species	Beluga; ringed seal; bearded seal; polar bear; walrus; bowhead whale; killer whale
Number	Total number
On/Off Transect	Within or outside of strip transect
Age	Adult; sub-adult; mother/calf; calf; unknown
Angle	Inclinometer angle
Activity	Feeding; resting; milling; socializing; travelling
Behaviour	Diving; swimming; blowing; breaching; tail slap; walking; looking; hauled out; dead; other; unknown
Speed	Slow; medium; fast; unknown
Heading	Clock face direction (12 o'clock is same direction as aircraft)
Other	Oceanographic feature; geographic feature; flocks of birds; ice edge

Lead Observer Records (at beginning/end of transect)	
Transect #	
Date	
Time	Hours, minutes and seconds
Altitude	In metres
Air Temp	In degree Celsius
Wind Speed	In knots
Cloud Cover	% (10% intervals)
St. Prim. Obs	Starboard primary observer's full name
Pt. Prim Obs	Port primary observer's full name
St. Sec. Obs	Starboard secondary observer's full name
Pt. Sec. Obs	Port secondary observer's full name

ATTACHMENT B

2008 Aerial Survey Data

Date	Transect number	Observer	Actual Time	Time on Transect (min)	Sightability	Visibility	Weather	Glare	Sea State	Beluga	Seal	Behaviour	Port/ Starboard	Angle of Observation	Comment
September 10, 2008	Coastline from Rankin Inlet to Chesterfield Inlet	Janine	9:42	43	Good	Good		no	2	1			Starboard	40	
September 10, 2008	Coastline from Rankin Inlet to Chesterfield Inlet	Janine	9:46	43	Good	Good		no	1-2	1		Heading north	Starboard	27	
September 10, 2008	Coastline from Rankin Inlet to Chesterfield Inlet	Janine	9:48	43	Good	Good	Clearing up, no rain	no	1	1		Travelling east, very near shore		55	
September 10, 2008	Coastline from Rankin Inlet to Chesterfield Inlet	Janine	10:16	43	Good	Good	Clearing up, no rain		1		1			50	Unidentified seal
September 10, 2008	5	Janine	13:58	18	Good	Excellent	Mixed sun and cloud	75° to heading	2	1			Starboard	35	
September 10, 2008	6	Janine	14:24	14	Good	Excellent	Mixed sun and cloud	270° to heading	2	3		Swimming north	Starboard	30	
September 10, 2008	6	Janine	14:26	14	Good	Excellent	Mixed sun and cloud	270° to heading	2	2		Travelling north east	Starboard	25-30	
September 10, 2008	6	Janine	14:27	14	Good	Excellent	Mixed sun and cloud	270° to heading	2	1		Travelling east	Starboard	30	
September 10, 2008	Between 7 and 8	Mark	missing		Unknown	Excellent	Mixed sun and cloud	270° to heading	2	15		Headed into shore - all oriented in the same direction	Port	Approx 40° - within 100m of observer visibilty range	
September 10, 2008	8	Janine	14:55	11	Good	Excellent	Mixed sun and cloud	270° to heading	2	1		Swimming 45° to heading	Starboard: Secondary observer		
September 10, 2008	Between 8 and 9: off transect, circling around animals			3	Good	Excellent	Mixed sun and cloud	270° to heading	2	12		Swimming along the shoreline	Starboard		
September 10, 2008	9	Janine	15:10	13	Good	Excellent	Mixed sun and cloud	120° to heading	2	2		Headed north on Port side (Mark records)	Port: navigator comment		Cow and calf
September 10, 2008	9	Janine	15:15	13	Good	Excellent	Mixed sun and cloud	120° to heading	2	1		Travelling north	Starboard	80	
September 10, 2008	10	Janine	15:40	16	Good	Poor due to glare of sun	overcast with sun	270° to heading	2	3		Heading north	Starboard	30	
September 10, 2008	Off transect: Circling Marble Island	Janine	17:35	13	Good	Poor	Clear skies and sunny	High Glare	2		1	South side on Marble Island seal swimming caraocally/playful towards marble Island at 45o	Starboard: secondary observer	45	
September 11, 2008	Departing Rankin Inlet	Mark	11:23	32 min						1		Headed south (the "wrong" way)	Port		
September 11, 2008	Departing Rankin Inlet	Mark	11:27	32 min						1		Moving east, along the coastline (?)	Port		Not sure if the whale is moving along the coastline. Whale was definitely moving east though.
September 11, 2008	Taking off from Chesterfield	Janine	12:33	61 min						1		Heading east	Starboard	50	
September 11, 2008	Taking off from Chesterfield	Janine	12:33	61 min						1		Heading west	Starboard	70	
September 11, 2008	Circling for group of whales	Todd	12:58	21 min							30		Starboard		Large group (approx 30) spotted by Todd and secondary observer
September 11, 2008	RI - CH	Janine	13:43	61 min							24		Starboard		2 groups seals (2 groups, 10-15 per group)

Date	Transect number	Observer	Actual Time	Time on Transect (min)	Sightability	Visibility	Weather	Glare	Sea State	Beluga	Seal	Behaviour	Port/ Starboard	Angle of Observation	Comment
September 11, 2008	RI - CH	Mark	13:55	61 min						1			Port observer comment		Secondary observer Ron sighted the animal, but no one else saw it
September 11, 2008		Mark	14:43	61 min						1		Headed east - in Chesterfield Inlet	Port		
September 11, 2008		Mark	14:48	61 min						1		Headed west	Port		
September 11, 2008		Mark	14:50	61 min						1		Headed east			
September 11, 2008	1	Todd	15:08	20 min						2			Starboard (seen by Port observer)		2 - 3 belugas
September 11, 2008	2	Mark	15:29	22 min						1		Headed south	Port		NOTE: All belugas seen thus far today, Sept 11th, have been well below the surface
September 11, 2008	2	Mark	15:43	22 min							1	Swimming to the east, appear to be diving	Starboard	75% = 35^{o}	Angle of observation correction by Todd
September 11, 2008	6	Todd	17:26	13 min						1		Swimming slowly to the west, did not break the surface	Starboard	35o off the end of the aircraft	
September 12, 2008	Chesterfield Inlet	Janine	12:04	2 hours					Beaufort State 2	1			Starboard	30 degrees	
September 12, 2008	Off transect: circling to look for animals?	Janine	12:19	10 min							24	Heading for the shore	Starboard		Large group of marine mammals, not sure what they are
September 12, 2008	Shoreline CI to RI	Todd	14:43	24 min						1		Swimming north along coastline	Starboard	35	End of survey (landed in Rankin Inlet)
September 13, 2008	Off transect	Todd	14:49	33 min						1		Swimming north	Starboard	40°	Sighted south side of Baker Forelands
September 13, 2008		Mark	15:00	41 min						1			Port		
September 15, 2008	Coastline	Todd Goodsell	10:50	83 min					3-4	1		Travelling subsurface (1-2 m), did not breach the surface	Starboard		
September 15, 2008	Coastline survey	Todd Goodsell	11:42	83 min						1		Swimming north, subsurface		30˚	

ATTACHMENT C

2009 Aerial Survey Data

Date	Transect	Time	Weather	Percent Ice Cover	Beaufort	Glare[1]	Sightability[2]	Species	Number	Angle	Age	Activity	Behaviour	Comments
July 29, 2009	1	14:35:14	partly cloudy	0	1	NO	EX	seal	1				feeding	flock of birds
July 29, 2009	8	21:40:13	overcast	0	1	MO	GOOD	beluga	1				swimming	
July 29, 2009	8	21:40:52	overcast	0	1	MO	GOOD	beluga	2				swimming	3 - 4 km away
July 29, 2009	8	21:41:15	overcast	0	1	MO	GOOD	beluga	8		adult		swimming	
July 29, 2009	8	21:41:31	overcast	0	1	MO	GOOD	beluga	4		mother/calf		swimming	
July 29, 2009	8	21:41:40	overcast	0	1	MO	GOOD	beluga	1				swimming	
July 29, 2009	8	21:42:03	overcast	0	1	MO	GOOD	beluga	1				swimming	
July 29, 2009	9	21:44:50	overcast	0	1	NO	EX	beluga	1					
July 29, 2009	9	21:45:34	overcast	0	1	NO	EX	beluga	1				swimming	
July 29, 2009	9	21:46:07	overcast	0	1	NO	EX	beluga	2	20			swimming	
July 29, 2009	9	21:46:29	overcast	0	1	NO	EX	beluga	4		adult; mother/calf			
July 29, 2009	9	21:47:16	overcast	0	1	NO	EX	beluga	6				swimming	
July 29, 2009	9	21:47:53	overcast	0	1	NO	EX	beluga	35	65	adult; mother/calf			
July 29, 2009	9	21:48:45	overcast	0	1	NO	EX	beluga	2				swimming	
July 29, 2009	9	21:48:53	overcast	0	1	NO	EX	beluga	6		adult		swimming	
July 29, 2009	Coast	22:56:20	partly cloudy	0	1	MO	GOOD	beluga	2		mother/calf	milling		
July 29, 2009	Coast	22:57:44	partly cloudy	0	1	MO	GOOD	beluga	1		adult			
July 29, 2009	Coast	22:58:56	partly cloudy	0	1	MO	GOOD	beluga	1		adult		diving	
July 29, 2009	Coast	22:59:10	partly cloudy	0	1	MO	GOOD	beluga	4		adult		diving	
July 29, 2009	Coast	22:59:21	partly cloudy	0	1	MO	GOOD	beluga	4		adult		swimming	headed northwards
July 29, 2009	Coast	22:59:37	partly cloudy	0	1	MO	GOOD	beluga	1	30			swimming	headed northwards
July 29, 2009	Coast	23:00:51	partly cloudy	0	1	MO	GOOD	beluga	1		adult	resting		
July 29, 2009	Coast	23:01:12	partly cloudy	0	1	MO	GOOD	beluga	20	21	adult; mother/calf		swimming	
July 29, 2009	Coast	23:02:37	partly cloudy	0	1	MO	GOOD	beluga	4	13				
July 29, 2009	Coast	23:03:11	partly cloudy	0	1	MO	GOOD	beluga	3	35			swimming	
July 29, 2009	Coast	23:03:36	partly cloudy	0	1	MO	GOOD	beluga	15	70	adult; mother/calf	resting		
July 29, 2009	Coast	23:04:17	partly cloudy	0	1	MO	GOOD	beluga	5	65		milling	diving	
July 29, 2009	Coast	23:04:30	partly cloudy	0	1	MO	GOOD	beluga	3			milling		
July 29, 2009	Coast	23:04:38	partly cloudy	0	1	MO	GOOD	beluga	5			resting		
July 29, 2009	Coast	23:04:52	partly cloudy	0	1	MO	GOOD	beluga	7		adult; mother/calf			
July 29, 2009	Coast	23:05:02	partly cloudy	0	1	MO	GOOD	beluga	10				swimming	
July 29, 2009	Coast	23:05:23	partly cloudy	0	1	MO	GOOD	beluga	2	70	mother/calf	resting		
July 29, 2009	Coast	23:05:40	partly cloudy	0	1	MO	GOOD	beluga	3	20		resting		
July 29, 2009	Coast	23:06:03	partly cloudy	0	1	MO	GOOD	beluga	3	25				
July 29, 2009	Coast	23:06:20	partly cloudy	0	1	MO	GOOD	beluga	5	50		resting		
July 29, 2009	Coast	23:06:30	partly cloudy	0	1	MO	GOOD	beluga	1	40			swimming	
July 29, 2009	Coast	23:06:57	partly cloudy	0	1	MO	GOOD	beluga	3				diving	
July 29, 2009	Coast	23:07:15	partly cloudy	0	1	MO	GOOD	beluga	30	22	adult; mother/calf			
July 29, 2009	Coast	23:07:38	partly cloudy	0	1	MO	GOOD	beluga	2				diving	
July 29, 2009	Coast	23:07:43	partly cloudy	0	1	MO	GOOD	beluga	3	60			swimming	
July 29, 2009	Coast	23:07:53	partly cloudy	0	1	MO	GOOD	beluga	1	30			swimming	
July 29, 2009	Coast	23:08:13	partly cloudy	0	1	MO	GOOD	beluga	4				diving	
July 29, 2009	Coast	23:09:35	partly cloudy	0	1	MO	GOOD	beluga	7	35			swimming	heading northwards
July 29, 2009	Coast	23:10:04	partly cloudy	0	1	MO	GOOD	beluga	1				diving	
July 29, 2009	Coast	23:10:22	partly cloudy	0	1	MO	GOOD	beluga	2	30				
July 29, 2009	Coast	23:10:31	partly cloudy	0	1	MO	GOOD	beluga	3	25		resting		
July 29, 2009	Coast	23:10:47	partly cloudy	0	1	MO	GOOD	beluga	5	65		resting		
July 29, 2009	Coast	23:11:08	partly cloudy	0	1	MO	GOOD	beluga	2	70			swimming	
July 29, 2009	Coast	23:11:24	partly cloudy	0	1	MO	GOOD	beluga	40	70	adult; mother/calf		swimming	
July 29, 2009	Coast	23:11:42	partly cloudy	0	1	MO	GOOD	beluga	20	35				
July 29, 2009	Coast	23:11:56	partly cloudy	0	1	MO	GOOD	beluga	10	40			swimming	
July 29, 2009	Coast	23:12:14	partly cloudy	0	1	MO	GOOD	beluga	10	70		resting		
July 29, 2009	Coast	23:13:02	partly cloudy	0	1	MO	GOOD	beluga	5	50		resting		
July 29, 2009	Coast	23:13:44	partly cloudy	0	1	MO	GOOD	beluga	1	40		resting		
July 29, 2009	Coast	23:14:20	partly cloudy	0	1	MO	GOOD	beluga	5	40			diving	
July 29, 2009	Coast	23:14:40	partly cloudy	0	1	MO	GOOD	beluga	2	60		resting		
July 29, 2009	Coast	23:14:55	partly cloudy	0	1	MO	GOOD	beluga	4	30				
July 29, 2009	Coast	23:15:06	partly cloudy	0	1	MO	GOOD	beluga	2	55			diving	
July 29, 2009	Coast	23:15:12	partly cloudy	0	1	MO	GOOD	beluga	4	68			swimming	
July 29, 2009	Coast	23:15:25	partly cloudy	0	1	MO	GOOD	beluga	2	50			diving	

Date	Transect	Time	Weather	Percent Ice Cover	Beaufort	Glare[1]	Sightability[2]	Species	Number	Angle	Age	Activity	Behaviour	Comments
July 29, 2009	Coast	23:24:12	partly cloudy	0	1	NO	EX	beluga	5	25		resting		
July 29, 2009	Coast	23:24:47	partly cloudy	0	1	NO	EX	beluga	4				swimming	
July 29, 2009	Coast	23:25:29	partly cloudy	0	1	NO	EX	beluga	4	50		resting		
July 29, 2009	Coast	23:26:15	clear	0	1	NO	EX	beluga	1	50			diving	
July 29, 2009	Coast	23:34:20	clear	0	1	NO	EX	beluga	1	25			swimming	
July 29, 2009	Coast	0:05:40	clear	0	1	NO	EX	beluga	2	25	adult	resting		
July 29, 2009	Coast	14:02:53	overcast	0	0	NO	EX	seal (unID)	1	61		milling		small, not bearded seals
July 29, 2009	Coast	14:02:54	overcast	0	0	NO	EX	seal (unID)	1	38		milling		small, not bearded seals
July 29, 2009	Coast	14:05:03	overcast	0	0	NO	EX	seal (unID)	1	45		milling		kelp bed
July 29, 2009	Coast	14:05:04	overcast	0	0	NO	EX	seal (unID)	1	56		milling		kelp bed
July 29, 2009	8	21:34:00	high overcast	5	2	MO	MI	walrus	20	12			hauled out	herd
July 29, 2009	8	21:39:00	high overcast	1	1	NO	GOOD	polar bear	1	40			swimming	
July 29, 2009	8	21:40:00	high overcast	1	2	MO	GOOD	beluga	1	50			swimming	
July 29, 2009	8	21:41:02	high overcast	1	2	MO	GOOD	beluga	15	43			swimming	
July 29, 2009	8	21:41:05	high overcast	1	2	MO	GOOD	beluga	9	65			swimming	
July 29, 2009	8	21:41:11	high overcast	1	2	MO	GOOD	beluga	5	25			swimming	
July 29, 2009	9	21:45:00	high overcast	0	2	NO	GOOD	beluga	6	53	mother/calf			
July 29, 2009	9	21:45:03	high overcast	0	2	NO	GOOD	beluga	2	22				
July 29, 2009	9	21:45:11	high overcast	0	2	NO	GOOD	beluga	1	30				
July 29, 2009	9	21:45:13	high overcast	0	2	NO	GOOD	beluga	4	43	mother/calf			
July 29, 2009	9	21:45:16	high overcast	0	2	NO	GOOD	beluga	1	19				
July 29, 2009	9	21:46:05	high overcast	0	2	NO	GOOD	beluga	5		mother/calf			
July 29, 2009	9	21:46:06	high overcast	0	2	NO	GOOD	beluga	4					
July 29, 2009	9	21:46:08	high overcast	0	2	NO	GOOD	beluga	1	25				
July 29, 2009	9	21:54:22	high overcast	0	1	NO	GOOD	beluga	200	4			socializing	
July 29, 2009	9	21:54:28	high overcast	0	1	NO	GOOD	beluga	1	41	adult			
July 29, 2009	9	21:54:29	high overcast	0	1	NO	GOOD	beluga	1	46	adult			
July 29, 2009	9	21:54:56	high overcast	0	1	NO	GOOD	beluga	6	20			feeding	
July 29, 2009	9	21:54:56	high overcast	0	1	NO	GOOD	beluga	6					
July 29, 2009	9	21:54:56	high overcast	0	1	NO	GOOD	beluga	8					
July 29, 2009	9	21:55:00	high overcast	0	1	NO	GOOD	beluga	12					
July 29, 2009	9	21:55:02	high overcast	0	1	NO	GOOD	beluga	6					
July 29, 2009	9	21:55:02	high overcast	0	1	NO	GOOD	beluga	5					
July 29, 2009	9	21:55:03	high overcast	0	1	NO	GOOD	beluga	8					
July 29, 2009	9	21:55:49	high overcast	0	1	NO	GOOD	beluga	2	31			swimming	
July 29, 2009	9	21:56:54	high overcast	0	1	NO	GOOD	beluga	7				swimming	
July 29, 2009	9	21:56:55	high overcast	0	1	NO	GOOD	beluga	8				swimming	
July 29, 2009	Coast	22:55:27	high overcast	0	3	SEV	MI	beluga	4	47	mother/calf			
July 29, 2009	Coast	22:56:05	high overcast	0	3	SEV	MI	beluga	30	10 - 63			feeding	
July 29, 2009	Coast	22:56:38	high overcast	0	3	SEV	MI	beluga	4	57	mother; subadult			right at shoreline
July 29, 2009	Coast	22:57:21	high overcast	0	3	SEV	MI	beluga	1	30	adult		surfacing	
July 29, 2009	Coast	23:01:12	high overcast	0	3	SEV	MI	beluga	2	60	mother/sub-adult			
July 29, 2009	Coast	23:03:25	high overcast	0	3	SEV	MI	beluga	6	58	2 mother/calf; 2 adults			
July 29, 2009	Coast	23:05:18	high overcast	0	3	SEV	MI	beluga	3	23	mother/calf			
July 29, 2009	Coast	23:05:26	high overcast	0	3	SEV	MI	beluga	5	60				
July 29, 2009	Coast	23:06:48	high overcast	0	2	SEV	SI	beluga	3					
July 29, 2009	Coast	23:06:49	high overcast	0	2	SEV	SI	beluga	1					
July 29, 2009	Coast	23:07:17	high overcast	0	2	SEV	SI	beluga	12		mother/calf			
July 29, 2009	Coast	23:07:40	high overcast	0	2	SEV	SI	beluga	4	55	mother/sub-adult			
July 29, 2009	Coast	23:07:50	high overcast	0	2	SEV	SI	beluga	8					
July 29, 2009	Coast	23:07:51	high overcast	0	2	SEV	SI	beluga	2					
July 29, 2009	Coast	23:08:06	high overcast	0	2	SEV	SI	beluga	1					
July 29, 2009	Coast	23:08:48	high overcast	0	2	SEV	SI	beluga	2		adult			
July 29, 2009	Coast	23:09:27	high overcast	0	2	SEV	SI	beluga	4	9				
July 29, 2009	Coast	23:09:41	high overcast	0	2	SEV	SI	beluga	1	23			surfacing	
July 29, 2009	Coast	23:09:43	high overcast	0	2	SEV	SI	beluga	1	48				
July 29, 2009	Coast	23:10:37	high overcast	0	2	MO	MI	beluga	1	47	adult		diving	
July 29, 2009	Coast	23:10:59	high overcast	0	2	MO	MI	beluga	6	20				
July 29, 2009	Coast	23:11:52	high overcast	0	2	MO	MI	beluga	50	9 - 70				scattered, small groups
July 29, 2009	Coast	23:11:56	high overcast	0	2	MO	MI	beluga	90	65			milling	

Date	Transect	Time	Weather	Percent Ice Cover	Beaufort	Glare[1]	Sightability[2]	Species	Number	Angle	Age	Activity	Behaviour	Comments
July 29, 2009	Coast	23:13:10	high overcast	0	2	MO	MI	beluga	6	12				
July 29, 2009	Coast	23:14:20	high overcast	0	2	SEV	MI	beluga	2	23			milling	
July 29, 2009	Coast	23:17:36	high overcast	0	2	SEV	MI	polar bear	15	55	adults/cubs			feeding on beluga carcass
July 29, 2009	Coast	23:21:02	high overcast	0	2	SEV	MI	beluga	4	9			feeding	
July 29, 2009	Coast	23:24:02	high overcast	0	1	MO	GOOD	beluga	3	38				
July 29, 2009	Coast	23:24:54	high overcast	0	1	MO	GOOD	beluga	1	55			swimming	
July 29, 2009	Coast	23:25:55	high overcast	0	1	MO	GOOD	beluga	5	35	mother/calf			
July 29, 2009	Coast	23:25:56	high overcast	0	1	MO	GOOD	beluga	3	37	mother/subadult			
July 29, 2009	Coast	23:26:21	high overcast	0	1	MO	GOOD	beluga	1	18			swimming	
July 29, 2009	Coast	23:41:41	high overcast	0	3	SEV	SI	beluga	1	46			swimming	
July 29, 2009	Coast	23:41:43	high overcast	0	3	SEV	SI	beluga	2	58				
July 29, 2009	Coast	23:48:45	high overcast	0	3	SEV	SI	seal	6	60			hauled out	
July 30, 2009	Coast	13:52:15	partly cloudy	0	0	MO	EX	seals	7					
July 30, 2009	Coast	13:54:08	partly cloudy	0	0	MO	EX	seal	5					~10 km away
July 30, 2009	6	19:12:31	overcast	0	1	MO	GOOD	beluga	10	25			travelling	incidental
July 30, 2009	Coast	19:24:37	overcast/fog	0	1	MO	GOOD	beluga	10	60	adult; mother/calf pairs		milling	
July 30, 2009	Coast	19:31:53	overcast/fog	0	1	MO	MI	beluga	1	55	adult			
July 30, 2009	Coast	19:31:56	overcast/fog	0	1	MO	MI	beluga	10	55	adults; mother/calf pairs		milling	
July 30, 2009	Coast	19:38:15	overcast	0	1	MO	GOOD	beluga	2	35				
July 30, 2009	Coast	19:38:26	overcast	0	1	MO	GOOD	beluga	1	53			diving	
July 30, 2009	Coast	19:38:45	overcast	0	1	MO	GOOD	beluga	10	21				
July 30, 2009	Coast	19:38:58	overcast	0	1	MO	GOOD	beluga	5	10				
July 30, 2009	Coast	19:39:07	overcast	0	1	MO	GOOD	beluga	15	8				
July 30, 2009	Coast	19:39:57	overcast	0	1	MO	GOOD	beluga	2	31	adults		milling	
July 30, 2009	Coast	19:41:29	overcast	0	1	MO	GOOD	beluga	8	14				
July 30, 2009	Coast	19:42:14	overcast	0	1	MO	GOOD	beluga	4	13				
July 30, 2009	Coast	19:42:57	overcast	0	1	MO	GOOD	beluga	1	18	adult		diving	
July 30, 2009	Coast	19:44:23	overcast	0	1	MO	GOOD	beluga	15	6				
July 30, 2009	Coast	19:44:43	overcast	0	1	MO	GOOD	beluga	5				swimming	
July 30, 2009	Coast	19:44:49	overcast	0	1	MO	GOOD	beluga	2					
July 30, 2009	Coast	19:45:00	overcast	0	1	MO	GOOD	beluga	4		mother/calf		swimming	
July 30, 2009	Coast	19:46:00	overcast	0	1	MO	GOOD	beluga						
July 30, 2009	Coast	19:47:39	overcast	0	1	MO	GOOD	beluga	15					
July 30, 2009	Coast	19:47:55	overcast	0	1	MO	GOOD	beluga	6	48			swimming	
July 30, 2009	Coast	19:48:00	overcast	0	1	MO	GOOD	beluga	4				swimming	
July 30, 2009	Coast	19:48:20	overcast	0	1	MO	GOOD	beluga	50				milling	
July 30, 2009	Coast	19:48:37	overcast	0	1	MO	GOOD	beluga	2	14				
July 30, 2009	Coast	19:49:15	overcast	0	1	MO	GOOD	beluga	4	30			swimming	
July 30, 2009	Coast	19:49:51	overcast	0	1	MO	GOOD	beluga	4					just under surface
July 30, 2009	Coast	19:50:10	overcast	0	1	MO	GOOD	beluga	50					
July 30, 2009	Coast	19:50:25	overcast	0	1	MO	GOOD	beluga	8				swimming	
July 30, 2009	Coast	19:50:28	overcast	0	1	MO	GOOD	beluga	20	16				
July 30, 2009	Coast	19:50:51	overcast	0	1	MO	GOOD	beluga	60	30 - 60			milling	
July 30, 2009	Coast	19:51:50	overcast	0	1	MO	GOOD	beluga	10	20				
July 30, 2009	Coast	19:52:14	overcast	0	1	MO	GOOD	beluga	2	14			diving	
July 30, 2009	Coast	19:52:44	overcast	0	1	MO	GOOD	beluga	3		adult		swimming	
July 30, 2009	Coast	19:52:55	overcast	0	1	MO	GOOD	beluga	1	15	adult			
July 30, 2009	Coast	19:56:00	overcast	0	1	MO	GOOD	beluga	1				diving	
July 30, 2009	Coast	19:58:00	overcast	0	1	MO	GOOD	beluga	10				swimming	
July 30, 2009	Coast	19:58:02	overcast	0	1	MO	GOOD	beluga	30				milling	many groups of 5 - 15 individuals ranging from angles 10 - 70; take up entire field of view;
July 30, 2009	OFF	20:42:49	partly cloudy	0	1	MO	EX	beluga	7	30				incidental; spotted en route to transect waypoint right by churchill river
July 30, 2009	OFF	20:43:00	partly cloudy	0	1	MO	EX	beluga	3	70			diving	incidental; spotted en route to transect waypoint
July 30, 2009	OFF	20:43:19	partly cloudy	0	1	MO	EX	beluga	3	25			milling	incidental; spotted en route to transect waypoint
July 30, 2009	9	20:46:36	partly cloudy	0	1	MO	EX	beluga	1				diving	below surface
July 30, 2009	9	20:47:45	partly cloudy	0	1	MO	EX	beluga	2	20			diving	
July 30, 2009	9	20:48:02	partly cloudy	0	1	MO	EX	beluga	1				diving	skittish in response to plane
July 30, 2009	9	20:49:50	partly cloudy	0	1	MO	EX	beluga	10	13				
July 30, 2009	9	20:50:15	partly cloudy	0	1	MO	EX	beluga	3		adult		diving	
July 30, 2009	9	20:50:25	partly cloudy	0	1	MO	EX	beluga	12				swimming	
July 30, 2009	9	20:50:49	partly cloudy	0	1	MO	EX	beluga	3	23			milling	

Date	Transect	Time	Weather	Percent Ice Cover	Beaufort	Glare[1]	Sightability[2]	Species	Number	Angle	Age	Activity	Behaviour	Comments
July 30, 2009	9	20:51:08	partly cloudy	0	1	MO	EX	beluga	7	60				
July 30, 2009	9	20:51:15	partly cloudy	0	1	MO	EX	beluga	2	70	adult			
July 30, 2009	9	20:51:29	partly cloudy	0	1	MO	EX	beluga	5	40			milling	
July 30, 2009	9	20:51:57	partly cloudy	0	1	MO	EX	beluga	4	47			milling	
July 30, 2009	9	20:52:16	partly cloudy	0	1	MO	EX	beluga	12				milling	diving in response to plane
July 30, 2009	9	20:52:36	partly cloudy	0	1	MO	EX	beluga	15	50 - 70	adult;mother/calf		milling	
July 30, 2009	9	20:53:05	partly cloudy	0	1	MO	EX	beluga	1					
July 30, 2009	9	20:53:31	partly cloudy	0	1	MO	EX	beluga	8	15				
July 30, 2009	9	20:55:07	partly cloudy	0	1	MO	EX	beluga	4	46	mother/calf		milling	
July 30, 2009	9	20:57:07	partly cloudy	0	1	MO	EX	beluga	2	15			milling	
July 30, 2009	9	20:57:47	partly cloudy	0	1	MO	EX	beluga	1				diving	
July 30, 2009	9	20:58:01	partly cloudy	0	1	MO	EX	beluga	1				milling	
July 30, 2009	9	20:58:10	partly cloudy	0	1	MO	EX	beluga	5	45	adults			
July 30, 2009	9	20:58:24	partly cloudy	0	1	MO	EX	beluga	6	42				
July 30, 2009	9	20:58:45	partly cloudy	0	1	MO	EX	beluga	5	35			diving	
July 30, 2009	9	20:59:17	partly cloudy	0	1	MO	EX	beluga	10	8				
July 30, 2009	9	20:59:20	partly cloudy	0	1	MO	EX	beluga	4	18			milling	
July 30, 2009	9	20:59:39	partly cloudy	0	1	MO	EX	beluga	2	25			diving	
July 30, 2009	9	21:00:07	partly cloudy	0	1	MO	EX	beluga	4	18				
July 30, 2009	9	21:00:19	partly cloudy	0	1	MO	EX	beluga	20	48				
July 30, 2009	9	21:00:39	partly cloudy	0	1	MO	EX	beluga	2	70			milling	
July 30, 2009	8	21:03:29	partly cloudy	0	1	MO	EX	beluga	1	10				
July 30, 2009	8	21:03:55	partly cloudy	0	1	MO	EX	beluga	15	30				
July 30, 2009	8	21:04:38	partly cloudy	0	1	MO	EX	beluga	2	17			milling	
July 30, 2009	8	21:04:57	partly cloudy	0	1	MO	EX	beluga	3	14				
July 30, 2009	8	21:05:08	partly cloudy	0	1	MO	EX	beluga	5	40				
July 30, 2009	8	21:05:37	partly cloudy	0	1	MO	EX	beluga	1		adult		diving	
July 30, 2009	Coast	13:13:00	overcast	0	2	NO	GOOD	seal	1	47			surfacing	
July 30, 2009	Coast	13:48:11	high overcast	0	0	MO	EX	seal	2				surfacing	
July 30, 2009	4	17:30:03	rain/mist	0	2	NO	MI	beluga	1	35			resting	
July 30, 2009	6	18:53:11	partly cloudy	0	3	NO	GOOD	seal	3	31			travelling	
July 30, 2009	6	19:03:25	overcast	0	2	NO	GOOD	seal	1	23			surfacing	
July 30, 2009	OFF	19:16:34	high overcast	0	3	NO	GOOD	beluga	1	50				
July 30, 2009	OFF	19:19:28	high overcast	0	3	NO	GOOD	beluga	1	25	adult		swimming	
July 30, 2009	Coast	19:24:53	high overcast	0	3	NO	GOOD	beluga	10		adult; mother/calf pairs		travellng	
July 30, 2009	Coast	19:33:01	high overcast	0	3	NO	GOOD	polar bear	1				swimming	towards shore
July 30, 2009	Coast	19:38:24	high overcast	0	3	NO	GOOD	beluga	1	32			swimming	
July 30, 2009	Coast	19:38:49	high overcast	0	3	NO	GOOD	beluga	1	52			diving	
July 30, 2009	Coast	19:39:08	high overcast	0	3	NO	GOOD	beluga	4				diving	
July 30, 2009	Coast	19:43:10	high overcast	0	3	NO	GOOD	beluga	16	33				
July 30, 2009	Coast	19:43:12	high overcast	0	3	NO	GOOD	beluga	10	42			swimming	
July 30, 2009	Coast	19:45:33	high overcast	0	3	NO	GOOD	beluga	9	19	mother/calf			
July 30, 2009	Coast	19:46:55	high overcast	0	3	NO	GOOD	beluga	15	55				
July 30, 2009	Coast	19:47:20	high overcast	0	3	NO	GOOD	beluga	25		2 mother/calf pairs			
July 30, 2009	Coast	19:47:25	high overcast	0	3	NO	GOOD	beluga	6					
July 30, 2009	Coast	19:47:49	high overcast	0	3	NO	GOOD	beluga	6		mother/calf			
July 30, 2009	Coast	19:48:03	high overcast	0	3	NO	GOOD	beluga	40	10 - 68				
July 30, 2009	Coast	19:50:29	high overcast	0	3	NO	GOOD	beluga	100					entire field of view scattered groups
July 30, 2009	Coast	19:50:50	high overcast	0	3	NO	GOOD	beluga	30					
July 30, 2009	Coast	19:51:05	high overcast	0	3	NO	GOOD	beluga	8		mother/calf			
July 30, 2009	Coast	19:53:40	high overcast	0	3	NO	GOOD	beluga	5	28	mother/calf			
July 30, 2009	Coast	19:56:11	high overcast	0	3	NO	GOOD	beluga	1				diving	skittish
July 30, 2009	Coast	20:03:12	high overcast	0	2	NO	GOOD	beluga	3				milling	
July 30, 2009	OFF	20:03:44	high overcast	0	2	NO	GOOD	beluga	35	15 - 65			milling	skittish
July 30, 2009	9	20:46:51	high overcast	0	2	NO	GOOD	beluga	2	13			milling	
July 30, 2009	9	20:47:56	high overcast	0	2	NO	GOOD	beluga	2	37	adult; sub-adult			
July 30, 2009	9	20:48:49	high overcast	0	2	NO	GOOD	beluga	4	42	mother/calf; adult			
July 30, 2009	9	20:49:01	high overcast	0	2	NO	GOOD	beluga	3	28	mother/calf; adult			
July 30, 2009	9	20:50:02	high overcast	0	2	NO	GOOD	beluga	3	13				
July 30, 2009	9	20:50:30	high overcast	0	2	NO	GOOD	beluga	1	58				

Date	Transect	Time	Weather	Percent Ice Cover	Beaufort	Glare[1]	Sightability[2]	Species	Number	Angle	Age	Activity	Behaviour	Comments
July 30, 2009	9	20:50:35	high overcast	0	2	NO	GOOD	beluga	1	45				
July 30, 2009	9	20:51:03	high overcast	0	2	NO	GOOD	beluga	3	35	adult			
July 30, 2009	9	20:51:12	high overcast	0	2	NO	GOOD	beluga	1	24				
July 30, 2009	9	20:51:13	high overcast	0	2	NO	GOOD	beluga	1	20				
July 30, 2009	9	20:51:27	high overcast	0	2	NO	GOOD	beluga	6	52	adult; sub-adult			
July 30, 2009	9	20:52:39	high overcast	0	2	NO	GOOD	beluga	2	27				
July 30, 2009	9	20:52:47	high overcast	0	2	NO	GOOD	beluga	50	15 - 60				
July 30, 2009	9	20:53:25	high overcast	0	2	NO	GOOD	beluga	4	27	adult; mother/calf pairs			
July 30, 2009	9	20:53:25	high overcast	0	2	NO	GOOD	beluga	2	30				
July 30, 2009	9	20:53:25	high overcast	0	2	NO	GOOD	beluga	4	15				
July 30, 2009	9	20:54:22	high overcast	0	2	NO	GOOD	beluga	4	35				
July 30, 2009	9	20:54:22	high overcast	0	2	NO	GOOD	beluga	6	12				
July 30, 2009	9	20:54:36	high overcast	0	2	NO	GOOD	beluga	2	45	mother.calf			
July 30, 2009	9	20:54:43	high overcast	0	2	NO	GOOD	beluga	4	22				
July 30, 2009	9	20:55:17	high overcast	0	2	NO	GOOD	beluga	30					
July 30, 2009	9	20:55:34	high overcast	0	2	NO	GOOD	beluga	8	29				
July 30, 2009	9	20:56:37	high overcast	0	1	NO	GOOD	beluga	22	19	adult; mother/calf pairs			
July 30, 2009	9	20:58:05	high overcast	0	1	NO	GOOD	beluga	1	37				
July 30, 2009	9	20:58:11	high overcast	0	1	NO	GOOD	beluga	1	13				
July 30, 2009	9	20:58:15	high overcast	0	1	NO	GOOD	beluga	15	12				facing each other; appeared to be a social interaction
July 30, 2009	9	20:58:45	high overcast	0	1	NO	GOOD	beluga	3	45	adult;mother/calf			
July 30, 2009	9	20:59:07	high overcast	0	1	NO	GOOD	beluga	2	60	mother/calf			
July 30, 2009	9	20:59:20	high overcast	0	1	NO	GOOD	beluga	1					
July 30, 2009	9	20:59:35	high overcast	0	1	NO	GOOD	beluga	6	27				
July 30, 2009	9	20:59:42	high overcast	0	1	NO	GOOD	beluga	1	45				
July 30, 2009	9	20:59:42	high overcast	0	1	NO	GOOD	beluga	2	50				
July 30, 2009	9	21:00:11	high overcast	0	1	NO	GOOD	beluga	7	33				
July 30, 2009	9	21:00:11	high overcast	0	1	NO	GOOD	beluga	5	30				
July 30, 2009	9	21:00:11	high overcast	0	1	NO	GOOD	beluga	2	27				
July 30, 2009	9	21:00:35	high overcast	0	1	NO	GOOD	beluga	7	52				
July 30, 2009	9	21:00:46	high overcast	0	1	NO	GOOD	beluga	3	45				
July 30, 2009	9	21:00:52	high overcast	0	1	NO	GOOD	beluga	12	47	mother/calf; adult			
July 30, 2009	9	21:01:08	high overcast	0	1	NO	GOOD	beluga	10	40				
July 30, 2009	9	21:01:17	high overcast	0	1	NO	GOOD	beluga	11	29				shallow water
July 30, 2009	8	21:03:58	high overcast	0	1	MO	GOOD	beluga	4	13				
July 30, 2009	8	21:04:14	high overcast	0	1	MO	GOOD	beluga	2	21				
July 30, 2009	8	21:04:52	high overcast	0	1	MO	GOOD	beluga	4	43	mother; subadult		travelling	
July 30, 2009	8	21:05:15	high overcast	0	1	MO	GOOD	beluga	7	30 - 40			milling	
July 30, 2009	8	21:30:29	high overcast	40	0	NO	EX	seal	1	47				
July 30, 2009	7	22:20:18	high overcast	0	3	NO	GOOD	beluga	1	48	adult			
August 31, 2009	8	12:18:36	clear	0	0	SEV	MI	beluga	1	35				
August 31, 2009	8	12:18:52	clear	0	0	SEV	MI	beluga	2					
August 31, 2009	8	12:19:03	clear	0	0	SEV	MI	beluga	1				diving	
August 31, 2009	8	12:19:10	clear	0	0	SEV	MI	beluga	1	75			swimming	
August 31, 2009	8	12:19:21	clear	0	0	SEV	MI	beluga	2	65	mother/calf		swimming	
August 31, 2009	8	12:19:32	clear	0	0	SEV	MI	beluga	8					
August 31, 2009	8	12:19:55	clear	0	0	MO	MI	beluga	50	43				
August 31, 2009	8	12:20:17	clear	0	0	MO	MI	beluga	1	20				
August 31, 2009	8	12:20:22	clear	0	0	MO	MI	beluga	2	70				
August 31, 2009	8	12:20:34	clear	0	0	MO	MI	beluga	2	20	mother/calf			
August 31, 2009	8	12:20:54	clear	0	0	MO	MI	beluga	2	35	adult		swimming	
August 31, 2009	8	12:21:40	clear	0	0	MO	MI	beluga	2	65	adult		swimming	
August 31, 2009	8	12:22:05	clear	0	0	MO	MI	beluga	1	30	adult		swimming	
August 31, 2009	8	12:22:16	clear	0	0	MO	MI	beluga	2	12				
August 31, 2009	8	12:22:25	clear	0	0	MO	MI	beluga	2	70	mother/calf			
August 31, 2009	8	12:22:44	clear	0	0	MO	MI	beluga	3	70	adult		swimming	
August 31, 2009	8	12:23:04	clear	0	0	MO	MI	beluga	4	65				
August 31, 2009	8	12:23:12	clear	0	0	MO	MI	beluga	5	20	adult		diving	
August 31, 2009	9	12:26:48	clear	0	0	MO	EX	beluga	100				milling	
August 31, 2009	9	12:27:40	clear	0	0	MO	EX	beluga	150	50	adult; mother/calf		swimming at surface	

Date	Transect	Time	Weather	Percent Ice Cover	Beaufort	Glare[1]	Sightability[2]	Species	Number	Angle	Age	Activity	Behaviour	Comments
August 31, 2009	9	12:28:10	clear	0	0	MO	EX	beluga	8	30				
August 31, 2009	9	12:28:22	clear	0	0	MO	EX	beluga	4	50			swimming	
August 31, 2009	9	12:28:35	clear	0	0	MO	EX	beluga	2	35	adult			
August 31, 2009	9	12:28:37	clear	0	0	MO	EX	beluga	10	12				
August 31, 2009	9	12:28:53	clear	0	0	MO	EX	beluga	55	60				
August 31, 2009	9	12:29:23	clear	0	0	MO	EX	beluga	100	48	adult; mother/calf		swimming/resting at surface	spaced out a bit; in little groups 2 - 8 but all relatively close to each other
August 31, 2009	9	12:30:08	clear	0	0	MO	EX	beluga	20	30				
August 31, 2009	9	12:30:32	clear	0	0	MO	EX	beluga	20	13				
August 31, 2009	9	12:31:02	clear	0	0	MO	EX	beluga	6	40			swimming	
August 31, 2009	9	12:31:10	clear	0	0	MO	EX	beluga	4	65				high densities in churchill river estuary
August 31, 2009	9	12:39:23	clear	0	0	MO	EX	beluga	30	30				
August 31, 2009	9	12:39:50	clear	0	0	MO	EX	beluga	2	70			diving	
August 31, 2009	9	12:40:00	clear	0	0	MO	EX	beluga	6	38			resting	
August 31, 2009	9	12:40:06	clear	0	0	MO	EX	beluga	1	46				
August 31, 2009	9	12:40:29	clear	0	0	MO	EX	beluga	1	41			diving	
August 31, 2009	9	12:40:50	clear	0	0	MO	EX	beluga	2	20	mother/calf		resting	
August 31, 2009	9	12:41:20	clear	0	0	MO	EX	beluga	10	45			resting	
August 31, 2009	9	12:41:33	clear	0	0	MO	EX	beluga	200				resting	whales take up entire field of view - can't get clinometer reading
August 31, 2009	Coast	13:36:25	clear	0	0	MO	GOOD	beluga	10	30				
August 31, 2009	Coast	13:36:36	clear	0	0	MO	GOOD	beluga	1	35			swimming	
August 31, 2009	Coast	13:36:47	clear	0	0	MO	GOOD	beluga	8	30				
August 31, 2009	Coast	13:36:55	clear	0	0	MO	GOOD	beluga	10	70	mother/calf; adult		diving	appear skittish in response to plane
August 31, 2009	Coast	13:46:36	clear	0	1	SEV	MI	beluga	2	12			resting at surface	
August 31, 2009	Coast	13:47:12	clear	0	1	SEV	MI	beluga	6	14				
August 31, 2009	Coast	13:47:29	clear	0	1	SEV	MI	beluga	5	55				
August 31, 2009	Coast	13:47:36	clear	0	1	SEV	MI	beluga	3	35				
August 31, 2009	Coast	13:47:40	clear	0	1	SEV	MI	beluga	5	18			resting at surface	
August 31, 2009	Coast	13:47:49	clear	0	1	SEV	MI	beluga	2	35	mother/calf		swimming	
August 31, 2009	Coast	13:48:00	clear	0	1	SEV	MI	beluga	15	24			swimming	
August 31, 2009	Coast	13:48:10	clear	0	1	SEV	MI	beluga	4	65			swimming	
August 31, 2009	Coast	13:48:30	clear	0	1	SEV	MI	beluga	1	40				
August 31, 2009	Coast	13:48:37	clear	0	1	SEV	MI	beluga	2	70	mother/calf			
August 31, 2009	Coast	13:48:46	clear	0	1	SEV	MI	beluga	7	18			resting	
August 31, 2009	Coast	13:49:23	clear	0	1	SEV	MI	beluga	10	50				
August 31, 2009	Coast	13:49:35	clear	0	1	SEV	MI	beluga	10	70				
August 31, 2009	Coast	13:49:43	clear	0	1	SEV	MI	beluga	2	65				
August 31, 2009	Coast	13:49:51	clear	0	1	SEV	MI	beluga	10	20			resting at surface	
August 31, 2009	Coast	13:50:01	clear	0	1	SEV	MI	beluga	3	10				
August 31, 2009	Coast	13:50:09	clear	0	1	SEV	MI	beluga	1	30				
August 31, 2009	Coast	13:50:15	clear	0	1	SEV	MI	beluga	1	15				
August 31, 2009	Coast	13:50:26	clear	0	1	SEV	MI	beluga	3	63				
August 31, 2009	Coast	13:50:33	clear	0	1	SEV	MI	beluga	10	39				
August 31, 2009	Coast	13:50:40	clear	0	1	SEV	MI	beluga	2	22				
August 31, 2009	Coast	13:50:45	clear	0	1	SEV	MI	beluga	1	70				
August 31, 2009	Coast	13:50:50	clear	0	1	SEV	MI	beluga	1	30				
August 31, 2009	Coast	13:50:55	clear	0	1	SEV	MI	beluga	3	36				
August 31, 2009	Coast	13:51:00	clear	0	1	SEV	MI	beluga	3	70			diving	
August 31, 2009	Coast	13:51:05	clear	0	1	SEV	MI	beluga	2	45				skittish
August 31, 2009	Coast	13:51:17	clear	0	1	SEV	MI	beluga	1	55				
August 31, 2009	Coast	13:51:24	clear	0	1	SEV	MI	beluga	2	30				
August 31, 2009	Coast	13:51:30	clear	0	1	SEV	MI	beluga	3	68				
August 31, 2009	Coast	13:51:37	clear	0	1	SEV	MI	beluga	20	40				
August 31, 2009	Coast	13:51:44	clear	0	1	SEV	MI	beluga	8	70				
August 31, 2009	Coast	13:51:56	clear	0	1	SEV	MI	beluga	1	30				
August 31, 2009	Coast	13:52:00	clear	0	1	SEV	MI	beluga	60	70				
August 31, 2009	Coast	13:52:16	clear	0	1	SEV	MI	beluga	50	10				
August 31, 2009	Coast	13:52:39	clear	0	1	SEV	MI	beluga	3	30			diving	
August 31, 2009	Coast	13:53:00	clear	0	1	SEV	MI	beluga	4	80				
August 31, 2009	Coast	13:53:06	clear	0	1	SEV	MI	beluga	3	50			swimming	
August 31, 2009	Coast	13:53:13	clear	0	1	SEV	MI	beluga	2	20				

Date	Transect	Time	Weather	Percent Ice Cover	Beaufort	Glare[1]	Sightability[2]	Species	Number	Angle	Age	Activity	Behaviour	Comments
August 31, 2009	Coast	13:53:23	clear	0	1	SEV	MI	beluga	5	10				
August 31, 2009	Coast	13:53:30	clear	0	1	SEV	MI	beluga	1	45				
August 31, 2009	Coast	13:53:34	clear	0	1	SEV	MI	beluga	10	60				
August 31, 2009	Coast	13:53:53	clear	0	1	SEV	MI	beluga	7	30				
August 31, 2009	Coast	13:53:59	clear	0	1	SEV	MI	beluga	10	35			diving	
August 31, 2009	Coast	13:54:05	clear	0	1	SEV	MI	beluga	3	50				
August 31, 2009	Coast	13:54:14	clear	0	1	SEV	MI	beluga	1	25				
August 31, 2009	Coast	13:54:27	clear	0	1	SEV	MI	beluga	2	27				
August 31, 2009	Coast	13:54:34	clear	0	1	SEV	MI	beluga	1	70				
August 31, 2009	Coast	13:54:43	clear	0	1	SEV	MI	beluga	2	40				
August 31, 2009	Coast	13:54:54	clear	0	1	SEV	MI	beluga	2	20				
August 31, 2009	Coast	13:55:05	clear	0	1	SEV	MI	beluga	2	37				
August 31, 2009	Coast	13:55:16	clear	0	1	SEV	MI	beluga	2	70	mother/calf			
August 31, 2009	Coast	13:55:25	clear	0	1	SEV	MI	beluga	1	70				
August 31, 2009	Coast	13:55:33	clear	0	1	SEV	MI	beluga	4	68				
August 31, 2009	Coast	13:55:42	clear	0	1	SEV	MI	beluga	2	55			diving	
August 31, 2009	Coast	13:57:20	clear	0	1	SEV	MI	beluga	1	30				in the shallows
August 31, 2009	Coast	14:07:07	clear	0	0	SEV	MI	beluga	2	10	adults		swimming	
August 31, 2009	Coast	14:07:48	clear	0	0	SEV	MI	beluga	2	13	adults		swimming	
August 31, 2009	Coast	14:10:11	clear	0	1	SEV	MI	beluga	1	69			divnig	
August 31, 2009	Coast	14:10:54	clear	0	1	SEV	MI	beluga	1	13			swimming	
August 31, 2009	Coast	14:11:28	clear	0	1	SEV	MI	beluga	2	35				
August 31, 2009	Coast	14:19:30	clear	0	1	SEV	MI	beluga	1,000	40	adult; mother/calf		milling	took up entire FOV, clinometer range 10 - 70
August 31, 2009	Coast	14:33:53	clear	0	1	MO	GOOD	beluga	100	30	adult		swimming	
August 31, 2009	Coast	14:35:15	clear	0	1	MO	GOOD	beluga	1	30	adult		diving	
August 31, 2009	Coast	14:35:51	clear	0	1	MO	GOOD	beluga	15	22				
August 31, 2009	Coast	14:36:04	clear	0	1	MO	GOOD	beluga	1	40	adult		swimming	
August 31, 2009	Coast	14:38:41	clear	0	1	MO	EX	beluga	3	40				
August 31, 2009	Coast	14:39:00	clear	0	1	MO	EX	beluga	2	55	mother/calf		moulting	appear to be rubbing against bottom; substrate is sand/rock
August 31, 2009	Coast	14:45:40	clear	0	1	MO	GOOD	beluga	2	33	adult		swimming	in the shallows
August 31, 2009	Coast	14:46:53	clear	0	1	MO	GOOD	beluga	1	20	adult		diving	submerged so off transect
August 31, 2009	Coast	14:47:46	clear		1	MO	GOOD	Unidentified-Seal	2	20			swimming	
August 31, 2009	Coast	14:48:00	clear	0	1	MO	GOOD	beluga	1	55			resting	
August 31, 2009	Coast	14:49:53	clear	0	1	MO	GOOD	beluga	1	18			swimming	
August 31, 2009	Coast	14:51:03	clear	0	1	MO	GOOD	beluga	3	70	adult		resting/moulting	appear to be rubbing on ocean floor
August 31, 2009	Coast	15:08:50	clear	0	1	NO	EX	beluga	1	65	calf		diving	
August 31, 2009	Coast	18:05:40	overcast	0	2	MO	GOOD	beluga	1	33	adult		diving	fog bank couple km away port side
August 31, 2009	Coast	8:42:45	Clear	0	3	NO	GOOD	HARP SEAL	1	30		swimming		
August 31, 2009	6	10:21:09	Clear	0	2	NO	GOOD	Unidentified-Seal	1	56		resting		
August 31, 2009	6	10:25:03	Clear	0	2	NO	GOOD	Unidentified-Seal	1	56		resting		
August 31, 2009	6	10:25:53	Clear	0	2	NO	GOOD	Unidentified-Seal	1	56		resting		
August 31, 2009	7	10:33:53	Clear	0	1	NO	EX	beluga	2	26	MC	resting		In very shallow water
August 31, 2009	7	10:36:36	Clear	0	1	NO	EX	beluga	1	64	AD	resting		
August 31, 2009	7	10:42:01	Clear	0	1	NO	EX	Unidentified-Seal	1	54	AD		surfacing	Likely Ring
August 31, 2009	7	10:42:35	Clear	0	1	NO	EX	Unidentified-Seal	1	47	AD		surfacing	Likely Ring
August 31, 2009	7	10:43:18	Clear	0	1	NO	EX	Unidentified-Seal	1	39	AD		surfacing	Likely Ring
August 31, 2009	7	10:47:54	Clear	0	1	NO	EX	Unidentified-Seal	1	40	AD		surfacing	Likely Harp or Bearded
August 31, 2009	7		Clear	0	1	NO	EX	RING SEAL	1	54	AD		surfacing	
August 31, 2009	7	10:53:36	Clear	0	1	NO	EX	HARP SEAL	3	54	AD		surfacing	
August 31, 2009	7	10:54:13	Clear	0	1	NO	EX	RING SEAL	1	57	AD		surfacing	
August 31, 2009	7	10:54:55	Clear	0	1	NO	EX	RING SEAL	1	55	AD		surfacing	
August 31, 2009	8	12:14:59	Clear	0	1	NO	EX	RING SEAL	1	43	AD		surfacing	
August 31, 2009	8	12:19:18	Clear	0	0	NO	EX	beluga	2	64	MC	resting		
August 31, 2009	8	12:19:41	Clear	0	0	NO	EX	beluga	1	65		resting		
August 31, 2009	8	12:19:50	Clear	0	0	NO	EX	beluga	2	16	MC	resting		
August 31, 2009	8	12:19:57	Clear	0	0	NO	EX	beluga	10	42				Groups of 3ish
August 31, 2009	8	12:20:16	Clear	0	0	NO	EX	beluga	25	38				scattered groups
August 31, 2009	8	12:21:14	Clear	0	0	NO	EX	beluga	57	37				scattered groups
August 31, 2009	8	12:21:35	Clear	0	0	NO	EX	beluga	14					5 MC pairs
August 31, 2009	8	12:21:52	Clear	0	0	NO	EX	beluga	2	24	MC	resting	milling	

Date	Transect	Time	Weather	Percent Ice Cover	Beaufort	Glare[1]	Sightability[2]	Species	Number	Angle	Age	Activity	Behaviour	Comments
August 31, 2009	8	12:22:00	Clear	0	0	NO	EX	beluga	1	22	AD	resting	milling	
August 31, 2009	8	12:22:00	Clear	0	0	NO	EX	beluga	1	30	AD	resting	milling	
August 31, 2009	8	12:22:00	Clear	0	0	NO	EX	beluga	2	16	AD	resting	milling	
August 31, 2009	8	12:22:17	Clear	0	0	NO	EX	beluga	7	30	AD, 2SA	resting	milling	
August 31, 2009	8	12:22:28	Clear	0	0	NO	EX	beluga	1	40		resting	milling	
August 31, 2009	8	12:22:52	Clear	0	0	NO	EX	beluga	2	14	MC	resting	milling	
August 31, 2009	8	12:23:01	Clear	0	0	NO	EX	beluga	5	53		resting	milling	
August 31, 2009	8	12:23:12	Clear	0	0	NO	EX	beluga	5	18	AD, 2SA	resting	milling	
August 31, 2009	8	12:23:38	Clear	0	0	NO	EX	beluga	8	70		resting	milling	
August 31, 2009	8	12:23:53	Clear	0	0	NO	EX	beluga	7	15		resting	milling	
August 31, 2009	8	12:23:55	Clear	0	0	NO	EX	beluga	5	35		resting	milling	
August 31, 2009	8	12:24:10	Clear	0	0	NO	EX	beluga	12	40		resting	milling	
August 31, 2009	8	12:24:10	Clear	0	0	NO	EX	beluga	7	12		resting	milling	
August 31, 2009	8	12:24:10	Clear	0	0	NO	EX	beluga	6	36		resting	milling	
August 31, 2009	8	12:24:46	Clear	0	0	NO	EX	beluga	2	53	MC	resting	milling	
August 31, 2009	9	12:27:48	Clear	0	0	NO	EX	beluga	59	35				scattered goups
August 31, 2009	9	12:29:59	Clear	0	0	NO	EX	beluga	15	12				
August 31, 2009	9	12:29:59	Clear	0	0	NO	EX	beluga	10	19				
August 31, 2009	9	12:29:59	Clear	0	0	NO	EX	beluga	12	12				
August 31, 2009	9	12:29:59	Clear	0	0	NO	EX	beluga	2	60	MC			
August 31, 2009	9	12:30:06	Clear	0	0	NO	EX	beluga	17	42	ALL	resting	milling	
August 31, 2009	9	12:31:04	Clear	0	0	NO	EX	beluga	260	39	ALL	resting	milling	40 groups, over a few minutes
August 31, 2009	9	12:33:00	Clear	0	0	NO	EX	beluga	24	39	ALL	resting	milling	
August 31, 2009	9	12:34:00	Clear	0	0	NO	EX	beluga	10	25	ALL	resting	milling	3 groups
August 31, 2009	9	12:40:00	Clear	0	0	MO	GOOD	beluga	2	24	MC			
August 31, 2009	9	12:40:17	Clear	0	0	MO	GOOD	beluga	18	50	MC			All most all MC
August 31, 2009	9	12:41:08	Clear	0	0	MO	GOOD	beluga	15	43				small groups
August 31, 2009	9	12:41:20	Clear	0	0	MO	GOOD	beluga	2	40				
August 31, 2009	9	12:41:25	Clear	0	0	MO	GOOD	beluga	6	50	AD, MC			
August 31, 2009	9	12:41:30	Clear	0	0	MO	GOOD	beluga	19		MC			
August 31, 2009	9	12:41:52	Clear	0	0	MO	GOOD	beluga	4	28				
August 31, 2009	9	12:41:59	Clear	0	0	MO	GOOD	beluga	2					
August 31, 2009	9	12:43:32	Clear	0	0	MO	GOOD	beluga	1000	38	ALL	resting	milling	groups of 10 average
August 31, 2009	Coast	13:37:37	Clear	0	1	NO	EX	beluga	1	60	AD			
August 31, 2009	Coast	13:37:45	Clear	0	1	NO	EX	beluga	2	55	MC			
August 31, 2009	Coast	13:37:54	Clear	0	1	NO	EX	beluga	6	35				
August 31, 2009	Coast	13:38:02	Clear	0	1	NO	EX	beluga	1	20				
August 31, 2009	Coast	13:38:08	Clear	0	1	NO	EX	beluga	8	35				
August 31, 2009	Coast	13:38:08	Clear	0	1	NO	EX	beluga	1	37				
August 31, 2009	Coast	13:38:08	Clear	0	1	NO	EX	beluga	1	32				
August 31, 2009	Coast	13:38:08	Clear	0	1	NO	EX	beluga	1	34				
August 31, 2009	Coast	13:48:17	Clear	0	1	NO	EX	beluga	3	35	MC			
August 31, 2009	Coast	13:48:22	Clear	0	1	NO	EX	beluga	4	48				
August 31, 2009	Coast	13:48:30	Clear	0	1	NO	EX	beluga	10	50				
August 31, 2009	Coast	13:48:38	Clear	0	1	NO	EX	beluga	6					
August 31, 2009	Coast	13:48:50	Clear	0	1	NO	EX	beluga	7					
August 31, 2009	Coast	13:48:50	Clear	0	1	NO	EX	beluga	3					
August 31, 2009	Coast	13:48:50	Clear	0	1	NO	EX	beluga	2					
August 31, 2009	Coast	13:48:50	Clear	0	1	NO	EX	beluga	2					
August 31, 2009	Coast	13:48:50	Clear	0	1	NO	EX	beluga	4					
August 31, 2009	Coast	13:48:50	Clear	0	1	NO	EX	beluga	1					
August 31, 2009	Coast	13:48:50	Clear	0	1	NO	EX	beluga	1					
August 31, 2009	Coast	13:48:50	Clear	0	1	NO	EX	beluga	4					
August 31, 2009	Coast	13:48:50	Clear	0	1	NO	EX	beluga	15	14				
August 31, 2009	Coast	13:49:05	Clear	0	1	NO	EX	beluga	1	18				
August 31, 2009	Coast	13:49:05	Clear	0	1	NO	EX	beluga	2	20	MC			
August 31, 2009	Coast	13:49:05	Clear	0	1	NO	EX	beluga	2	36	AD,SA			
August 31, 2009	Coast	13:49:05	Clear	0	1	NO	EX	beluga	3	30				
August 31, 2009	Coast	13:49:30	Clear	0	1	NO	EX	beluga	30	12-65				several groups
August 31, 2009	Coast	13:49:45	Clear	0	1	NO	EX	beluga	7	50				

Date	Transect	Time	Weather	Percent Ice Cover	Beaufort	Glare[1]	Sightability[2]	Species	Number	Angle	Age	Activity	Behaviour	Comments
August 31, 2009	Coast	13:49:45	Clear	0	1	NO	EX	beluga	3	17				
August 31, 2009	Coast	13:50:38	Clear	0	1	NO	EX	beluga	1	50				
August 31, 2009	Coast	13:50:45	Clear	0	1	NO	EX	beluga	1	50				
August 31, 2009	Coast	13:50:51	Clear	0	1	NO	EX	beluga	7		MC			
August 31, 2009	Coast	13:50:51	Clear	0	1	NO	EX	beluga	2					
August 31, 2009	Coast	13:50:51	Clear	0	1	NO	EX	beluga	12					
August 31, 2009	Coast	13:50:51	Clear	0	1	NO	EX	beluga	1					
August 31, 2009	Coast	13:50:51	Clear	0	1	NO	EX	beluga	1					
August 31, 2009	Coast	13:51:14	Clear	0	1	NO	EX	beluga	15	20				
August 31, 2009	Coast	13:51:14	Clear	0	1	NO	EX	beluga	12					
August 31, 2009	Coast	13:51:14	Clear	0	1	NO	EX	beluga	15					
August 31, 2009	Coast	13:51:14	Clear	0	1	NO	EX	beluga	7					
August 31, 2009	Coast	13:51:27	Clear	0	1	NO	EX	beluga	5	50				
August 31, 2009	Coast	13:51:33	Clear	0	1	NO	EX	beluga	10	19				
August 31, 2009	Coast	13:51:40	Clear	0	1	NO	EX	beluga	5	50				
August 31, 2009	Coast	13:51:45	Clear	0	1	NO	EX	beluga	12	50				
August 31, 2009	Coast	13:51:50	Clear	0	1	NO	EX	beluga	5	45				
August 31, 2009	Coast	13:51:50	Clear	0	1	NO	EX	beluga	5	30				
August 31, 2009	Coast	13:51:50	Clear	0	1	NO	EX	beluga	5	20				
August 31, 2009	Coast	13:51:50	Clear	0	1	NO	EX	beluga	6	18				
August 31, 2009	Coast	13:51:50	Clear	0	1	NO	EX	beluga	7	12				
August 31, 2009	Coast	13:52:09	Clear	0	1	NO	EX	beluga	70	12		resting	milling	30 groups of 2 or3 individuals
August 31, 2009	Coast	13:52:34	Clear	0	1	NO	EX	beluga	200	10-60	ALL	resting	milling	small goups
August 31, 2009	Coast	13:52:00	Clear	0	1	NO	EX	beluga	20	10				
August 31, 2009	Coast	13:53:20	Clear	0	1	NO	EX	beluga	15					
August 31, 2009	Coast	13:53:20	Clear	0	1	NO	EX	beluga	4					
August 31, 2009	Coast	13:53:20	Clear	0	1	NO	EX	beluga	1					
August 31, 2009	Coast	13:53:20	Clear	0	1	NO	EX	beluga	2					
August 31, 2009	Coast	13:53:33	Clear	0	1	NO	EX	beluga	8	31				
August 31, 2009	Coast	13:53:37	Clear	0	1	NO	EX	beluga	7			resting	milling	
August 31, 2009	Coast	13:53:50	Clear	0	1	NO	EX	beluga	27	10-60		resting	milling	small groups
August 31, 2009	Coast	13:54:37	Clear	0	0	NO	EX	beluga	10	20		resting	milling	
August 31, 2009	Coast	13:54:44	Clear	0	1	NO	EX	beluga	45					moving towards shore
August 31, 2009	Coast	13:55:10	Clear	0	0	NO	EX	beluga	16	18				
August 31, 2009	Coast	13:55:23	Clear	0	0	NO	EX	beluga	7	32				
August 31, 2009	Coast	13:55:30	Clear	0	0	NO	EX	beluga	5	35				
August 31, 2009	Coast	13:55:30	Clear	0	0	NO	EX	beluga	6	20				
August 31, 2009	Coast	13:55:47	Clear	0	0	NO	EX	beluga	9	12				
August 31, 2009	Coast	13:55:47	Clear	0	0	NO	EX	beluga	1	20				
August 31, 2009	Coast	13:55:47	Clear	0	0	NO	EX	beluga	1	55				
August 31, 2009	Coast	13:56:12	Clear	0	0	NO	EX	beluga	1	27				
August 31, 2009	Coast	13:56:29	Clear	0	0	NO	EX	beluga	5					
August 31, 2009	Coast	13:56:54	Clear	0	0	NO	EX	beluga	15					
August 31, 2009	Coast	13:57:02	Clear	0	0	NO	EX	beluga	5	17		resting	milling	
August 31, 2009	Coast	13:57:49	Clear	0	0	NO	EX	beluga	12	12-30	AD	resting	milling	spread out
August 31, 2009	Coast	13:58:15	Clear	0	0	NO	EX	beluga	1	26	AD	resting	milling	
August 31, 2009	Coast	13:58:15	Clear	0	0	NO	EX	beluga	1	28	AD	resting	milling	
August 31, 2009	Coast	14:07:00	Clear	0	0	NO	EX	Polar bear	1	50	AD		swimming	swimming in Shallow water close to shore
August 31, 2009	Coast	14:10:30	Clear	0	0	NO	EX	beluga	1	25	AD	resting	diving	dive when they hear the plan
August 31, 2009	Coast	14:10:40	Clear	0	0	NO	EX	beluga	1	54	AD	resting	diving	
August 31, 2009	Coast	14:11:23	Clear	0	0	NO	EX	beluga	2	26	MC	resting	swimming	
August 31, 2009	Coast	14:15:47	Clear	0	0	NO	EX	beluga	1	26	AD	resting	swimming	
August 31, 2009	Coast	14:16:03	Clear	0	0	NO	EX	beluga	5	50	AD	resting	swimming	
August 31, 2009	Coast	14:16:45	Clear	0	0	NO	EX	beluga	10	25	AD	resting	swimming	
August 31, 2009	Coast	14:18:29	Clear	0	1	NO	EX	beluga	1	47	AD	resting	swimming	
August 31, 2009	Coast	14:20:18	Clear	0	1	NO	EX	beluga	2	60	MC	resting	swimming	
August 31, 2009	Coast	14:20:33	Clear	0	1	NO	EX	beluga	1	34	AD	resting	swimming	
August 31, 2009	Coast	14:21:37	Clear	0	1	NO	EX	beluga	2	60	M, SA	resting	swimming	
August 31, 2009	Coast	14:21:37	Clear	0	1	NO	EX	beluga	1	62	AD	resting	swimming	

Date	Transect	Time	Weather	Percent Ice Cover	Beaufort	Glare[1]	Sightability[2]	Species	Number	Angle	Age	Activity	Behaviour	Comments
August 31, 2009	Coast	14:24:04	Clear	0	1	NO	EX	beluga	2	41	MC			
August 31, 2009	Coast	14:24:04	Clear	0	1	NO	EX	beluga	1	50	AD			
August 31, 2009	Coast	14:24:40	Clear	0	1	NO	EX	beluga	1	24	AD			
August 31, 2009	Coast	14:25:04	Clear	0	1	NO	EX	beluga	5	61				
August 31, 2009	Coast	14:26:26	Clear	0	1	NO	EX	beluga	1	54				
August 31, 2009	Coast	14:28:17	Clear	0	1	NO	EX	beluga	3	47	M,SA			
August 31, 2009	Coast	13:29:13	Clear	0	1	NO	EX	beluga	5	23				
August 31, 2009	Coast	14:30:31	Clear	0	1	NO	EX	beluga	4	14			milling	
August 31, 2009	Coast	14:31:53	Clear	0	1	NO	EX	Polar bear	1	33	AD	swimming	looking	
August 31, 2009	Coast	14:33:35	Clear	0	2	NO	EX	beluga	2	33				
August 31, 2009	Coast	14:34:16	Clear	0	2	NO	EX	beluga	2	30	MC			
August 31, 2009	Coast	14:34:24	Clear	0	2	NO	EX	beluga	2	27	MC			
August 31, 2009	Coast	14:34:34	Clear	0	2	NO	EX	beluga	1	30				
August 31, 2009	Coast	13:35:19	Clear	0	2	NO	EX	beluga	41	13-65		milling		groups of 5 - 6, and scattered individuals
August 31, 2009	Coast	14:37:10	Clear	0	2	NO	EX	beluga	4		20			
August 31, 2009	Coast	14:37:10	Clear	0	2	NO	EX	beluga	1		30			
August 31, 2009	Coast	14:37:10	Clear	0	2	NO	EX	beluga	1		40			
August 31, 2009	Coast	14:37:37	Clear	0	2	NO	EX	beluga	2			travel	swimming	
August 31, 2009	Coast	14:37:53	Clear	0	2	NO	EX	beluga	1			travel	swimming	
August 31, 2009	Coast	14:38:17	Clear	0	2	NO	EX	beluga	2	46	MC			
August 31, 2009	Coast	14:39:24	Clear	0	2	NO	EX	beluga	1	12	AD		diving	
August 31, 2009	Coast	14:39:34	Clear	0	2	NO	EX	beluga	1	50	AD		swimming	
August 31, 2009	Coast	14:42:32	Clear	0	2	NO	EX	beluga	5	42		milling		
August 31, 2009	Coast	14:42:52	Clear	0	2	NO	EX	beluga	1	49	AD	milling		
August 31, 2009	Coast	14:43:43	Clear	0	2	NO	EX	beluga	1	50				close to bottom
August 31, 2009	Coast	14:53:22	Clear	0	2	NO	EX	beluga	3	65	AD	milling		
August 31, 2009	Coast	14:56:31	Clear	0	2	NO	GOOD	beluga	1	61	AD		swimming	
August 31, 2009	Coast	15:00:14	Clear	0	3	NO	GOOD	beluga	1	24	AD		swimming	
August 31, 2009	Coast	15:00:14	Clear	0	3	NO	GOOD	beluga	1	30	AD		swimming	
August 31, 2009	Coast	15:09:29	Overcast	0	3	NO	GOOD	beluga	2	50	AD		swimming	
September 3, 2009	Coast	10:03:08	Clear	0	3	SEV	SI	beluga	1	48	adult		resting	not moving, shallow water
September 3, 2009	Coast	10:22:15	Clear	0	2	MO	GOOD	beluga	9	42		adult	milling	
September 3, 2009	Coast	10:24:12	Clear	0	2	SEV	SI	beluga	2	65		mother/calf	milling	
September 3, 2009	Coast	10:50:49	Partly cloudy	0	3	SEV	SI	beluga	10	55-65	adult; mother/calf		swimming	in a line
September 3, 2009	Coast	10:52:41	Partly cloudy	0	2	MO	MI	beluga	2	45	mother/calf		milling	
September 3, 2009	Coast	10:53:52	Partly cloudy	0	2	MO	MI	beluga	4	20			swimming	
September 3, 2009	Coast	10:55:33	Partly cloudy	0	2	MO	MI	beluga	2	23	adults		swimming	
September 3, 2009	Coast	10:55:56	Partly cloudy	0	2	MO	MI	beluga	2	15; 20	adults		swimming	
September 3, 2009	Coast	10:57:05	Partly cloudy	0	2	MO	GOOD	beluga	3	25;30;35			swimming	
September 3, 2009	Coast	10:57:54	Partly cloudy	0	2	MO	GOOD	beluga	2	24	mother/calf		swimming	
September 3, 2009	Coast	10:58:36	Partly cloudy	0	2	MO	MI	beluga	6	60				
September 3, 2009	Coast	10:58:45	Partly cloudy	0	2	MO	MI	beluga	10				swimming	
September 3, 2009	Coast	10:59:51	Partly cloudy	0	2	MO	MI	beluga	8	43			swimming	tight group
September 3, 2009	Coast	11:00:05	Partly cloudy	0	2	MO	GOOD	beluga	3	40			swimming	heading north in tight group
September 3, 2009	Coast	11:00:49	Partly cloudy	0	2	MO	GOOD	beluga	1	29			milling	
September 3, 2009	Coast	11:01:03	Partly cloudy	0	2	MO	GOOD	beluga	3	60	adult; mother/calf		milling	
September 3, 2009	Coast	11:01:40	Partly cloudy	0	2	MO	GOOD	beluga	1	37			milling	
September 3, 2009	Coast	11:02:20	Partly cloudy	0	3	MO	GOOD	beluga	2	60	mother/calf			
September 3, 2009	Coast	11:02:23	Partly cloudy	0	3	MO	GOOD	beluga	4	42	adults; sub-adult			
September 3, 2009	Coast	11:02:25	Partly cloudy	0	3	MO	GOOD	beluga	1	38	adult			
September 3, 2009	Coast	11:02:49	Partly cloudy	0	3	MO	GOOD	beluga	3	60			milling	underwater
September 3, 2009	Coast	11:03:21	Partly cloudy	0	3	MO	GOOD	beluga	5				swimming	
September 3, 2009	Coast	11:03:28	Partly cloudy	0	3	MO	GOOD	beluga	2	41	mother/calf			
September 3, 2009	Coast	11:03:40	Partly cloudy	0	3	MO	GOOD	beluga	1	46	adult			
September 3, 2009	Coast	11:03:56	Partly cloudy	0	3	MO	GOOD	beluga	1	30			swimming	
September 3, 2009	Coast	11:04:11	Partly cloudy	0	2	MO	MI	beluga	1	47				
September 3, 2009	Coast	11:04:48	Partly cloudy	0	2	MO	MI	beluga	1	24			swimming	
September 3, 2009	Coast	11:05:07	Partly cloudy	0	2	MO	MI	beluga	3				milling	underwater
September 3, 2009	Coast	11:05:40	Partly cloudy	0	2	MO	MI	beluga	4	20-40	mother/calf			
September 3, 2009	Coast	11:05:42	Partly cloudy	0	2	MO	MI	beluga	3	20-40				

Date	Transect	Time	Weather	Percent Ice Cover	Beaufort	Glare[1]	Sightability[2]	Species	Number	Angle	Age	Activity	Behaviour	Comments
September 3, 2009	Coast	11:05:44	Partly cloudy	0	2	MO	MI	beluga	1	20-40				
September 3, 2009	Coast	11:05:46	Partly cloudy	0	2	MO	MI	beluga	3	20-40				
September 3, 2009	Coast	11:05:48	Partly cloudy	0	2	MO	MI	beluga	7	20-40				
September 3, 2009	Coast	11:05:50	Partly cloudy	0	2	MO	MI	beluga	6	20-40				
September 3, 2009	Coast	11:05:52	Partly cloudy	0	2	MO	MI	beluga	1	20-40				
September 3, 2009	Coast	11:06:58	Clear	0	2	SEV	MI	beluga	2	24	adults			
September 3, 2009	Coast	11:07:08	Clear	0	2	SEV	MI	beluga	1	21				
September 3, 2009	Coast	11:07:08	Clear	0	2	SEV	MI	beluga	1					
September 3, 2009	Coast	11:07:08	Clear	0	2	SEV	MI	beluga	1					
September 3, 2009	Coast	11:07:08	Clear	0	2	SEV	MI	beluga	2		mother/calf			
September 3, 2009	Coast	11:07:08	Clear	0	2	SEV	MI	beluga	2	60	mother/calf			
September 3, 2009	Coast	11:07:20	Clear	0	2	SEV	MI	beluga	3					
September 3, 2009	Coast	11:07:20	Clear	0	2	SEV	MI	beluga	8					
September 3, 2009	Coast	11:07:20	Clear	0	2	SEV	MI	beluga	1					
September 3, 2009	Coast	11:07:20	Clear	0	2	SEV	MI	beluga	1					
September 3, 2009	Coast	11:07:20	Clear	0	2	SEV	MI	beluga	2		mother/calf			
September 3, 2009	Coast	11:07:20	Clear	0	2	SEV	MI	beluga	2		mother/calf			
September 3, 2009	Coast	11:07:20	Clear	0	2	SEV	MI	beluga	3					
September 3, 2009	Coast	11:07:20	Clear	0	2	SEV	MI	beluga	4					
September 3, 2009	Coast	11:07:20	Clear	0	2	SEV	MI	beluga	1					
September 3, 2009	Coast	11:07:20	Clear	0	2	SEV	MI	beluga	7					
September 3, 2009	Coast	11:07:20	Clear	0	2	SEV	MI	beluga	4					
September 3, 2009	Coast	11:07:20	Clear	0	2	SEV	MI	beluga	2					
September 3, 2009	Coast	11:07:20	Clear	0	2	SEV	MI	beluga	1					
September 3, 2009	Coast	11:07:20	Clear	0	2	SEV	MI	beluga	2					
September 3, 2009	Coast	11:07:20	Clear	0	2	SEV	MI	beluga	1					
September 3, 2009	Coast	11:07:20	Clear	0	2	SEV	MI	beluga	1					
September 3, 2009	Coast	11:07:20	Clear	0	2	SEV	MI	beluga	1					
September 3, 2009	Coast	11:07:20	Clear	0	2	SEV	MI	beluga	2					
September 3, 2009	Coast	11:07:20	Clear	0	2	SEV	MI	beluga	3					
September 3, 2009	Coast	11:07:20	Clear	0	2	SEV	MI	beluga	5					
September 3, 2009	Coast	11:07:20	Clear	0	2	SEV	MI	beluga	2		mother/calf			
September 3, 2009	Coast	11:07:20	Clear	0	2	SEV	MI	beluga	1					
September 3, 2009	Coast	11:07:20	Clear	0	2	SEV	MI	beluga	6					~200 in area; associated with plume line; facing different directions;
September 3, 2009	Coast	11:19:48	Clear	0	2	MO	MI	beluga	32	12			resting	
September 3, 2009	Coast	11:19:48	Clear	0	2	MO	MI	beluga	1	25			resting	
September 3, 2009	Coast	11:19:48	Clear	0	2	MO	MI	beluga	1	40			resting	
September 3, 2009	Coast	11:20:02	Clear	0	2	MO	MI	beluga	3	36			resting	
September 3, 2009	Coast	11:20:05	Clear	0	2	MO	MI	beluga	8	60			resting	
September 3, 2009	Coast	11:21:30	Clear	0	2	MO	MI	beluga	3	60			resting	skittish; diving when hear plane
September 3, 2009	Coast	11:22:17	Clear	0	2	MO	MI	beluga	1	43			surfacing	
September 3, 2009	Coast	11:22:46	Clear	0	2	MO	MI	beluga	1	14				
September 3, 2009	Coast	11:22:50	Clear	0	2	MO	MI	beluga	20	26				a lot of whales coming around point
September 3, 2009	Coast	11:22:56	Clear	0	2	MO	MI	beluga	18					swimming along shoreline; heading north
September 3, 2009	Coast	11:23:02	Clear	0	2	MO	MI	beluga	8					swimming along shoreline; heading north
September 3, 2009	OFF	12:09:04	Partly cloudy	0	2	SEV	MI	beluga	200	20-60	mother/calf; sub-adults			incidental
September 3, 2009	OFF	12:11:19	Partly cloudy	0	2	MO	MI	beluga	2	40	mother/calf			incidental
September 3, 2009	OFF	12:11:24	Partly cloudy	0	2	MO	MI	beluga	1	65				incidental
September 3, 2009	OFF	12:11:27	Partly cloudy	0	2	MO	MI	beluga	2	37	mother/calf			incidental
September 3, 2009	OFF	12:11:29	Partly cloudy	0	2	MO	MI	beluga	1	30				incidental
September 3, 2009	OFF	12:11:33	Partly cloudy	0	2	MO	MI	beluga	1	40				incidental
September 3, 2009	OFF	12:12:12	Partly cloudy	0	2	MO	MI	beluga	1	24	sub-adult			incidental
September 3, 2009	OFF	12:12:14	Partly cloudy	0	2	MO	MI	beluga	1	30	adult			incidental
September 3, 2009	OFF	12:12:14	Partly cloudy	0	2	MO	MI	beluga	1	14				incidental
September 3, 2009	OFF	12:12:30	Partly cloudy	0	2	MO	MI	beluga	2	60			surfacing	incidental
September 3, 2009	OFF	12:12:30	Partly cloudy	0	2	MO	MI	beluga	2	60				incidental
September 3, 2009	OFF	12:12:30	Partly cloudy	0	2	MO	MI	beluga	1	60	subadult			incidental
September 3, 2009	OFF	12:12:57	Partly cloudy	0	2	MO	MI	beluga	2	47	mother; subadult			incidental
September 3, 2009	OFF	12:16:17	Partly cloudy	0	2	NO	GOOD	beluga	1	27	adult		milling	incidental

Date	Transect	Time	Weather	Percent Ice Cover	Beaufort	Glare[1]	Sightability[2]	Species	Number	Angle	Age	Activity	Behaviour	Comments
September 3, 2009	OFF	12:17:13	Partly cloudy	0	2	NO	GOOD	beluga	2	60	mother/calf			incidental
September 3, 2009	OFF	12:17:20	Partly cloudy	0	2	NO	GOOD	beluga	2		mother/calf			incidental
September 3, 2009	OFF	12:17:25	Partly cloudy	0	2	NO	GOOD	beluga	6	22				tightly packed
September 3, 2009	OFF	12:17:27	Partly cloudy	0	2	NO	GOOD	beluga	2	55	mother/calf			incidental
September 3, 2009	OFF	12:17:27	Partly cloudy	0	2	NO	GOOD	beluga	1	55				incidental
September 3, 2009	OFF	12:17:27	Partly cloudy	0	2	NO	GOOD	beluga	1	55				incidental
September 3, 2009	OFF	12:17:57	Partly cloudy	0	2	NO	GOOD	beluga	1	40				incidental
September 3, 2009	OFF	12:17:57	Partly cloudy	0	2	NO	GOOD	beluga	10	35				incidental
September 3, 2009	OFF	12:17:57	Partly cloudy	0	2	NO	GOOD	beluga	2	20				incidental
September 3, 2009	OFF	12:17:57	Partly cloudy	0	2	NO	GOOD	beluga	3	20				incidental
September 3, 2009	OFF	12:18:15	Partly cloudy	0	2	NO	GOOD	beluga	4	24	mother/calf; adults			incidental
September 3, 2009	OFF	12:18:15	Partly cloudy	0	2	NO	GOOD	beluga	4	30	mother/calf; adults			incidental
September 3, 2009	OFF	12:25:36	Partly cloudy	0	2	NO	GOOD	beluga	7	22-60				spread out
September 3, 2009	OFF	12:25:36	Partly cloudy	0	2	NO	GOOD	beluga	16	22-60				incidental
September 3, 2009	OFF	13:36:58	Partly cloudy	0	3	NO	GOOD	beluga	3	58	mother/calf; adult		diving	
September 3, 2009	Coast	14:07:42	Overcast	0	3	NO	GOOD	beluga	1	64			swimming	large; underwater
September 3, 2009	Coast	14:12:17	Overcast	0	3	NO	GOOD	beluga	2	20	adult; sub-adult		swimming	
September 3, 2009	Coast	14:12:20	Overcast	0	3	NO	GOOD	beluga	4	25	adult; sub-adult; mother		swimming	
September 3, 2009	Coast	14:15:04	Overcast	0	3	NO	GOOD	beluga	1	40	adult		swimming	
September 3, 2009	Coast	14:16:36	Overcast	0	3	NO	GOOD	beluga	1	65			swimming	
September 3, 2009	Coast	14:20:00	Overcast	0	3	NO	GOOD	beluga	2	20	mother/calf		swimming	
September 3, 2009	Coast	14:20:25	Overcast	0	3	NO	GOOD	beluga	3		adult			
September 3, 2009	Coast	14:21:59	Overcast	0	3	NO	GOOD	beluga	10	30	adults; mother/calf		swimming	tightly packed, hugging shoreline
September 3, 2009	Coast	14:49:52	Overcast	0	2	NO	GOOD	beluga	7	47	adult; mother/calf		swimming	
September 3, 2009	Coast	14:56:51	Overcast	0	1	NO	GOOD	beluga	1	51	adult		milling	
September 3, 2009	Coast	14:58:27	Overcast	0	1	NO	GOOD	beluga	1	25	adult		resting	
September 3, 2009	OFF	15:15:27	Overcast/Low lying fog	0	1	NO	MI	beluga	1	30	adult		swimming	
September 3, 2009	1	15:17:51	Overcast/Low lying fog	0	1	NO	GOOD	polar bear	2	61	mother/cub			on land; on an island; spooked from plane
September 3, 2009	Coast	10:04:30	clear	0	2	NO	GOOD	beluga	2	40	mother/calf		milling	in shallows
September 3, 2009	Coast	10:11:10	clear	0	3	NO	GOOD	beluga	4	7				
September 3, 2009	Coast	10:12:33	clear	0	3	NO	GOOD	beluga	10	10			swimming	close to coast; protected area
September 3, 2009	Coast	10:15:49	clear	0	1	NO	GOOD	beluga	2	32	adult		swimming	
September 3, 2009	Coast	10:17:32	clear	0	1	NO	GOOD	beluga	2	45	mother/calf		swimming	
September 3, 2009	Coast	10:18:21	clear	0	1	NO	GOOD	beluga	3	12			swimming	
September 3, 2009	Coast	10:18:35	clear	0	1	NO	GOOD	beluga	3	24			swimming	
September 3, 2009	Coast	10:18:44	clear	0	1	NO	GOOD	beluga	50	25-40	mother/calf; adult; sub-adult		milling; resting; moulting	loosely congregated in shallows; some rubbing against bottom
September 3, 2009	Coast	10:19:05	clear	0	1	NO	GOOD	beluga	20	40	mother/calf; adult; sub-adult		swimming	
September 3, 2009	Coast	10:27:35	clear	0	2	NO	GOOD	beluga	3	38	adult		milling	
September 3, 2009	Coast	10:27:49	clear	0	2	NO	GOOD	beluga	1	29	adult		milling	
September 3, 2009	Coast	10:29:13	clear	0	1	NO	EX	beluga	6	13	adult			
September 3, 2009	Coast	10:29:29	clear	0	1	NO	EX	beluga	2	38			milling	
September 3, 2009	Coast	10:29:41	clear	0	1	NO	EX	beluga	3	18	adults		milling	
September 3, 2009	Coast	10:30:43	partly cloudy	0	1	NO	GOOD	seal	2	70			swimming	
September 3, 2009	Coast	10:32:07	partly cloudy	0	1	NO	GOOD	beluga	1	23				underwater
September 3, 2009	Coast	10:34:26	partly cloudy	0	1	MOD	GOOD	beluga	1	14	adult		milling	
September 3, 2009	Coast	10:34:37	partly cloudy	0	1	MOD	GOOD	beluga	5	12				
September 3, 2009	Coast	10:34:54	partly cloudy	0	1	MOD	GOOD	beluga	1	18	adult			
September 3, 2009	Coast	10:35:04	partly cloudy	0	1	MOD	GOOD	beluga	1	16	adult			
September 3, 2009	Coast	10:35:13	partly cloudy	0	1	MOD	GOOD	beluga	2	8	adult			
September 3, 2009	Coast	10:39:24	partly cloudy	0	2	MOD	GOOD	beluga	2	39	mother/calf		milling	
September 3, 2009	Coast	10:39:46	partly cloudy	0	2	MOD	GOOD	beluga	2	50	mother/calf		diving	
September 3, 2009	Coast	10:39:53	partly cloudy	0	2	MOD	GOOD	beluga	2	43	adults		swimming	
September 3, 2009	Coast	10:42:58	partly cloudy	0	2	MOD	GOOD	beluga	1	34	adult		milling	
September 3, 2009	Coast	10:43:20	partly cloudy	0	2	MOD	GOOD	beluga	4	14			milling	
September 3, 2009	Coast	10:45:04	clear	0	2	NO	GOOD	polar bear	1	30				on spit of land
September 3, 2009	Coast	10:52:04	clear	0	2	NO	GOOD	beluga	8	12	mother/calf; adults		swimming	
September 3, 2009	Coast	10:52:22	clear	0	2	NO	GOOD	beluga	3	70	adult		resting	
September 3, 2009	Coast	10:52:26	clear	0	2	NO	GOOD	beluga	3	50	mother/calf; adult		swimming	

Date	Transect	Time	Weather	Percent Ice Cover	Beaufort	Glare[1]	Sightability[2]	Species	Number	Angle	Age	Activity	Behaviour	Comments
September 3, 2009	Coast	10:54:27	partly cloudy	0	2	NO	GOOD	beluga	1	19			milling	
September 3, 2009	Coast	10:54:47	partly cloudy	0	2	NO	GOOD	beluga	4	25			milling	
September 3, 2009	Coast	10:54:56	partly cloudy	0	2	NO	GOOD	beluga	10	30	adults; mother/calf		swimming	
September 3, 2009	Coast	10:57:02	partly cloudy	0	2	NO	GOOD	beluga	1	51	adult		swimming	
September 3, 2009	Coast	10:57:12	partly cloudy	0	2	NO	GOOD	beluga	2	70	mother/calf		swimming	
September 3, 2009	Coast	10:57:40	partly cloudy	0	2	NO	GOOD	beluga	1	37	adult		swimming	underwater
September 3, 2009	Coast	10:57:52	partly cloudy	0	2	NO	GOOD	beluga	2	68				
September 3, 2009	Coast	10:57:59	partly cloudy	0	2	NO	GOOD	beluga	1	51	adult		swimming	
September 3, 2009	Coast	10:59:28	partly cloudy	0	2	MOD	MI	beluga	1	56	adult		swimming	
September 3, 2009	Coast	10:59:40	partly cloudy	0	2	MOD	MI	beluga	12	72	adults; sub-adults		swimming	
September 3, 2009	Coast	11:00:42	cloudy	0	2	MOD	GOOD	beluga	8	73	adults		resting	approaching Seal River Estuary
September 3, 2009	Coast	11:02:10	partly cloudy	0	2	MOD	GOOD	beluga	2	73				
September 3, 2009	Coast	11:02:14	partly cloudy	0	2	MOD	GOOD	beluga	4	55	adults; calf		milling	
September 3, 2009	Coast	11:03:47	partly cloudy	0	2	MOD	GOOD	beluga	1	50	adults		resting	
September 3, 2009	Coast	11:03:47	partly cloudy	0	2	MOD	GOOD	beluga	2	61	adults		resting	
September 3, 2009	Coast	11:03:58	partly cloudy	0	2	MOD	GOOD	beluga	6	34			swimming	
September 3, 2009	Coast	11:04:10	partly cloudy	0	2	MOD	GOOD	beluga	5	75	adults		diving	
September 3, 2009	Coast	11:05:50	partly cloudy	0	2	MOD	GOOD	beluga	2	32	mother/calf			
September 3, 2009	Coast	11:06:04	partly cloudy	0	2	MOD	GOOD	beluga	2	70			swimming	
September 3, 2009	Coast	11:06:13	partly cloudy	0	2	MOD	GOOD	beluga	3	36	adults		resting	
September 3, 2009	Coast	11:06:23	partly cloudy	0	2	MOD	GOOD	beluga	2	40	adults		swimming	
September 3, 2009	Coast	11:06:28	partly cloudy	0	2	MOD	GOOD	beluga	10	55	adults		swimming	
September 3, 2009	Coast	11:06:38	partly cloudy	0	2	MOD	GOOD	beluga	3	25			swimming	
September 3, 2009	Coast	11:07:53	partly cloudy	0	2	MOD	GOOD	beluga	1	47	adult			
September 3, 2009	Coast	11:08:03	clear	0	1	NO	GOOD	beluga	2	40	mother/calf		diving	
September 3, 2009	Coast	11:08:21	clear	0	1	NO	GOOD	beluga	1	80			swimming	
September 3, 2009	Coast	11:08:27	clear	0	1	NO	GOOD	beluga	3	55			swimming	
September 3, 2009	Coast	11:08:35	clear	0	1	NO	GOOD	beluga	30	40				
September 3, 2009	Coast	11:08:49	clear	0	1	NO	GOOD	beluga	20	70				
September 3, 2009	Coast	11:08:54	clear	0	1	NO	GOOD	beluga	10	55				
September 3, 2009	Coast	11:08:58	clear	0	1	NO	GOOD	beluga	8	53				
September 3, 2009	Coast	11:09:04	clear	0	1	NO	GOOD	beluga	6	58				
September 3, 2009	Coast	11:09:11	clear	0	1	NO	GOOD	beluga	3	70				
September 3, 2009	Coast	11:09:22	clear	0	1	NO	GOOD	beluga	15	65				shallows
September 3, 2009	Coast	11:20:20	clear	0	1	MOD	MI	beluga	2	34	adults			
September 3, 2009	Coast	11:21:21	clear	0	1	MOD	MI	beluga	3	58	adults			
September 3, 2009	Coast	11:21:21	clear	0	1	MOD	MI	beluga	2	33	adults			
September 3, 2009	Coast	11:21:21	clear	0	1	MOD	MI	beluga	1	18	adults			
September 3, 2009	Coast	11:25:44	clear	0	1	SEV	SI	beluga	4	74				
September 3, 2009	OFF	12:10:30	clear	0	2	NO	GOOD	beluga	12	46			swimming	incidental
September 3, 2009	OFF	12:10:46	clear	0	2	NO	GOOD	beluga	4	48			swimming	incidental
September 3, 2009	OFF	12:10:56	clear	0	2	NO	GOOD	beluga	1	62	adult		swimming	incidental
September 3, 2009	OFF	12:11:00	clear	0	2	NO	GOOD	beluga	1	40			swimming	incidental
September 3, 2009	OFF	12:11:04	clear	0	2	NO	GOOD	beluga	20	45				incidental
September 3, 2009	OFF	12:11:38	clear	0	2	NO	GOOD	beluga	2	58				incidental
September 3, 2009	OFF	12:11:47	clear	0	2	NO	GOOD	beluga	4	66				incidental
September 3, 2009	OFF	12:11:52	clear	0	2	NO	GOOD	beluga	4	35				incidental
September 3, 2009	OFF	12:11:57	clear	0	2	NO	GOOD	beluga	2	46				incidental
September 3, 2009	OFF	12:12:02	clear	0	2	NO	GOOD	beluga	1	70				incidental
September 3, 2009	OFF	12:12:06	clear	0	2	NO	GOOD	beluga	1	37				incidental
September 3, 2009	OFF	12:12:12	clear	0	2	NO	GOOD	beluga	3	30			swimming	incidental
September 3, 2009	OFF	12:12:18	clear	0	2	NO	GOOD	beluga	2	34			milling	incidental
September 3, 2009	OFF	12:12:25	clear	0	2	NO	GOOD	beluga	2	52	mother/calf			incidental
September 3, 2009	OFF	12:12:38	clear	0	2	NO	GOOD	beluga	10	20				incidental
September 3, 2009	OFF	12:12:43	clear	0	2	NO	GOOD	beluga	1	35	adult			incidental
September 3, 2009	OFF	12:13:05	clear	0	2	NO	GOOD	beluga	1	39				incidental
September 3, 2009	OFF	12:13:14	clear	0	2	NO	GOOD	beluga	1	24				incidental
September 3, 2009	OFF	12:13:21	clear	0	2	NO	GOOD	beluga	3	45			swimming	incidental
September 3, 2009	OFF	12:13:29	clear	0	2	NO	GOOD	beluga	2	71	mother/calf			incidental
September 3, 2009	OFF	12:13:40	clear	0	2	NO	GOOD	beluga	5	38			swimming	incidental

Date	Transect	Time	Weather	Percent Ice Cover	Beaufort	Glare[1]	Sightability[2]	Species	Number	Angle	Age	Activity	Behaviour	Comments
September 3, 2009	OFF	12:13:46	clear	0	2	NO	GOOD	beluga	3	46			diving	incidental
September 3, 2009	OFF	12:13:55	clear	0	2	NO	GOOD	beluga	5	25				incidental
September 3, 2009	OFF	12:14:05	clear	0	2	NO	GOOD	beluga	3	42			diving	incidental
September 3, 2009	OFF	12:14:10	clear	0	2	NO	GOOD	beluga	6	28			diving	incidental
September 3, 2009	OFF	12:15:06	clear	0	2	NO	GOOD	beluga	1	56			diving	incidental
September 3, 2009	OFF	12:18:18	clear	0	2	NO	GOOD	beluga	5	20				incidental
September 3, 2009	OFF	12:18:40	clear	0	2	NO	GOOD	beluga	3	60	adults		diving	incidental
September 3, 2009	OFF	12:18:55	clear	0	2	NO	GOOD	beluga	5	32	adults			incidental
September 3, 2009	OFF	12:19:11	clear	0	2	NO	GOOD	beluga	1	15				incidental
September 3, 2009	Coast	14:22:06	overcast/light mist	0	2	MOD	GOOD	beluga	1	29	adult		resting	
September 3, 2009	Coast	14:28:40	overcast/light mist	0	2	NO	MI	beluga	20	40			swimming	close to shore; following contours of coast
September 3, 2009	Coast	14:28:54	overcast/light mist	0	2	NO	MI	beluga	4	30			swimming	close to shore; following contours of coast
September 3, 2009	Coast	14:29:01	overcast/light mist	0	2	NO	MI	beluga	7	15			swimming	close to shore; following contours of coast
September 3, 2009	Coast	14:48:04	overcast/light mist	0	2	NO	GOOD	beluga	2	21	adult			
September 3, 2009	Coast	14:51:08	overcast	0	2	NO	GOOD	beluga	20	26	adult; sub-adult		swimming	
September 3, 2009	Coast	14:53:31	overcast	0	2	NO	GOOD	beluga	1	71	adult		swimming	
September 3, 2009	Coast	14:54:15	overcast	0	1	NO	GOOD	beluga	1	26	adult		swimming	
September 3, 2009	Coast	14:59:59	overcast	0	2	MOD	MI	beluga	1	65	adult		diving	
September 3, 2009	Coast	15:00:10	overcast	0	2	MOD	MI	beluga	1	48	adult		diving	
September 3, 2009	Coast	15:00:45	overcast	0	2	MOD	MI	beluga	6	25	adult		swimming	
September 3, 2009	Coast	15:02:00	overcast/light mist	0	2	NO	MI	beluga	1	38	adult		swimming	
September 3, 2009	Coast	15:04:01	overcast/light mist	0	2	NO	MI	beluga	1	20	adult			
September 3, 2009	2	16:20:40	overcast		2	NO	GOOD	beluga	3	16			swimming	

NOTES:

[1] Glare abbreviations: NO = none, MO = moderate, SEV = severe

[2] Sightability abbreviations: EX = excellent, GOOD = good, MI = moderately impaired, SI = severely impaired,

Grey = Coastal surveys

White = Offshore suveys