MADRID-BOSTON PROJECT
FINAL ENVIRONMENTAL IMPACT STATEMENT

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Glossary and Abbreviations

Terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document.

CESCC	Canadian Endangered Species Conservation Council
DOE	Department of Environment
EAA	Existing and approved authorizations
EBSA	Ecologically and biologically significant areas
EIS	Environmental Impact Statement
IBA	Important bird area
KIA	Kitikmeot Inuit Association
KMHS	Key Marine Habitat Site
KTHS	Key Terrestrial Habitat Site
LSA	Local study area
MLSA	Marine wildlife local study area
MRSA	Marine wildlife regional study area
NIRB	Nunavut Impact Review Board
NTKP	Naonaiyaotit Traditional Knowledge Project
RSA	Regional study area
SARA	*Species at Risk Act*
TK	Traditional knowledge
VEC	Valued ecosystem component
VSEC	Valued socio-economic component
WMMP	Wildlife Mitigation and Monitoring Plan

11. Marine Wildlife

This section presents the existing conditions of the marine wildlife surrounding the proposed Project and identifies and evaluates the potential Project-related effects and cumulative effects on marine wildlife and their habitat within a local and regional context.

11.1 INCORPORATION OF TRADITIONAL KNOWLEDGE

11.1.1 Incorporation of Traditional Knowledge for Existing Environment and Baseline Information

Baseline studies were designed to characterize marine wildlife identified as culturally important to Inuit and to characterize important marine wildlife habitat. The baseline programs conducted between 2010 and 2013 included the collection and analysis of data on the relative seasonal and annual trends in abundance and distribution of marine wildlife identified as important to Inuit. Marine wildlife habitat use within the marine wildlife local study area (MLSA) and marine wildlife regional study area (MRSA), including the identification of important habitat features such as breeding and staging areas for seabirds, and pupping and moulting areas for ringed seals was also documented. These studies were guided by Traditional Knowledge (TK) and included local assistance with surveys in areas deemed as important habitat for marine wildlife. This information was also used as baseline information around which the human and environmental risk assessments (Volume 6, Section 5) were developed.

11.1.2 Incorporation of Traditional Knowledge for Marine Wildlife VEC Selection

The results of the Inuit TK for TMAC Resources Inc. Proposed Hope Bay Project, Naonaiyaotit Traditional Knowledge Project (NTKP) draft report (Banci and Spicker 2016) were used for scoping and refining the potential VEC/VSEC list. The TK report presents maps of the locations where valued animal species are more abundant and hunted, environmental components, and traditional land use activities. This information was used to determine if these values potentially interacted with the Madrid-Boston Project, and if so, they were included in the initial VEC/VSEC list.

11.1.3 Incorporation of Traditional Knowledge for Spatial and Temporal Boundaries

The NTKP report (Banci and Spicker 2016) was used to guide the selection of the MLSA and MRSA. Baseline marine wildlife field studies were completed in those study areas to encompass potential Project effects on marine wildlife resulting from construction, operation and closure of the Madrid-Boston Project.

Current Inuit use of the water for hunting and travel overlaps the marine study areas (Volume 6, Section 4; Land Use), and was also considered in the delineation of these boundaries (Banci and Spicker 2012; Banci and Spicker 2016). The MRSA encompasses an area large enough to characterize potential effects to species which may come into contact with the Madrid-Boston Project or Project-related activities during their lifetime. In particular, the MRSA includes the northern portion of Bathurst Inlet, which TK identified as an important area for collecting marine bird eggs and marine birds, and for hunting marine mammals.

11.1.4 Incorporation of Traditional Knowledge for Project Effects Assessment

The list of potential effects to be considered in the effects assessment was based in part on Inuit input. TK information related to the distribution and habitat use was included in the assessment of potential effects on marine wildlife by determining the potential overlap of wildlife species with the spatial boundaries of the Madrid-Boston project. TK helped to determine the location of potential marine wildlife receptors and the spatial and temporal overlap with the Madrid-Boston Project in these areas such as timing and location of sea bird staging and ringed seal congregations. In particular, the traditional use of the northern portion of Bathurst Inlet was considered in the assessment.

11.1.5 Incorporation of Traditional Knowledge for Mitigation and Adaptive Management

As summarized within the Socio-economic (Volume 6, Section 3) and Land Use Section (Volume 6 Section 4), focus group sessions revealed Inuit concerns about the potential for marine wildlife, forage, or habitat quality to be affected by the Project. Mitigation measures are designed primarily to reduce the potential for adverse effects on marine wildlife and wildlife habitat. Mitigation and management strategies in place for the Doris Project will also be used for the Madrid-Boston Project. These strategies are in place for a number of Valued Ecosystem Components (VECs) including the marine physical environment, marine fish, and wildlife and Valued Socio-economic Components (VSECs) which will serve to minimize the potential effects of the Project on marine wildlife and wildlife habitat. In particular, only open-water season shipping (no ice-breaking) will occur so as to avoid potential negative effects on wildlife dependent on ice, and the design of the permanent in-water infrastructure minimizes habitat loss for marine wildlife.

Direct and indirect mitigation and adaptive management strategies for marine wildlife and the ways in which TK was incorporated into the development of these strategies, are detailed in other sections of the EIS including:

- Air Quality (Volume 4, Section 2);
- Marine Physical Processes (Volume 5, Section 7);
- Marine Water Quality (Volume 5, Section 8);
- Marine Sediment Quality (Volume 5, Section 9);
- Marine Fish (Volume 5, Section 10);
- Terrestrial Wildlife and Wildlife Habitat (Volume 4, Section 9); and
- Land Use (Volume 6, Section 4).

11.2 EXISTING ENVIRONMENT AND BASELINE INFORMATION

11.2.1 Regional Overview

The Hope Bay Development comprises existing and approved projects and the Madrid-Boston Project. The Project is located approximately 125 km southwest of Cambridge Bay, Nunavut, on the southern shore of Melville Sound in the West Kitikmeot region of Nunavut. Infrastructure associated with the Hope Bay Development is present along the southern shoreline of Roberts Bay (68º 12' N, 106º 38' W), a small inlet that empties into Melville Sound and is bordered by Hope Bay (west) and Ida Bay (east).

Shipping access to the Project is via the Arctic Ocean terminating at the port site in Roberts Bay. Shipping occurs along existing shipping route through the Northwest Passage and includes shipping outside of the MRSA. The common Northwest Passage shipping route starts in Nunavut at Lancaster Sound, and passes through Barrow Strait, Peel Sound, Victoria Strait, and the Queen Maud Gulf. Ships would then travel south into northern Bathurst Inlet, and enter from the west into Melville Sound terminating in Roberts Bay.

Roberts Bay and the surrounding waters in the MRSA are typically ice covered from late October to June, most of that time with land-fast ice that is about 1.5 m thick. The marine wildlife community of Roberts Bay and the greater regional area of Melville Sound are representative of an Arctic marine ecosystem, and include the seasonal use of marine habitat by a variety of marine wildlife species including several species of marine mammals and seabirds.

This section provides a summary of the methods and results of studies for marine wildlife conducted in the MRSA as baseline studies for the Madrid-Boston Project and as ongoing monitoring of the Doris Project.

11.2.2 Proximity to Designated Environmental Areas

There are no existing or proposed parks or conservation areas near the proposed Project. The nearest conservation area is the Queen Maud Gulf Migratory Bird Sanctuary approximately 50 km east of Roberts Bay by air and over 300 km by water (as Melville Sound is isolated from the Queen Maud Gulf by the Kent Peninsula). The Draft Nunavut Land Use Plan (Nunavut Planning Commission 2016) has designated northern Bathurst Inlet, Melville Sound, and Elu Inlet as a key bird habitat site, and thus the Project marine LSA and MRSA are contained within this area. The proposed Hiukitak River Cultural Area is on the eastern shore of northern Bathurst Inlet and is outside of the MRSA, approximately 120 km northeast of Roberts Bay (by water).

Outside of the MRSA but along the current shipping routes used for the approved Project, several additional ecologically and biologically significant areas (EBSAs) and Key Marine or Terrestrial Habitat Sites (KMHS and KMTS) and Important Bird Areas (IBAa) occur. EBSAs are identified as a management tool to provide information about important species, habitat and ecosystem components, and ultimately provide the primary inputs for the design of Marine Protected Areas. Key habitat sites are identified as marine or terrestrial areas supporting at least 1% of the Canadian population of at least one species of migratory birds (or in some cases subspecies). IBAs identify habitats that are important to species of conservation concern, to large congregations of migratory birds, and to species that are limited by range or habitat (IBA 2012a).

The following sections summarize the regional setting for marine mammals and seabirds and present the spatial and temporal distributions of these species as well as important habitat areas for marine wildlife species along the commercial shipping routes.

11.2.2.1 Marine Mammals

Several species of marine mammals likely occur along the shipping routes, including: walrus (*Odobenus rosmarus*), narwhal (*Monodon monoceros*), beluga whale (*Delphinapterus leucas*), bowhead whale (*Balaena mysticetus*), polar bear (*Ursus arctos*) and ringed seals. In addition, several other species may occur on a small proportion of the commercial shipping routes including, bearded seal (*Erignathus barbatus*), harp seal (*Phoca groenlandica*), hooded seal (*Crystophora cristata*), and killer whales (*Orcinus orca*). TK indicates that these species are not commonly observed in the MRSA (Banci and Spicker 2016). Spatial and temporal distributions of these species along the commercial shipping routes are presented in Figures 11.2-1 and 11.2-2 and Table 11.2-1.

Most of the marine mammals along the commercial shipping routes likely would not come into close contact with vessels, regardless of the number of vessels, because of their distribution or preferred habitats. The commercial shipping route is located well offshore or in mid-channel, whereas many of the marine mammals are coastal and some are found only in low numbers along the commercial shipping routes.

The relatively few times and locations when marine mammals could occur near the commercial shipping route during the shipping season are as follows:

- A population of bowhead whales occur in the Peel Sound/Franklin Strait area and in Barrow Strait during August and September. The Eastern Arctic bowhead population is present in Lancaster Sound and Prince Regent Inlet from late June through September as ice conditions allow.
- Beluga whales occur in deep-water areas offshore in Peel Sound called the Franklin Trench from mid-August to early/mid-September. The Western Beaufort Sea beluga population is in the western Mackenzie River estuary and delta from June to late August.
- Narwhals occur in small numbers in Barrow Strait and Peel Sound during August and September. During fall migration back to Baffin Bay via Lancaster Sound, narwhal are dispersed in open-water and remain there as long as open-water permits.
- Very few walrus use the offshore waters and south shores of Barrow Strait, the west shores of Prince Regent Inlet and the Gulf of Boothia, or Peel Sound.

11.2.2.2 Seabirds and Seaducks

Several areas along the mainland coast host large numbers of breeding waterfowl, such as the Queen Maud Gulf Migratory Bird Sanctuary and the Kent Peninsula (Mallory and Fontaine 2004; Zinifex 2007; Dickson 2012b). The islands of the Arctic Archipelago also contain breeding and staging habitat for a large number of seabirds and seaducks. In particular, the coastal areas and islands within the vicinity of Barrow Strait/Lancaster Sound contain several well-known breeding colonies. The Barrow Strait/Lancaster Sound area supports large percentages of the Canadian Arctic population of thick-billed murre (27%), northern fulmar (57%), and black-legged kittiwake (35%; Mallory and Fontaine 2004).

Breeding areas for seabirds and seaducks that are adjacent to or near the commercial shipping route are mapped in Figures 11.2-3 and 11.2-4. Most of these areas are identified as Key Marine and Terrestrial Habitat Sites (KMHS and KMTS), or IBAs. Additional areas outside of the wildlife MRSA, such as northern Baffin Island and Devon Island, and their associated marine areas (e.g., Lancaster Sound) are identified as important nesting and foraging areas for a variety of seabirds including murres, gulls, and eiders (Mallory and Fontaine 2004). TK also identified a number of seabird and seaduck habitats within the MRSA (Banci and Spicker 2016).

Polynyas are habitats of particular importance for marine birds; polynyas are year-round ice-free areas. Many species that breed in the Arctic rely on polynyas to stopover and feed before moving to breeding grounds (Mallory and Fontaine 2004). Several polynyas occur in the Arctic, including the Lambert Channel Polynya in the Coronation Gulf which is a Key Marine Habitat Site (Environment Canada 2014), the Franklin Strait Polynya, the Bellot Strait Polynya in Peel Sound, and the Lancaster Sound Polynya between Baffin and Devon Islands which has also been identified as a Key Marine Habitat Site (Mallory and Fontaine 2004; Hannah, Dupont, and Dunphy 2009; Environment Canada 2014). The Lambert Channel polynya is a regular stopover point for a subspecies of common eider (Pacific common eider; *Somateria mollissima v-nigra*) that breed in the Bathurst Inlet and Elu Inlet Key Marine Habitat Site area (Dickson 2012b).

Figure 11.2-1

Migratory Routes and Main Summering Areas of Whales along the Commercial Shipping Route

Figure 11.2-2
Main Summering Areas of Seals, Walrus, and Polar Bears along the Commercial Shipping Route

Figure 11.2-3

Important Breeding and Staging Habitat for Seabirds and Seaducks along the Commercial Shipping Route – Southern, Arctic Mainland

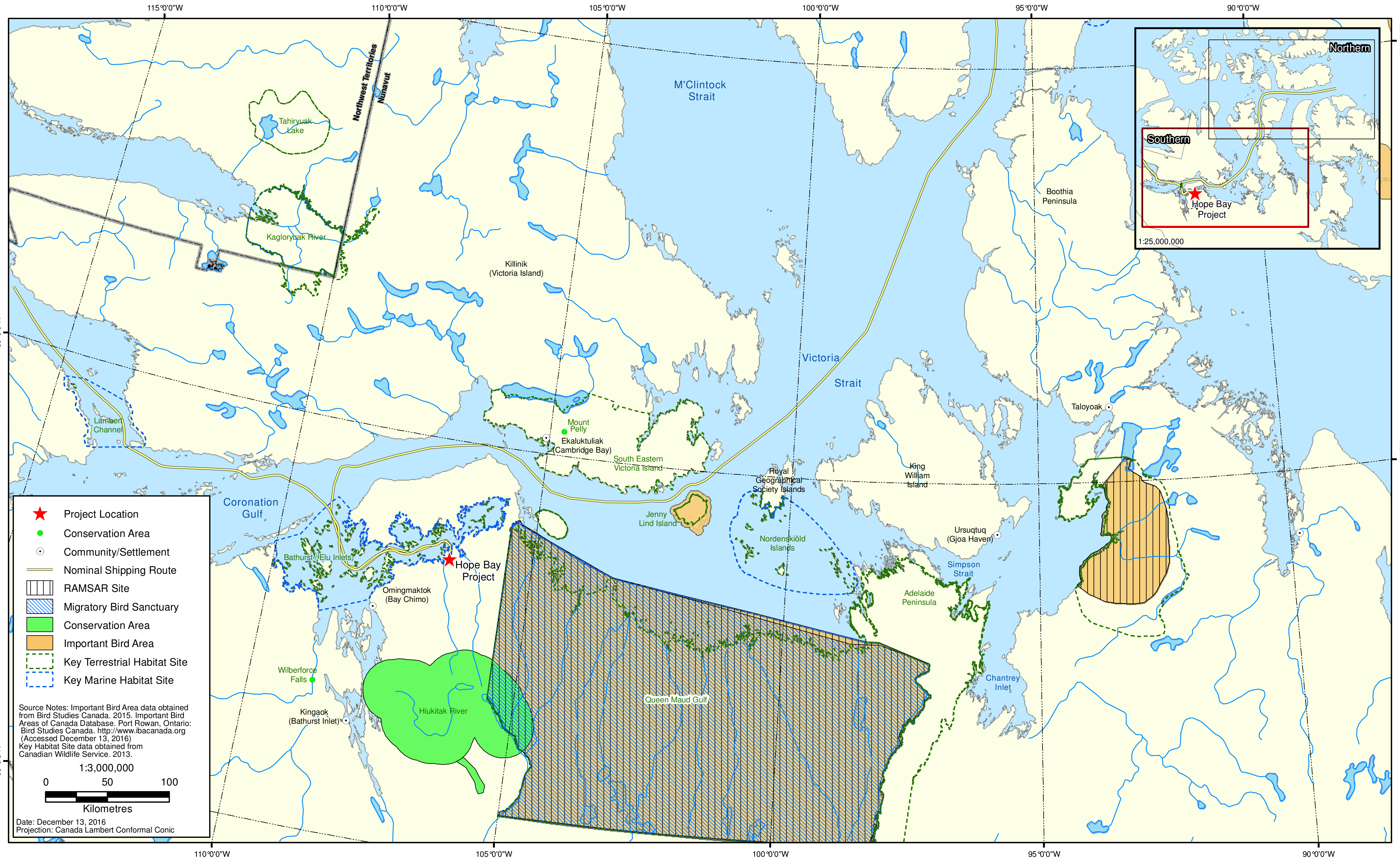


Figure 11.2-4

Important Breeding and Staging Habitat for Seabirds and Seaducks along the Commercial Shipping Route – Northern, Arctic Islands

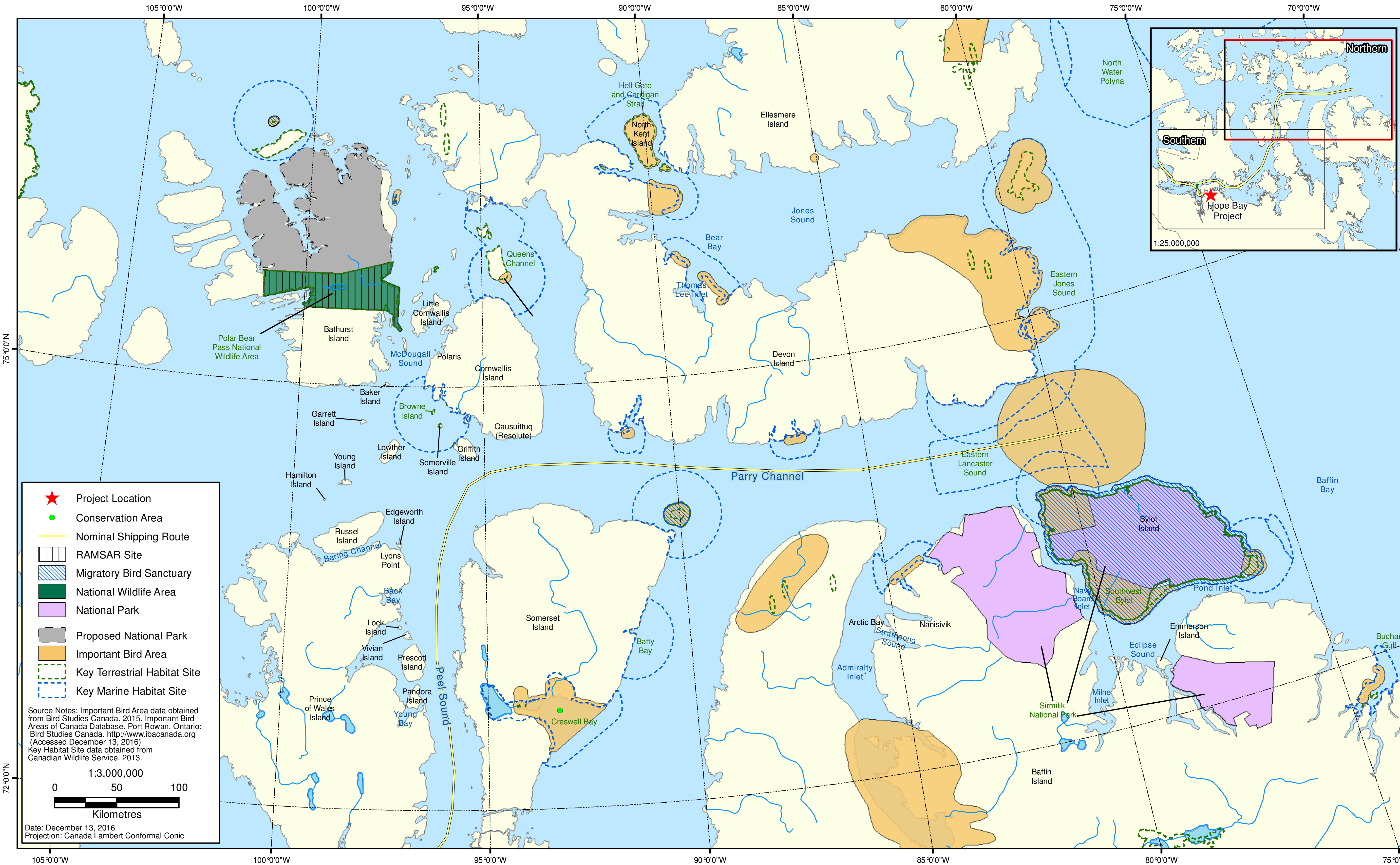


Table 11.2-1. Spatial and Temporal Distribution of Marine Mammals along the Commercial Shipping Route

Species	Overlap with Proposed Shipping Route in Nunavut	Typical Spatial Distribution[1]	Temporal Distribution	References
Main Species Occurring on the Proposed Shipping Route				
Ringed Seal	West and East	Arctic Archipelago	year-round	(McLaren 1958; Heide-Jørgensen, Stewart, and Leatherwood 1992; Harris et al. 1997; Harris et al. 1998; Kapel et al. 1998; Lawson and Moulton 1999; Teilmann, Born, and Acquarone 1999; Moulton and Lawson 2001; Moulton et al. 2002; Kelly et al. 2010)
Walrus	East	Lancaster Sound and Barrow Strait	Spring Migration: June – early-August	(Davis, Koski, and Finley 1978; Koski and Davis 1979; Koski 1980a, 1980b; Stewart 2008)
			Summer: August and September	(Johnson et al. 1976; Koski and Davis 1979)
			Fall Migration: end-September - October	(Koski 1980a)
		Baffin Bay	Wintering: late-October - June	(Riewe 1976; Davis, Koski, and Finley 1978; Kiliaan and Stirling 1978; Sjare and Stirling 1996) (Stewart 2008)
Narwhal	East	Lancaster Sound	Spring Migration: April – July	(Finley et al. 1990)
			Fall Migration: mid-September – early October	(Heide-Jørgensen, Dietz, et al. 2003)
		North of Baffin Island, Prince Regent Inlet, Somerset Island, Gulf of Boothia, Barrow Strait, and Peel Sound	Summer: August and September	(Finley and Johnston 1977; Fallis, Klenner, and Kemper 1983; Smith et al. 1985; Koski and Davis 1994; Richard et al. 1994; Heide-Jørgensen, Dietz, et al. 2003; Heide-Jørgensen, Richard, et al. 2003; Marcoux, Auger-Méthé, and Humphries 2009)
		Davis Strait and Baffin Bay	Winter: October - June	(McLaren and Davis 1982)
Beluga (Eastern High Arctic-Baffin Bay stock)	East	Lancaster Sound (April – July)	Spring Migration: late-April/early May – July	(Davis and Finley 1979; Finley and Renaud 1980; Koski, Davis, and Finley 2002)
			Fall Migration: early-September- November	(Richard et al. 2001; Heide-Jørgensen, Richard, et al. 2003)
		Barrow Strait, Peel Sound, Franklin Strait, Prince Regent Inlet, Somerset Island	Summer: mid-July – mid-August	(Finley 1976; Smith et al. 1985; Richard et al. 2001; Koski, Davis, and Finley 2002)
		Baffin Bay	Wintering: late-September – early-May	(Davis and Finley 1979; Finley and Renaud 1980; McLaren and Davis 1983; Heide-Jørgensen, Richard, et al. 2003)

Species	Overlap with Proposed Shipping Route in Nunavut	Typical Spatial Distribution[1]	Temporal Distribution	References
Beluga (Eastern Beaufort Sea Stock)	West	Beaufort Sea (western Chukchi Sea may be important fall migration destination)	Spring Migration: April - July	(COSEWIC 2004)
		Mackenzie Delta, Amundsen Gulf, Viscount Melville Sound	Summer: July and August	(Richard, Martin, and Orr 2001; COSEWIC 2004)
		Bering Sea	Winter: November - April	(Tynan, Ainley, and Stirling 2009)
Bowhead Whale (Davis Strait-Baffin Bay stock)	East	Lancaster Sound, Gulf of Boothia, Prince Regent Inlet	Spring Migration: early/mid-May – early-August	(Davis and Koski 1980; Reeves et al. 1983; Moore and Reeves 1993)
			Fall Migration: late-August - October	(Koski and Davis 1980)
		Milne Inlet, and Admiralty Inlet (summer)	Summer: August and September	(Davis and Koski 1980; Koski and Davis 1980; Finley 1990, 2001)
		Hudson Strait, Baffin Bay	Wintering: October – May/June	(Koski, Heide-Jørgensen, and Laidre 2006)
Polar Bear	East	Northern Arctic Archipelago	Summer: August – September	(Amstrup et al. 2000)
		Ice-Covered Waters across Arctic Archipelago as far south as Larsen Sound	Winter: October – June/July	(LGL Limited 2005)
Other Species that May Occur on the Proposed Shipping Route				
Bearded Seal	West and East	Northern circumpolar	Year-round, moves with ice as ice retreats and reforms	(Fedoseev 1965; Johnson et al. 1966; Burns and Frost 1979; Burns 1981; Kelly 1988)
Harp Seal	East	Lancaster sound, Peel Sound	Spring Migration: July – late-August Fall Migration: late-September-early October	(Finley 1976; Koski and Davis 1980)
		Davis Strait, Baffin Bay, Lancaster Sound, Prince Regent Inlet, Barrow Strait, Peel Sound	Summer: late-August – late-September	(Johnson et al. 1976; Koski and Davis 1979; Fallis, Klenner, and Kemper 1983; Lavigne and Kovacs 1988)
		Labrador coast	Winter: October – mid-June/July	(Koski and Davis 1980)
Hooded Seal	East	Lancaster Sound, Baffin Bay, Davis Strait	Summer: August and September	(Sergeant 1976)
		Newfoundland/Labrador/ Davis Strait	Winter/Spring: late-September – late-July	(Sergeant 1976)
Killer Whale	East	Lancaster Sound, Prince Regent and Admiralty Inlets	Summer: mid-August – early-October, but rare	(Koski and Davis 1979; Baird 2001; Reeves et al. 2002)
		North Atlantic (open-water)	Winter: early-October through August	(Davis, Finley, and Richardson 1980)

[1] *Spatial Distribution only includes distribution of populations and areas with potential for overlap with the proposed shipping route.*

KMTS surrounding terrestrial breeding sites were delineated using a 15 or 30 km buffer from land, the buffered areas relating to the species occupying the terrestrial site and primary area in which that species forage while nesting and raising young (roughly from June through early August). For example, marine habitats extending 30 km from nesting sites were used for long ranging species such as thick-billed murre and black-legged kittiwakes, while 15 km buffers were used for species known to forage closer to nesting colonies, such as black guillemots and common eider (Mallory and Fontaine 2004). Some KMHSs were identified as important staging or moulting areas used on a regular basis during migration. These are sites which are integral to sustaining bird populations either during the pre-breeding spring migration (May and June) or post-breeding fall migration (August through October). For example, the Bathurst and Elu Inlet KMHS is important for moulting and staging purposes; male and female Pacific common eider use marine habitat in this area from July through early October. In addition, areas of national importance to migratory birds are designated as Migratory Bird Sanctuaries (MBS). MBS, and other areas with territorial or federal protection that are important to seabirds and seaducks, are shown on Figures 11.2-3 and 11.2-4. The approximate numbers of seabirds and seaducks using these KTHSs or IBAs and other known nesting areas during the breeding season are shown in Table 11.2-2.

Table 11.2-2. Breeding Areas for Seabirds and Seaducks along the Commercial Shipping Route in the Southern and Northern Arctic

Name	Designation[1]	Principle Nesters	Estimated Number of Birds[2]	Date of Estimate
Southern Arctic/Mainland				
Lambert Channel	KMHS, KTHS	Pacific Common Eider	Not available	
South Eastern Victoria Island	KTHS	Canada goose, King eider, Long-tailed duck	Not available	
Melbourne Island	KMHS, KTHS	Greater white-fronted goose, Snow Goose, Canada Goose	Not available	
Queen Maud Gulf	MBS, IBA, KTHS	Snow Goose, Ross's Goose, Cackling Goose, Brant, Greater White-fronted Goose, Tundra Swan, Common Eider, King Eider, Long-tailed duck, Northern Pintail, Sandhilll Crane	1,463,650	1990, 1998
Jenny Lind Island	IBA, KTHS	Snow Goose, Ross's Goose, Cackling Goose	20,500	1990, 1998
Nordenskiöld Islands[3]	KMHS, KTHS	Pacific Common Eider	11,500	1995
Northern Arctic/Arctic Islands				
Seymour Island	IBA, KMHS, KTHS	Ivory Gull*	110	2005
Cheyne Islands	IBA, KTHS	Ross's Gull*, Northern Common Eider, Arctic Tern	1,230	2002, 2006
Washington Point, Baillie-Hamilton Island	IBA, KTHS	Black-legged Kittiwake, Black Guillemot, Glaucous Gull	3,000	1975
Cornwallis Island	none	Ivory Gull*	3	2005
Browne Island	KTHS, KMHS	Black-legged Kittiwake	1,692	2003
Prince Leopold Island	MBS, IBA, KMHS, KTHS	Thick-billed Murre, Northern Fulmar, Black Guillemot, Black-legged Kittiwake, Brant, Common Eider, Parasitic Jaeger, Glaucous Gull	362,400	1977
Batty Bay	KTHS, KMHS	Black-legged Kittiwake	350	1974
Sydkap Ice Field	IBA, KMHS	Ivory Gull*	0**	2003

Name	Designation[1]	Principle Nesters	Estimated Number of Birds[2]	Date of Estimate
Northwestern Brodeur Peninsula	IBA,KTHS	Ivory Gull*	0**	2005
Cape Hay	MBS, IBA, KMHS	Thick-billed Murre, Black-legged Kittiwake	160,000	2000
Southwest Bylot Island	MBS, IBA, KTHS	Snow Goose, Long-tailed Duck, King Eider	156,000	1993
Cape Liddon	IBA, KMHS	Northern Fulmar, Black Guillemot	20,200	1977
Hobnose Inlet	IBA, KMHS	Northern Fulmar, Glaucous Gull, Thayer's Gull, Black Guillemot	50,000	1977
Berlinguet Inlet	IBA, KTHS	Snow Goose	14,700	1983
Baillarge Bay	IBA, KMHS, KTHS	Northern Fulmar	23,000	2002
Cambridge Point, Coburg Island	IBA, KTHS, National Wildlife Area	Black-legged Kittiwake, Thick-billed Murre, Northern Fulmar, Black Guillemot, Glaucous Gull, Common Eider, Atlantic Puffin	381,130	2000, 2004
Eastern Devon Island Nunataks	IBA, KTHS	Ivory Gull*	3	2005
Inglefield Mountains	IBA, KTHS	Ivory Gull*	200	2005
Cape Graham Moore	MBS, IBA, KMHS	Thick-billed Murre, Black-legged Kittiwake	33,000	2000

Notes:
[1] KMHS = Key Marine Habitat Site, KTHS = Key Terrestrial Habitat Site, IBA = Important Bird Area, MBS = Migratory Bird Sanctuary.
[2] Rounded to nearest 10.
[3] Some habitat sites polygons provided by CWS encompassed both terrestrial and marine habitat, where terrestrial habitats were generally clusters of small islands. In these cases, terrestrial habitat sites were mapped with ArcGIS around the outer edge of all islands within the boundaries of the polygon as per direction from the CWS.
** Species listed under Schedule 1 of SARA (2002).*
*** No ivory gulls were counted at the Sydkap Ice Field in 2003, but up to 300 individuals had been recorded in the area in the late 1980s. Similarly, no ivory gulls were counted on the Brodeur Peninsula in 2005; however, 54 individuals counted in 2004 (COSEWIC 2006).*
Sources: Mallory and Fontaine (2004), IBA (2012b), Latour et al. (2008), COSEWIC (2006), Raven and Dickson (2009), Environment Canada (unpublished data).

Several species of seabirds and seaducks in addition to those discussed in Section 11.2.7 occur along the commercial shipping route, including black-legged kittiwake (*Rissa tridactyla*), black guillemot (*Cepphus grille*), northern fulmar (*Fulmarus glacialis*), Ross's goose (*Chen rossii*), and thick-billed murre (*Uria lomvia*). Other species may also occur, though their presence would be infrequent. Some species may only use marine areas during one part of the open-water season (e.g., staging), and others occur in low numbers or have restricted breeding ranges in the Arctic. These species include Atlantic puffin (*Fratercula arctica*), dovekie (*Alle alle*), ivory gull (*Pagophila eburnean*), Ross's gull (*Rhodostethia rosea*), Sabine's gull (*Xema sabini*), and Thayer's gull (*Larus glaucoides*). Ivory and Ross's gulls have reached critically low population numbers in the Canadian Arctic. The *Species at Risk Act* (SARA) lists these two species on Schedule 1 as Endangered (ivory gull) and Threatened (Ross's gull; Government of Canada 2012).

There are several areas along the commercial shipping route where it is likely that vessels will pass in close proximity to breeding or staging areas used by a number of seabirds and seaducks. In part, the route itself will lessen the frequency of interactions, as ships pass well offshore or in mid-channel except in Bathurst Inlet and Melville Sound, whereas many of the breeding or staging areas are located in marine habitats within 30 km from the shores of the mainland and Arctic Islands (Figures 11.2-3 and 11.2-4).

11.2.3 Regulatory Framework

Several federal regulations guide development where it pertains to marine wildlife and habitat protection. These include the:

- Canada *Fisheries Act* (1985);
- *Canada Migratory Birds Convention Act* (1994);
- *Nunavut Wildlife Act* (2003); and
- Canada *Species at Risk Act* (2002).

The following sections describe these acts, regulations, and guidelines and how they apply to the protection of marine wildlife and marine wildlife habitat.

11.2.3.1 Canada Fisheries Act

Marine mammals fall under the jurisdiction of the Department of Fisheries and Oceans Canada (DFO), and are protected under the federal *Fisheries Act* (1985). Although cetaceans and pinnipeds are mammals, their inclusion in this Act reflects the fact that they were once managed and harvested as "fish" stocks. Section 32 and 35(1) of the federal *Fisheries Act* protect marine mammals and their habitat from alteration, disruption, or destruction. Section 7 of the Marine Mammal Regulations protects marine mammals from being disturbed.

11.2.3.2 Migratory Birds Convention Act

Seabirds and seaducks, and their nests are protected by the federal *Migratory Birds Convention Act* (1994), which prohibits killing migratory birds and their eggs, taking their nests, and also prohibits the deposition of harmful substances in areas frequented by migratory birds (which include seabirds and seaducks).

11.2.3.3 Nunavut Wildlife Act

Wildlife in Nunavut, including marine wildlife are protected under the *Nunavut Wildlife Act* (2003). The *Nunavut Wildlife Act* identifies and defines wildlife management strategies for Nunavut, including strategies for conservation, protection and recovery of species at risk, managing nuisance wildlife, and possession of wildlife. The Act provides interpretation of approved and restricted hunting and related activities, including the possession of wildlife and enforcement that will follow should any of the Act's issued sections and corresponding regulations be contravened. The *Nunavut Wildlife Act* prohibits destruction of bird nests when these are being used for breeding by birds, as well as disturbance to a 'substantial number' of birds.

11.2.3.4 Canada Species at Risk Act

The federal *Species at Risk Act* (SARA; 2002) is designed to prevent Canadian indigenous species, subspecies, and distinct populations from becoming extirpated or extinct. The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses and identifies species at risk. COSEWIC is designated under SARA to assess species according to their level of conservation concern: *extinct*, *extirpated*, *endangered*, *threatened*, *special concern*, *not at risk* or *data deficient*. Only those wildlife species listed in SARA Schedules qualify for legal protection and recovery under SARA. The Act prohibits the killing, harming, harassing, capturing or taking of an individual of a wildlife species that is listed in

Schedule 1 as *extirpated*, *endangered* or *threatened* by SARA (section 32(1)). SARA also protects the residence of species listed as *extirpated*, *endangered* or *threatened* from being damaged and destroyed as specified in Section 33.

11.2.4 Data Sources

Specific sources of baseline information on marine wildlife used in this Section include the following Hope Bay Development Project reports:

- *Hope Bay Belt Project: Marine Wildlife Report 2011* (Appendix V5-11A);
- *Inuit Traditional Knowledge for TMAC Resources Inc. Proposed Hope Bay Project, Naonaiyaotit Traditional Knowledge Project (NTKP)* (Banci and Spicker 2016);
- *Doris North Project: 2015 Wildlife Mitigation and Monitoring Plan Compliance Monitoring Report* (ERM 2016);
- *Doris North Project: 2014 Wildlife Mitigation and Monitoring Plan Compliance Monitoring Report* (ERM 2015a);
- *Doris North Project: 2013 Wildlife Compliance Monitoring Report (ERM Rescan 2014);*
- *Doris North Project: 2012 Wildlife Mitigation and Monitoring Program Report* (Rescan 2013b);
- *Doris North Project: 2011 Wildlife Mitigation and Monitoring Program Report* (Rescan 2011b);
- *Hope Bay Belt Project: Marine Wildlife Baseline Report 2011* (Rescan 2011d);
- *Doris North Gold Mine Project: 2010 Wildlife Mitigation and Monitoring Report* (Rescan 2011a);
- *Doris North Gold Mine Project: 2009 Wildlife Mitigation and Monitoring Report* (Rescan 2010);
- *Doris North Project: Wildlife Mitigation and Monitoring Program – 2008 Final Report* (Golder 2009);
- *Doris North Project: Wildlife Mitigation and Monitoring Program – 2007 Final Report* (Golder 2009); and
- *Doris North Project: Wildlife Mitigation and Monitoring Program – 2006 Final Report* (Golder 2007).

In addition to the baseline studies, publically available data from other nearby studies (e.g. Back River Project; Rescan 2013a; Sabina 2015a, 2015b) and that reported in the literature (e.g. Dickson 2012b; Environment Canada 2014) was used for comparison to data collected as part of the Hope Bay baseline and monitoring programs.

11.2.5 Methods

Baseline surveys were conducted in the MRSA to document the presence and distribution of marine species, including marine mammal and seabirds in relation to the Project and proposed Project activities (e.g., shipping) as well as to document spring migration crossing routes for Dolphin and Union caribou (discussed in Volume 4, Section 9.2). The collection of baseline data was limited to the MRSA. Shipping activities for the Project will occur outside of the MRSA, along the commercial shipping route. A discussion on the presence, distribution, and timing of marine wildlife (including marine mammals and seabirds), and important habitat areas along the commercial shipping route, is discussed in Section 11.2.2.1 and 11.2.2.2.

Within the MRSA, two survey methods were implemented for the documentation of marine mammals: An aerial survey was flown in the early spring of 2010 to document the presence and distribution of seals on the pack ice; and a vessel-based survey was conducted in late summer of 2010 to document the presence of larger marine mammals, such as belugas and seabirds.

Aerial surveys were also conducted between 2006 and 2015 during the early and late breeding period to document the presence and distribution of seabirds within marine areas surrounding the port site at Roberts Bay. Additional seabird-specific surveys were conducted in July and August of 2009 and 2010 to include greater coverage of the marine areas and islands surrounding the Roberts Bay port site. In addition of aerial and vessel-based surveys for seabirds in July of 2006, 2009, and 2010, ground-based seabird nest searches were conducted on small islands (less than 20 ha) to document the presence of common eider nest sites in the marine areas adjacent to and surrounding the Roberts Bay port site. Details on survey methods for marine wildlife species are discussed in the baseline data sections for each marine wildlife VEC.

11.2.6 Characterization of Baseline Conditions for Marine Mammals

Marine mammals that have the potential to occur in the MRSA include ringed seal (*Pusa hispida*), bearded seal (*Erignathus barbatus*), beluga whale (*Delphinapterus leucas*), narwhal (*Monodon monoceros*), bowhead whale, walrus and polar bear (Table 11.2-3). Polar bear and bowhead whale are listed on Schedule 1 of SARA. Ringed seals are designated as Not at Risk by COSEWIC (COSEWIC 2012). Ringed seals and bearded seals (at a lower abundance) occur regularly (Rescan 2011d). Beluga whales are infrequent summer visitors to Bathurst Inlet based on historical evidence (Stewart and Burt 1994; Priest and Usher 2004; NPC 2008), but were recently detected in 2011 (>100 individuals) in Melville Sound (Banci and Spicker 2016). Narwhal are observed infrequently in western Queen Maud Gulf as far east as Cambridge Bay (NPC 2008), but have recently been observed (in 2011) in Cambridge Bay when summer ice conditions were uncharacteristically open (Alex Buchan, pers. Comm. 2011) and on the northeast side of the Kent Peninsula near the Mac Alpine Islands in 2013 (Banci and Spicker 2016). Historically, narwhal have been hunted in Bathurst Inlet by Inuit (Banci and Spicker 2016). Traditional knowledge also indicates that bowhead whales were historically abundant in the MRSA, especially in the mouth of Bathurst Inlet and in 2011, a bowhead whale was observed off Cockburn Islands at the mouth of Melville Sound (Banci and Spicker 2016). Walrus (in the islands west of Umingmaktok) and polar bear (in the mouth of Bathurst Inlet) were also reported to be historically rare in the MRSA (Banci and Spicker 2016).

For the purpose of the environmental assessment, ringed seal is considered the representative species for marine mammals as it is more abundant relative to the bearded seal in the assessment area. Ringed seals were also identified as the most important marine mammal species to the local Inuit as they are hunted for food and their fur used for boot soles, kayaks and tents (Banci and Spicker 2016). Therefore, further details are provided for ringed seals.

11.2.6.1 Ringed Seal

<u>Population Trends and Conservation</u>

Ringed seals are the most abundant marine mammal in the Canadian Arctic. Population estimates are typically based on surveys of visible seals hauled-out on the ice in spring. Published estimates include:

- at least 40,000 ringed seals in the Canadian Beaufort Sea (Stirling, Kingsley, and Calvert 1981);
- 50,000 in northern Amundsen Gulf (Kingsley 1990), northwest of the Madrid-Boston Project;
- 49,000 in Prince Albert Sound, the south west inlet on Victoria Island in the Amundson Gulf (Kingsley 1990); and
- 90,000 in the Canadian High Arctic (Kingsley, Stirling, and Calvert 1985; Kingsley 1990).

Table 11.2-3. Marine Mammal Species Potentially Occurring in the Regional Study Area and their Regularity and Timing of Occurrence and Conservation Status

Common Name	Scientific Name	Regularity of Occurrence	Detected during Baseline Studies*	Timing of Occurrence	Conservation Status				
					NU Rank	COSEWIC	SARA	Global Rank	IUCN Red List
Ringed Seal	*Pusa hispida*	Regular	Y	Breeding	NA	NAR		G5	Least Concern
Bearded Seal	*Erignathus barbatus*	Regular	Y	Breeding	NA			G4G5	Least Concern
Beluga Whale (Eastern Beaufort Sea population)	*Delphinapterus leucas*	Rare	N	Summer Migrant	NA	NAR		G4TNR	Near Threatened
Narwhal	*Monodon monoceros*	Rare	N	Summer Migrant	NA	SC		G4	Near Threatened
Bowhead Whale (Bering-Chukchi-Beaufort population)	*Balaena mysticetus*	Historically Regular	N	Summer Migrant	NA	SC	Schedule 1	G3T3	Least Concern
Walrus	*Odobenus rosmarus*	Historically Rare	N	Migrant?	NA	SC		G4	Data Deficient
Polar Bear	*Ursus maritimus*	Historically Rare	N	Migrant	Sensitive	SC	Schedule 1	G3	Vulnerable

Large natural fluctuations in ringed seal numbers have been documented over short periods of time (Stirling, Archibald, and DeMaster 1977). For example, in 1974 to 1975, there was a marked decrease (50%) in the abundance and productivity of seals in the Canadian Beaufort Sea and Amundsen Gulf to the northwest of the Project (Stirling, Archibald, and DeMaster 1977; Smith and Stirling 1978). Stirling et al (1982) noted a doubling of the same population between 1974 and 1979. Another decrease in this same population was reported between 1982 and 1985 (Harwood and Stirling 1992). Unusual thick ice conditions were identified as a possible cause of the decrease in the seal population, while large-scale immigration was a factor attributed to the increase (Stirling, Kingsley, and Calvert 1982).

There are few population estimates in the literature based on open-water surveys, likely because ringed seals are only visible during aerial surveys over open-water in ideal conditions (e.g., low sea state, no forward glare). Densities estimated under such conditions are lower than those in spring, and highly variable. Estimated densities of ringed seals in the Beaufort Sea during the open-water season (late summer) were 0.42/km^2 in 1982, 0.15/km^2 in 1984, 0.08/km^2 in 1985, and 0.19/km^2 in 1986 (Harwood and Stirling 1992).

Baseline surveys to estimate ringed seal densities were conducted in Bathurst Inlet. Surveys conducted in late June of 2004 and 2007 during the moulting season (when seals were basking in the sun on the ice) provided an ringed seal density of 0.69/ km^2 in Coronation Gulf (LGL Limited 2005) and 0.3/km^2 in Bathurst Inlet (LGL Limited 2007). In 2012, and 2013, additional surveys were conducted in Bathurst Inlet during the moulting season in June and found a ring seal density of 0.5/km^2 (2.05/km^2 after correcting for observer bias) in 2012 and 1.2/km^2 in 2013 (Rescan 2013a; Sabina 2015a). These survey estimates are within the range of densities for ringed seals seen on the ice during studies in other areas in the Canadian and US Arctic (Table 11.2-4).

Table 11.2-4. Comparative Ringed Seal Densities on Ice from Other Studies in the Alaskan and Canadian Arctic

Year	Country	Location	*Number/km^2	Citation
1975	Canada	Central Arctic (early June)	1.32	Finley (1976)
1975	Canada	Central Arctic (late June)	0.67	Finley (1976)
1978	Canada	Baffin Island Fiords	1.72	Finley et al. (1983)
1979	Canada	Northwest Baffin Island	1.31	Finley et al. (1983)
1980, 1981	Canada	Central Arctic	0.27, 0.41	Kingsley et al. (1985)
1981 to 1983	Canada	Beaufort, Amundsen, Prince Albert Sound	0.06 to 0.41	Kingsley (1984)
1985 to 1999	US	North Slope, Alaska	0.58 to 1.67	Frost et al. (2002)
1997	Canada	Barrow Strait Fiords (Freemans Cove)	3.26 to 4.86	Finley (1979)
1997	Canada	Barrow Strait Fiords (Aston Bay)	0.98 to 10.44	Finley (1979)
1997 to 2002	US	Prudhoe Bay Area	0.39 to 0.83	Moulton et al. (2005)
2004	Canada	Coronation Gulf	0.69	LGL Ltd., (2005)
2007	Canada	Bathurst Inlet	0.30	LGL Ltd., (2007)
2012	Canada	Bathurst Inlet	0.5	Rescan (2013a)
2013	Canada	Bathurst Inlet	1.2	Sabina (2015a)

**Density not corrected for observer bias.*

Migration Patterns and Distribution

Ringed seals are year-round residents of the Arctic and are highly adapted for living in the winter fast-ice environment. Unlike other northern seals such as harp and hooded seals, the ringed seal is adapted to ice-covered waters and does not migrate to open-water areas in the winter (Siegstad et al. 1998). Ice conditions influence ringed seal distribution and abundance (Smith and Stirling 1975, 1978; Moulton et al. 2002). During winter and late spring (roughly November to mid-June), when virtually the entire Canadian Arctic Archipelago is ice-covered, only ringed seals and bearded seals could occur in Melville Sound, Bathurst Inlet, and the Coronation Gulf in fast-ice conditions. Ringed seals use the ice as a platform for building lairs to birth and raise pups, and during the spring to bask in the sun during the moulting period. Ringed seal movement during this time is usually relatively small (Kelly et al. 2010). Ice begins to break up in June (late spring), and the open-water period in Melville Sound, Bathurst Inlet, and Coronation Gulf usually lasts throughout July, August, and September or October. Ringed seals disperse during the open-water period and occur in lower abundance in the MRSA in Melville Sound, Bathurst Inlet and the Coronation Gulf relative to when these areas are covered in sea ice. TK indicates that ringed seals are common in the mouth of Bathurst Inlet, Melville Sound, and Elu Inlet during the spring and near coastal areas and islands during the winter (Banci and Spicker 2016).

Although not considered a migratory species, ringed seals are capable of moving distances of 1,000 km or more from their wintering grounds to summer habitat (Heide-Jørgensen, Stewart, and Leatherwood 1992; Kapel et al. 1998; Teilmann, Born, and Acquarone 1999). Summer movements of up to 1,800 km from winter to spring ranges have been recorded (Kelly et al. 2010). Site fidelity has also been documented in this species, with tagged seals returning to the same 1 to 2 km^2 areas during the winter months over multiple years (Teilmann, Born, and Acquarone 1999; Kelly et al. 2010).

During summer, ringed seals are distributed throughout open-water areas (Banci and Spicker 2016). Some disperse to offshore areas after the ice breaks up in summer (Heide-Jørgensen, Stewart, and Leatherwood 1992), while some move into coastal waters. Ringed seals encountered in the Alaskan Beaufort Sea during open-water seismic exploration were broadly dispersed as individuals or small groups (Harris et al. 1997; Harris et al. 1998; Lawson and Moulton 1999; Moulton and Lawson 2001; Moulton et al. 2002). It is unclear how far ringed seals disperse from their winter habitat in Melville Sound and Bathurst Inlet. Seals are hunted by boat in Bathurst Inlet during the summer months (Banci and Spicker 2016).

Information obtained from a recent satellite tagging study of ringed seals suggests winter habitat partitioning between adults and subadults in Alaska (Crawford et al. 2012). Crawford et al. (2012) reported that subadults traveled south to the ice edge during the late-fall and winter, returning north as ice receded in the spring; adult movements were more limited and farther from the ice edge. These data suggest that subadults, unhampered by breeding requirements for territory maintenance or pup rearing, may move to areas that afford better feeding opportunities, require less energetic costs, and limit predation exposure.

Habitat Use

Ringed seals use stable ice platforms for pupping and nursing (McLaren 1958, 1962; Smith and Stirling 1975; Finley et al. 1983; Kelly 1988). Ringed seals prefer to breed on ice that has frozen to coast lines (landfast ice) and extends from land into the sea (McLaren 1958; Kelly 1988), but they also breed on the pack ice (Finley et al. 1983; Kelly 1988). Lairs are constructed as early as mid-March (Smith, Hammill, and Taugbol 1991) below the snow on the ice often where snow accumulates, such as near pressure ridges (Chapskii 1940; McLaren 1958; Smith and Stirling 1975). Lairs are usually excavated above breathing holes to allow access to the sea while providing a stable platform with which the species may give birth, raise young, and rest, while being sheltered from winter and early spring climate conditions, and predators. Ringed seal lairs have been observed in the MRSA, including the northern portion of Bathurst Inlet among the islands southwest of Umingmaktok and in areas north of Umingmaktok (Sabina 2015a).

Ringed seals also use the sea ice during the moulting period from approximately mid-May through mid-July, depending on the region and annual conditions, to haul-out on and rest (Vibe 1950; McLaren 1958; Smith 1973; Smith and Hammill 1981; Smith 1987; Kunnasranta et al. 2002). Ringed seals can spend more than 60% of their time on the ice in June when they are actively moulting (Kelly et al. 2010). Time spent on ice decreases (to approximately 30% in the Alaskan Beaufort Sea) into late June and July (Kelly et al. 2010) as the condition of ice deteriorates.

11.2.6.2 Baseline Data for Marine Mammals

Two of the four possible marine mammal species, ringed seal and bearded seal, were detected during the aerial and barge surveys conducted in 2010. Results of baseline surveys indicate that habitat within the wildlife marine LSA and RSA constitutes primarily spring moulting habitat for ringed seals. No lairs were observed during the spring seal aerial surveys and the density of all marine mammals was low during the open water season when the summer barge survey was conducted. Some foraging habitat is also available within the LSA and RSA during the open water season, as seals have been documented in these areas, albeit in low densities during that time.

Spring Seal Aerial Survey

A spring seal survey was conducted concurrently with the Dolphin and Union caribou ice crossing survey in June 2010 in the MRSA (Volume 4, Section 9, Section 9.2.5.2) (Figure 11.2-5). Surveys occurred on June 3, 4, and 5, 2010, and recorded 777 seals, including 87 bearded seals, 386 ringed seals, and 322 unknown seals (Rescan 2011d), and 129 open breathing holes (Figure 11.2-5). Of the seals that were observed, a total of 48 bearded, 210 ringed, and 41 unknown seals were observed on transect (Figure 11.2-5; Table 11.2-5). Of the breathing holes that were observed, 79 were observed on transect (Table 11.2-5). The remaining observations were recorded incidentally.

Table 11.2-5. Results of the Spring Seal Survey, 2010

Survey Area	Total Length of Transects Surveyed	Species									Breathing Hole	
		Bearded Seal			Ringed Seal			Unknown Seal				
		#	# / km² On	Inc.[1]	#	#/ km² On	Inc.[1]	#	#/ km² On	Inc.[1]	#	Inc.[1]
Melville Sound	423.3	28	0.07	11	93	0.22	21	10	0.02	56	54	3
Coronation Gulf	270	20	0.07	6	117	0.43	15	13	0.05	113	25	2
Transit to/ from Doris Site	-	0		22	0		122	0		112	0	45
Survey Total		**48**	**0.07**	**39**	**210**	**0.30**	**158**	**41**		**281**	**79**	**50**

[1] Inc. = incidental observation (more than 500 m from the helicopter or during ferry flights) and not included in calculations.

The density of seals in the survey area was 0.43/km^2; 0.30/km^2 for ringed seal and 0.07/km^2 for bearded seal. Ringed seal densities observed during this study were similar to that reported in a study in Bathurst inlet conducted in 2007 (LGL Limited 2007) and in 2012 and 2013 (Rescan 2013a) as well as to those reported during other studies in the Central Arctic and Beaufort Sea (see Table 11.2-4). However, ringed seal densities were lower than those reported in studies conducted in Bathurst Inlet 2013 (Table 12.2-6; Sabina 2015a). Ringed seal density was greater in the Coronation Gulf relative to Melville Sound (Table 11.2-5).

Seals and breathing holes were more frequently observed in upper Bathurst Inlet and in the Coronation Gulf in comparison to areas within Melville Sound (Figure 11.2-5). The highest number of bearded seals per km was recorded on Transect CG3 in the Coronation Gulf (Figure 11.2-5). The highest number of ringed seals per km was also recorded in the Coronation Gulf along Transect CG1 (Figure 11.2-5). The relatively large number of seals of unknown species recorded during the spring seal survey results from seals frequently diving before positive species identification could be made. In addition, many seals were too far from the helicopter to enable positive species identification.

Spring seal surveys indicated that the majority of habitat within the marine wildlife RSA was suitable as moulting habitat for ringed and bearded seals. Only one unidentified seal was observed within the marine LSA; however, no transect lines overlapped with the marine wildlife LSA in Roberts Bay and all observations within the LSA were incidental. In addition, no lairs were documented within the marine wildlife RSA. However, lairs are difficult to detect during aerial surveys as they typically occur near pressure ridges (Chapskii 1940; McLaren 1958; Smith and Stirling 1975).

Summer Marine Mammal Barge Survey

A marine mammal survey was conducted aboard the "Sea Commander" barge on September 10 and 12, 2010, following a transect through the MRSA (Figure 11.2-6) from the Doris North Jetty in Roberts Bay to Cambridge Bay and back. Survey methodology was based on Kenyon (2009) with modifications in regards to survey distance based on Hyrenbach et al. (2007). For each marine mammal observation, the time, GPS location, distance and bearing, group size, species, certainty of identification, and activity (e.g., flying, feeding, resting) were recorded. Weather conditions such as precipitation, visibility, and sea state were recorded.

Few marine wildlife species were recorded during the barge surveys (Figure 12.2-10; Rescan 2011d); two ringed seals, one bearded seal, and one unknown seal (Figure 11.2-6). One ringed seal was recorded at the entrance of Roberts Bay while the other was recorded midway through Melville Sound (Figure 11.2-6). The bearded seal and the unknown seal were both observed at the entrance of Melville Sound (Figure 11.2-6).

Results of the marine barge survey indicate that ringed seals continue to use the marine LSA and RSA during the open water period, likely for foraging. Inuit TK has indicated observations of ringed seals in Bathurst Inlet and Melville Sound during the summer months and even observations of seals following fish up major river systems (Banci and Spicker 2016). Bearded seals are primarily benthic feeders and feed on a variety of small prey found along the ocean floor, including clams, squid and fish. Adults tend to feed in shallow coastal areas no more than 200 m deep (Burns and Frost 1983; Finley and Evans 1983), thus bearded seals are most abundant in areas where they can reach the bottom to feed.

11.2.6.3 Doris Project

Between 1996 and 2004, exploration occurred in the Hope Bay Belt. In 2005, the FEIS for the Doris Project was submitted and a certificate for a two year underground mine was issued in 2006 (Miramar 2005)(Miramar 2005). Construction of the Doris Project began in 2009, but was put into care and maintenance following changes in market conditions in 2010, and was re-opened for additional construction and resource exploration in 2015. To date, the Roberts Bay laydown has disturbed an area of marine beach of approximately 100 m in length, through the use of the area as a barge and boat landing.

Figure 11.2-5
Distribution of Seals and Breathing Holes Observed during Spring Seal Aerial Surveys, June 2010

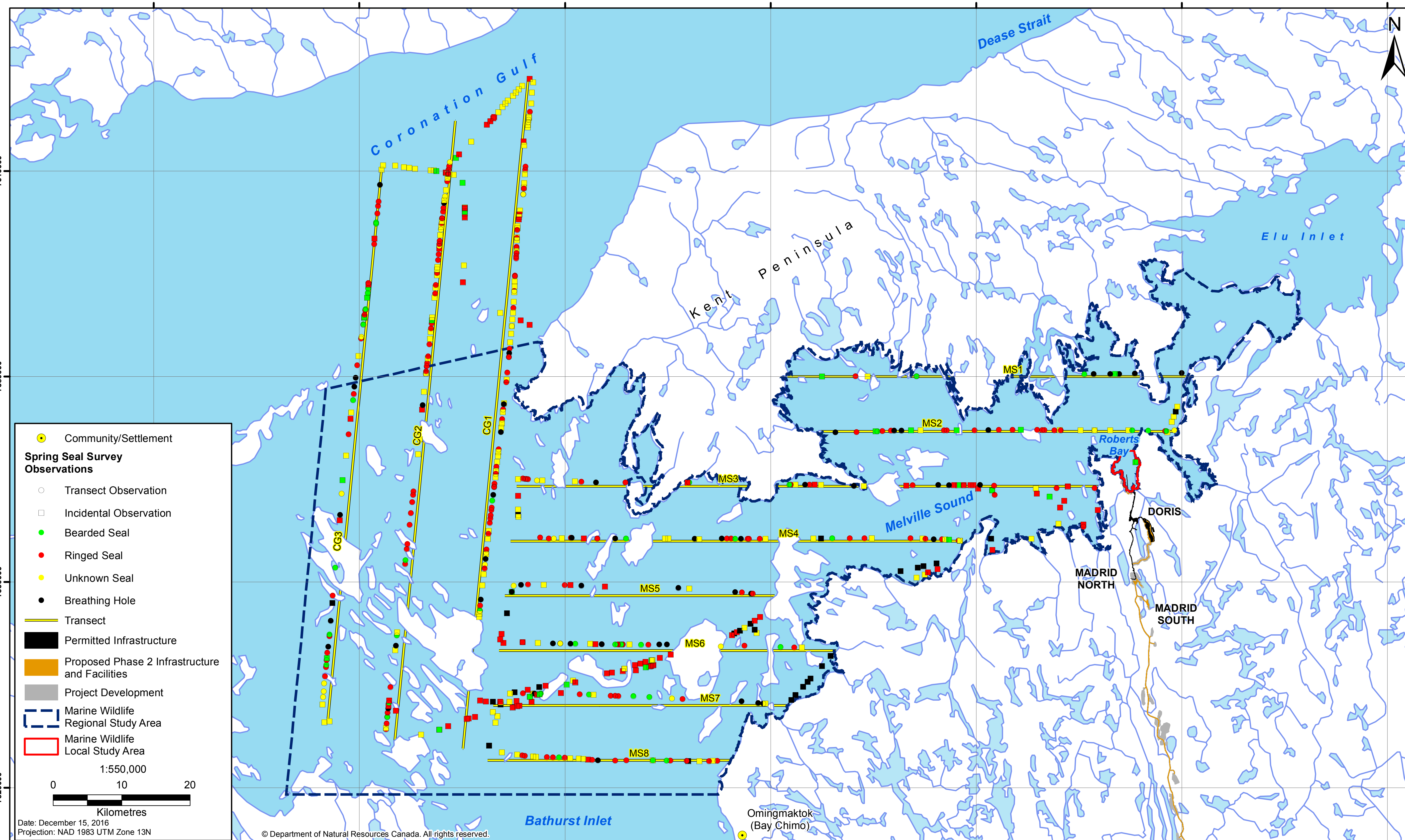
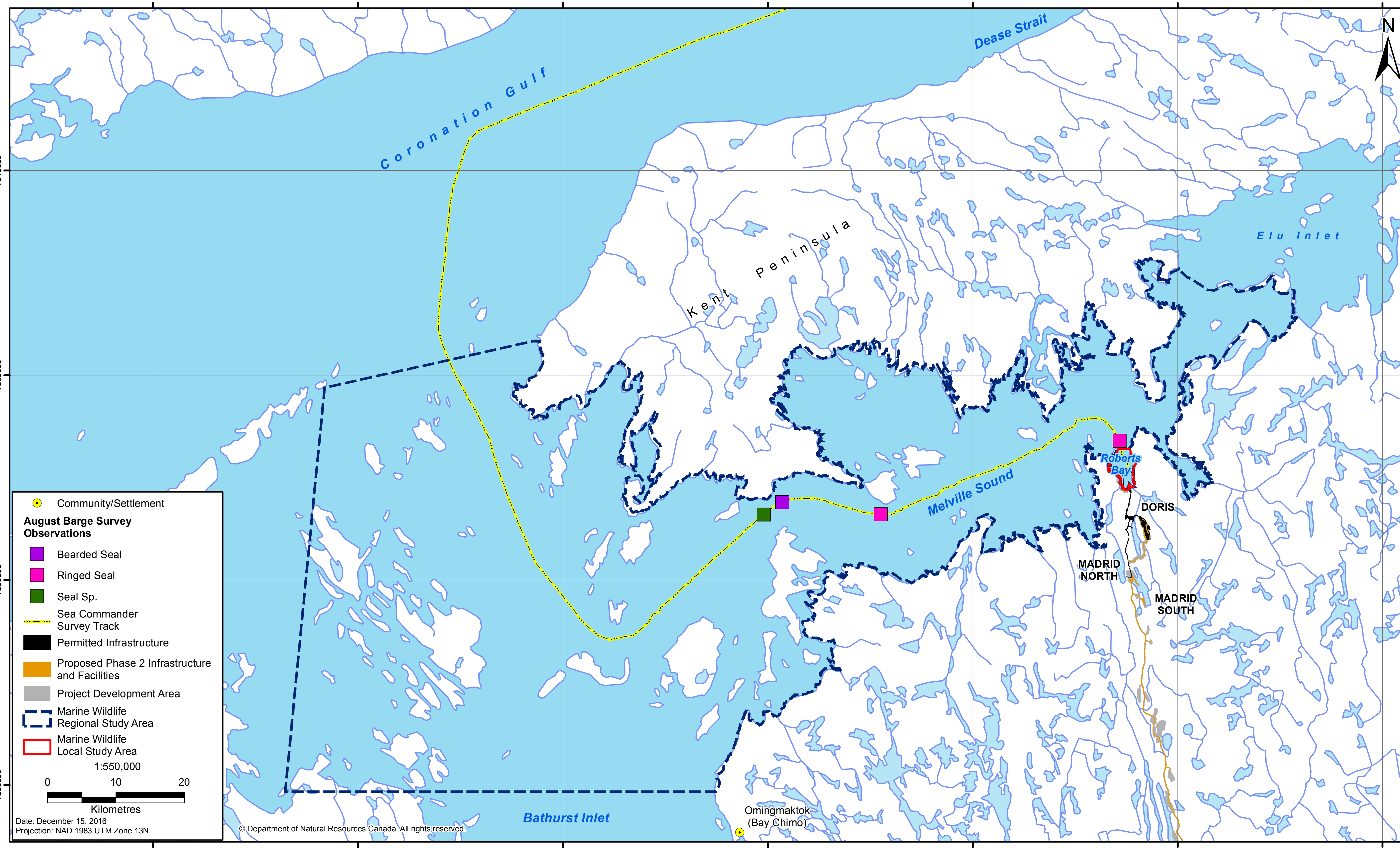


Figure 11.2-6

Marine Mammal Observations Recorded during the Barge Survey, September 2010



The Wildlife Mitigation and Monitoring Plan (WMMP) for the Doris Project included monitoring of marine mammals for potential incidents and mortality through incidental reporting. All project personnel are required to report any wildlife mortality and wildlife incidents to the Doris Project Environment and Social Responsibility (ESR) lead. During the nine years of WMMP program monitoring (2007 to 2016), there have been no reported mortalities of marine mammals due to the Doris Project.

There have been several wildlife incidents involving marine mammals, but none of these incidents resulted in injury or mortality to the animal. On July 22, 2010 a seal was found in a trap net deployed in Roberts Bay during marine fisheries surveys. The seal was able to move freely and breathe from the surface; when discovered, the trap net was cut open to release the seal. On three occasions during May 5 to 7, 2011, a hauled-out seal was moved from the Roberts Bay to Doris camp road and to open water. Land users on site speculated that the seal was using the road surface as a movement corridor to inland lakes or was curious about the Doris Project.

11.2.7 Characterization of Baseline Conditions for Marine Birds

For the purposes of this assessment, "marine birds" or "seabirds and seaducks" is used as a collective term to describe all migratory bird species that may use marine areas during any time of the year. As such, seabirds and seaducks encompass a very diverse group of avian species, from eider ducks and scoters that have a strong association with marine habitats through the breeding, staging, and migration periods, to geese, dabbling ducks, and other diving ducks that may only use marine habitats during the staging and migration periods. Several of the species in the latter category are also considered to be migratory waterbirds (Volume 4, Section 9), as they breed in terrestrial habitats rather than marine. The seabirds and seaducks assessment only considers potential effects of the Project to species using marine habitats for breeding and staging surrounding the Project.

Seabirds and seaducks, and their nests are protected by the federal *Migratory Birds Convention Act* (1994), which prohibits killing migratory birds and their eggs, taking their nests, and also prohibits the deposition of harmful substances in areas frequented by migratory birds (which include seabirds and seaducks). In addition, seabirds and seaducks in Nunavut are protected under the *Nunavut Wildlife Act* (2003), which prohibits destruction of bird nests when these are being used for breeding by birds, as well as disturbance to a 'substantial number' of birds, such as to flocks of birds that amass during the spring and fall staging periods.

A total of 26 species which use marine habitats have the potential to occur within the marine RSA (Table 11.2-6) including 5 species of geese and swans, 11 species of ducks and seaducks, 3 species of loons, and 7 species of gulls. Two species potentially occurring in the wildlife RSA are listed on Schedule 1 (Table 11.2-6) under the federal Species at Risk Act (SARA): Ross's gull (*Mouette rosee*), listed as "Threatened" and Ivory gull (*Pagophila eburnean*), listed as "Endangered". However, based on species ranges, both of these species are considered to have a rare occurrence in the RSA and are considered migrants.

Four Ross's gull nesting locations of have been documented in Canada; three are in Nunavut (Cheyne Islands, and Penny Strait, both located north of the marine RSA, and Prince Charles Island in Foxe Basin, east of the marine RSA), and one located near Churchill, Manitoba (COSEWIC 2007). Ivory gull colonies are concentrated around Jones and Lancaster sounds on southeastern end of Ellesmere Island, eastern Devon Island, and the Brodeur Peninsula of northern Baffin Island (COSEWIC 2007), all located north of the marine RSA. However, some of these areas are located on the Northwest Passage shipping route that is currently used for the Hope Bay Project.

Table 11.2-6. Seabird Species Potentially Occurring in Marine Wildlife RSA and their Conservation Status

Common Name	Scientific Name	Regularity of Occurrence	Detected during Marine Baseline Studies*	Timing of Occurrence	Conservation Status				
					NU Rank	COSEWIC	SARA	Global Rank	IUCN Red List*
Geese and Swans									
Tundra Swan	*Cygnus columbianus*	Regular	Y	Breeding	Secure			G5	LC
Canada Goose	*Branta canadensis*	Regular	Y	Breeding	Secure			G5	LC
Greater White-fronted Goose	*Anser albifrons*	Regular	Y	Breeding	Secure			G5	LC
Brant	*Branta bernicla*	Regular	N	Migrant	Secure			G5	LC
Snow Goose	*Chen caerulescens*	Regular	N	Migrant	Secure			G5	LC
Loons									
Red-throated Loon	*Gavia stellata*	Regular	Y	Breeding	Secure			G5	LC
Pacific Loon	*Gavia pacifica*	Regular	Y	Breeding	Secure			G5	LC
Yellow-billed Loon	*Gavia adamsii*	Regular	Y	Breeding	Secure	NAR		G4	LC
Seaducks									
King Eider	*Somateria spectabilis*	Regular	Y	Breeding	Sensitive			G5	LC
Common Eider	*Somateria mollissima*	Regular	Y	Breeding	Sensitive			G5	NT
Surf Scoter	*Melanitta perspicillata*	Rare	Y	Migrant	Undetermined			G5	LC
White-winged Scoter	*Melanitta fusca*	Rare	Y	Migrant	Undetermined			G5	LC
Black (American) Scoter	*Melanitta nigra*	Rare	N	Migrant	Undetermined			G5	LC
Long-tailed Duck	*Clangula hyemalis*	Regular	Y	Breeding	Sensitive			G5	LC
Greater Scaup	*Aythya marila*	Regular	Y	Breeding	Secure			G5	LC
Northern Pintail	*Anas acuta*	Regular	Y	Breeding	Secure			G5	LC
Red-breasted Merganser	*Mergus serrator*	Regular	Y	Breeding	Secure			G5	LC
Thick-billed Murre	*Uria lomvia*	Rare	N	Migrant	May be at risk			G5	LC
Common Murre	*Uria aalge*	Rare	Y	Migrant	No Rank			G5	LC

Common Name	Scientific Name	Regularity of Occurrence	Detected during Marine Baseline Studies*	Timing of Occurrence	Conservation Status				
					NU Rank	COSEWIC	SARA	Global Rank	IUCN Red List*
Gulls and Terns									
Herring Gull	*Larus argentatus*	Regular	Y	Breeding	Secure			G5	LC
Glaucous Gull	*Larus hyperboreus*	Regular	Y	Breeding	Sensitive			G5	LC
Sabine's Gull	*Xema sabini*	Rare	N	Breeding	Secure			G5	LC
Thayer's Gull	*Larus thayeri*	Rare	N	Breeding	Sensitive			G5	LC
Arctic Tern	*Sterna paradisaea*	Regular	N	Breeding	Sensitive			G5	LC
Ross's Gull[1]	*Rhodostethia rosea*	Rare	N	Migrant	At Risk	Threatened	Schedule 1	G3G4	LC
Ivory Gull[1]	*Pagophila eburnean*	Rare	N	Migrant	At Risk	Endangered	Schedule 1	G5	NT

**LC = Least Concern; NT = Near Threatened.*

[1] *The only known nesting colonies of Ross's and ivory gull are located over 800 km to the north of the Project in the Barrow Strait and Lancaster Sound area (Mallory and Fontaine 2004; COSEWIC 2006, 2007).*

In addition to species listed under SARA, the following seabird and seaduck species are listed under the Canadian Endangered Species Conservation Council (CESCC) for Nunavut: Ross's gull and Ivory gull listed as "At Risk", thick-billed murre listed as "May be At Risk", and king eider, common eider, glaucous gull, Thayer's gull, and long-tailed duck listed as "Sensitive" (CESCC 2010). Species designated as "Sensitive" by CESCC rankings are species that may require special attention to prevent population declines (CESCC 2010). Of the species listed under the CESCC designations for Nunavut, the thick billed murre, king eider, common eider, glaucous gull and Thayer's gull breed in marine habitat. However, similar to Ross's gull and Ivory gull, based on the species range, the thick billed murre are considered to have a rare occurrence in the RSA and is considered a migrant in the area. Common eider (the Pacific common eider subspecies), glaucous gull and Thayer's gull have the potential to breed in the marine RSA. King eider, primarily breeds north west of the Project near Victoria and Banks Island (Dickson 2012a). The long-tailed duck is frequently observed in the marine habitat during staging periods, but commonly breeds in the terrestrial freshwater environment.

11.2.7.1 Marine Birds

<u>Population Trends and Conservation</u>

Regulatory organizations that track and assign conservation status based on population trends and other criteria for seabirds and seaducks include the North American Waterbird Conservation Plan (Kushlan et al. 2002), the North American Waterfowl Management Plan (North American Waterfowl Management Plan (NAWMP) 2004), and the Sea Duck Joint Venture Strategic Plan (Sea Duck Joint Venture Management Board 2008). This section focuses on the population trends and conservation of species of concern listed as sensitive in Nunavut that regularly occur within the RSA and nest in marine habitats (common eider, Thayer's gull, and glaucous gull).

Common eiders nesting in the western and central Arctic declined by more than 50% from 1976 to 1996, based on spring migration counts in Alaska (Goudie, Robertson, and Reed 2000; Suydam et al. 2000). More recent spring migration counts (2002 and 2003) suggest that common eider populations may be stabilizing and possibly rebounding (Suydam et al. 2009). However, the local population of Pacific common eider in Bathurst Inlet still seem to be experiencing a population decline. Between 1995 and 2008 the number of Pacific common eider breeding in Bathurst Inlet area declined by an additional 43 to 50% from almost 17,000 (Cornish and Dickson 1997) to less than 10,000 individuals (Raven and Dickson 2009).

The population status of Thayer's gull in Canada, is likely unchanged since the 1970s (Environment Canada 2011b). However, since Canada hosts a large percentage of the global breeding population of Thayer's gull (more than 80 % of global population) with approxiately 10,000 to 25, 000 breeding birds, the conservation of this species is of very high priority (Environment Canada 2011b).

The population status of glaucous gull in Canada has likely modelerately decreased in abundance since 1970 (Environment Canada 2011a). However, pouplation data from much of the species' range is lacking. The population estimate in Canada is approximately 25,000 to 50,000 breeding birds which constitues less than 20 % of the global population. Thus, while the population in Nunavut is considered sensitive (CESCC 2011), the conservation priority status in Canada is considered low (Environment Canada 2011a).

Many breeding areas and marine staging areas (used for moulting or foraging) are identified as Key Terrestrial Habitat Sites (KTHSs) and Key Marine Habitat Sites (KMHSs) for migratory birds by the Canadian Wildlife Service (Mallory and Fontaine 2004; Latour et al. 2008), or are designated as Important Bird Areas (IBAs) by partnership of conservation organizations including Bird Studies Canada, Nature Canada, and Birdlife International (IBA 2012b; Environment Canada 2014). The marine wildlife

RSA falls within the Bathurst Inlet and Elu Inlet KMHS. This area was designated as a KMHS as it hosts greater than 10% of the Canadian population of common eider and Thayer's gull which is greater than the percentage of 'sustainable loss' that the population of common eider can tolerate (estimated sustainable loss for common eider is 8 to 9% of the population; Environment Canada 2014).

Habitat Use

A variety of terrestrial and marine nesting and moulting habitat are used by various species of seabirds and seaducks. This section focuses on the habitat use of species of concern listed as sensitive in Nunavut that regularly occur within the RSA and nest in marine habitats (common eider, Thayer's gull, and glaucous gull).

Pacific common eider are predominately associated with marine habitats throughout the year, spending little more than a month in terrestrial areas to nest (Dickson 2012b). For Pacific common eider, small, coastal islands are important nesting habitat (Goudie, Robertson, and Reed 2000; Dickson 2012b). For the remainder of the year, which encompasses the annual migrations (including staging), moulting, and wintering periods, Pacific common eider are found in marine habitats. During these times, habitat use appears to be concentrated in productive habitats with access to food. For example, Dickson (2012b) suggests that moult sites for Pacific common eider are likely selected because they provide shelter, protection from predators, and an abundance of food required to replace flight feathers.

Thayer's and glaucous gulls utilize a variety of coastal terrestrial and marine environments across the year. Both species nest in coastal terrestrial environments; typical nesting habitats is tall, coastal cliffs (including those located on islands) and other areas of steep topography near coasts that provide protection from terrestrial predators (such as foxes; Snell 2002; Weiser and Gilchrist 2012). Nesting areas for both species are rarely located far inland; however, nesting habitats for glaucous gull have also been documented on islands of freshwater lakes, where they may find protection from predators (Weiser and Gilchrist 2012). Outside of the nesting season, Thayer's and glaucous gulls are dispersed across coastal and marine habitats used for feeding and resting. During migrations, glaucous gull travel along coastlines and are rarely recorded in offshore areas, whereas Thayer's gull may utilize both near shore and offshore environments during annual migrations (Snell 2002; Weiser and Gilchrist 2012).

Distribution and Migration

Seabirds and seaducks are generally present in the Arctic from May through October, with variation amongst species in the lengths of time spent on their breeding grounds along the coasts of the Arctic. The spring migration period spans from May through early June, while the fall migration period spans from August through October (Mallory and Fontaine 2004). Nesting is generally initiated by June and seabirds spend one to two months following nesting raising their young, after which they move to marine staging areas to moult and gain resources for the upcoming migration. This section outlines the distribution and migration patterns specific to species of conservation concern listed as sensitive in Nunavut that regularly occur within the RSA and nest in marine habitats (common eider, Thayer's gull, and glaucous gull).

The Bathurst Inlet and Elu Inlet KMHS, which overlaps with the marine RSA, and the associated KTHS that encompasses many of the island chains in northern Bathurst Inlet and Elu Inlet to the east, including small islands within Parry Bay and Melville Sound, are important breeding areas for Pacific common eider and for supporting colonies of other seabirds such as glaucous gulls and Thayer's gull (Hoover, Dickson, and Dufour 2010; Dickson 2012b).

The Pacific common eider in the marine RSA primarily belong to the Nauyak Lake nesting colony located just off of Parry Bay on the Kent Peninsula (Dickson 2012b). At least 9,000 individuals breed in this area and the general area including Victoria Island, Bathurst Inlet, Elu Inlet, and the central Queen Maud Gulf support more than 80% of Canada's population of common eiders (Dickson et al. 2005). In addition to breeding, the islands in Parry Bay just south and west of the Nauyak Lake nesting colony, represent an important moulting location especially for female eiders with fewer females staging in Melville Sound, while males staged in Bathurst Inlet, Dolphin and Union Strait, Cape Parry and Cape Bathurst on the eastern portion of the fall migration route (Dickson 2012b). The timing of use and movements to and from these moulting and staging areas differs between males and females. Male common eider typically move from breeding areas to moult and stage for the fall migration in early July; moulting areas are utilized from mid-July through mid-October depending on location. Males that moult in Bathurst Inlet within the marine RSA use the area from late July through early October, after which they will depart to the west for wintering areas outside the marine RSA (Dickson 2012b). In contrast, females use habitats in Parry Bay and Melville Sound for moulting and staging from late July through mid- to late October (Dickson 2012b), departing to the west at a time when ice formation in marine habitats begins. Individuals breeding in the Nauyak Lake nesting colony typically return to marine habitat within the marine RSA in the spring in early June (Dickson 2012b), after which they return to terrestrial nesting areas.

Traditional Knowledge supports these observations on the distribution of eiders; Inuit have commented on the abundance of eider ducks in the Elu inlet area near the island chains at the mouth of Bathurst Inlet, where they hunt for eiders in the spring (Banci and Spicker 2016). Eiders are an important species to local Inuit, as they are hunted as a food source by coastal Inuit on islands within Melville Sound and Elu Inlet (Banci and Spicker 2016) in the marine RSA as well as on the Kent Peninsula (Banci and Spicker 2016).

There are no identified nesting colonies of Thayer's or glaucous gull within the marine RSA. These two species are thought to be relatively widely distributed in the marine RSA, utilizing suitable rocky and rugged coastlines for nesting and rearing of young from May to August. Of the two species, Thayer's gull appear to arrive to breeding sites earlier (early May) than glaucous gull (late May) (late May; Snell 2002; Weiser and Gilchrist 2012). Following the fledging of young in late August, Thayer's or glaucous gull begin their fall migration and move westward along the coasts toward wintering grounds in Alaska and off the West Coast (Snell 2002; Weiser and Gilchrist 2012).

11.2.7.2 Baseline Information on Seabirds and Seaducks

Baseline data collection for seabirds and seaducks in the RSA included:

- aerial surveys conducted in spring and summer from 2006 to 2015 for detection of waterbirds on coastal transects in the Roberts Bay survey block and Doris North Survey block;
- dedicated seabird surveys conducted in July and August of 2009 and 2010 in a survey block covering Hope Bay, Roberts Bay and Reference;
- seabird Barge survey conducted in September 2010 in Melville Sound, upper Bathurst Inlet, and the Coronation Gulf; and
- seabird nest surveys conducted in 2006, 2009 and 2010 on small islands (<20 ha) within and surrounding Reference Bay, Roberts Bay, and Hope Bay.

Of the species with potential to occur in the marine RSA, a total of 17 species have been observed from 2006 to 2015 within the RSA including four species listed as sensitive in Nunavut (king and common eider, glaucous gull, and long-tailed duck; Table 11.2-6). The following assessment includes those species that have been documented in marine habitats during surveys conducted for the Project within the marine wildlife RSA (Section 11.2.7.5). Potential effects to this species group will vary temporally as fewer species are expected to use marine habitats during the nesting and brood-rearing period as compared to migration periods. Additional seabird and seaduck species occur outside of the marine wildlife RSA; these species are not considered within the effects assessment but are summarized in Section 11.2.1.

Aerial Surveys over Marine Areas

Pair and Brood Coastal Surveys

Aerial surveys for waterbirds and seabirds were conducted between 2006 and 2015. Surveys were conducted in early and late summer during all years between 2006 and 2015 (Table 11.2-7). These surveys were conducted as part of the waterbird pair (late-June/early-July) and brood (late-July/ early-August) surveys flown over the Roberts Bay and the Doris survey blocks (Volume 4, Section 9, Section 9.2.5.8). Transects within each of these survey blocks were 16 km long oriented in an east-west direction, and spaced 2 km apart. Each survey block contained six transects. However, only transects that covered marine areas were considered for the seabird data summary. This included five transects from the Roberts Block (R2 to R6) and three transects from the Doris Block (D6 to D8).

Table 11.2-7. Survey Timing of Pair and Brood Surveys, 2006 to 2015

Year	Pair Survey	Brood Survey
2006	June 21 to 28	August 9
2007	June 27	August 6
2008	July 5	July 29 and 30
2009	July 7	July 27 and 28
2010	July 6	July 27 and 28
2011	July 7	July 27 and July 28
2012	June 22	August 4
2013	June 12 to 22	August 4 and 5
2014	June 21	July 27 and 28
2015	June 24 and 25	August 4 and 5

Transects were flown by helicopter, flying an average of 80 to 100 km/h at 45 m altitude. Surveyors recorded waterfowl within 400 m on either side of the aircraft, yielding an 800 m-wide belt transect during the pair surveys and within 200 m on either side of the aircraft, yielding a 400 m-wide belt transect during the brood surveys. Waterbirds observed over terrestrial habitat on these transects were also removed from the data summary. Marine bird data reported in Section 11.2.7.5 includes only observations that were observed in marine habitat or the shoreline of the coastal mainland defined by a 100 m buffer inland from the shore. Waterbird data reported on marine islands were included as marine observations and reported in this Section. Observations of waterbirds during surveys conducted between 2006 and 2015, occurring in terrestrial habitat, are summarized in the Terrestrial Wildlife Section (Volume 4, Section 9, Section 9.2.11.5).

Overall, a total of 369 waterbirds were observed in marine habitats during the waterbird surveys conducted between 2006 and 2015. A greater number of seabirds and seaducks were detected in marine habitat during the brood surveys (231 individuals) relative to pair surveys (138 individuals). Glaucous gulls were the most commonly detected species during surveys accounting for a little over a quarter of the seabirds and seaducks detected (97 individuals), followed by red-breasted mergansers (54 individuals), Pacific loons (38 individuals), herring gulls (29) and common eiders (22 individuals) (Figure 11.2-7). An additional 12 eider were detected that could not be identified to species and were most likely common eider. Waterbirds were most abundant during surveys conducted in 2010, and species richness was also highest during this year (Figure 11.2-8).

During the pair surveys, conducted in late June early July between 2006 and 2015, a total of 138 waterbirds were observed in marine habitats. The most commonly detected species were Pacific loon (24 individuals), glaucous gull (17 individuals), common eider (13 individuals), long-tailed duck (12 individuals), and red-breasted merganser (11 individuals) and (Figure 11.2-7). The total number of seabirds and seaducks detected in marine habitat, were highest in 2010 (37 birds) and lowest in 2007 with no birds detected in the marine RSA during the pair survey (Figure 11.2-8). Species richness was highest in 2010 and 2015 with 11 species detected during pair surveys and lowest in 2007 with no species detected in marine habitats (Figure 11.2-8).

During the brood surveys conducted in late-July early August between 2006 and 2015, a total of 231 waterbirds were detected in marine habitats. The most commonly detected species were glaucous gull (80 individuals), red-breasted merganser (43 individuals), herring gull (24 individuals), Pacific loon (14 individuals), and Canada goose (12 individuals; Figure 11.2-7). A large number of eider were also detected (19 individuals), although approximately half (10 individuals) could not be identified to species. Total number of seabirds and seaducks detected in marine habitat within the survey area, were highest in 2010 (51 birds) and lowest in 2007 when no birds were detected (Figure 11.2-8). Across brood surveys, species richness was highest in 2010 with a total of 11 species detected and lowest in 2007 when no species were detected in marine habitats (Figure 11.2-8).

Dedicated Seabird Surveys

In 2009 and 2010, seabird specific surveys were conducted in the marine areas surrounding Hope Bay, Roberts Bay and Reference Bay. Marine transects from the northern survey block (Roberts Bay Block) and the northern three transects (D6, D7, and D8) of the Doris Block used for waterbird surveys were extended to the west to include greater coverage of the marine areas and islands in Hope Bay (Figure 11.2-7). In addition, two additional transects were added to the north side of the Roberts Bay Block (Figure 11.2-7) to include greater coverage of Reference Bay as well as a part of Melville Sound at the entrances of Hope Bay, Roberts Bay and Reference Bay (Rescan 2010, 2011a).

Overall, the dedicated seabird survey block contained 11 transects spaced 2 km apart running in an east-west direction. The eight northern-most transects were 23 km long while the three southern transects designed to survey lower Hope Bay were 17.5 km long. Surveys were carried out using a helicopter travelling at a speed of 80 to 100 km/h and from an altitude of 45 m, with observers recording seabirds within 200 m on either side of the aircraft for a transect width of 400 m. Although land-based birds were counted while travelling over the terrestrial habitat, results herein only consider seabird observations made in the marine environment. The total survey area for each inlet and its overall coverage with respect to the entire survey block is shown in Table 11.2-8.

Table 11.2-8. Transect Characteristics of Dedicated Seabird Surveys in 2009 and 2010

Basin	Area[1] (km^2)	Transect Length[2] (km)	Transect Area[3] (km^2)	Transect Coverage (%)
Roberts Bay	39.8	32.7	13.1	32.9
Hope Bay	80.5	45.4	18.2	22.6
Reference Bay	57.2	23.5	9.4	16.4

[1] *Total survey area for each inlet.*
[2] *Total added length of transects within each survey area.*
[3] *Total Area surveyed within each survey area based on observation of seabirds 200 m on either side of the transects.*

Seabird Species Abundance during Pair and Brood Waterbird Surveys, 2006 to 2015

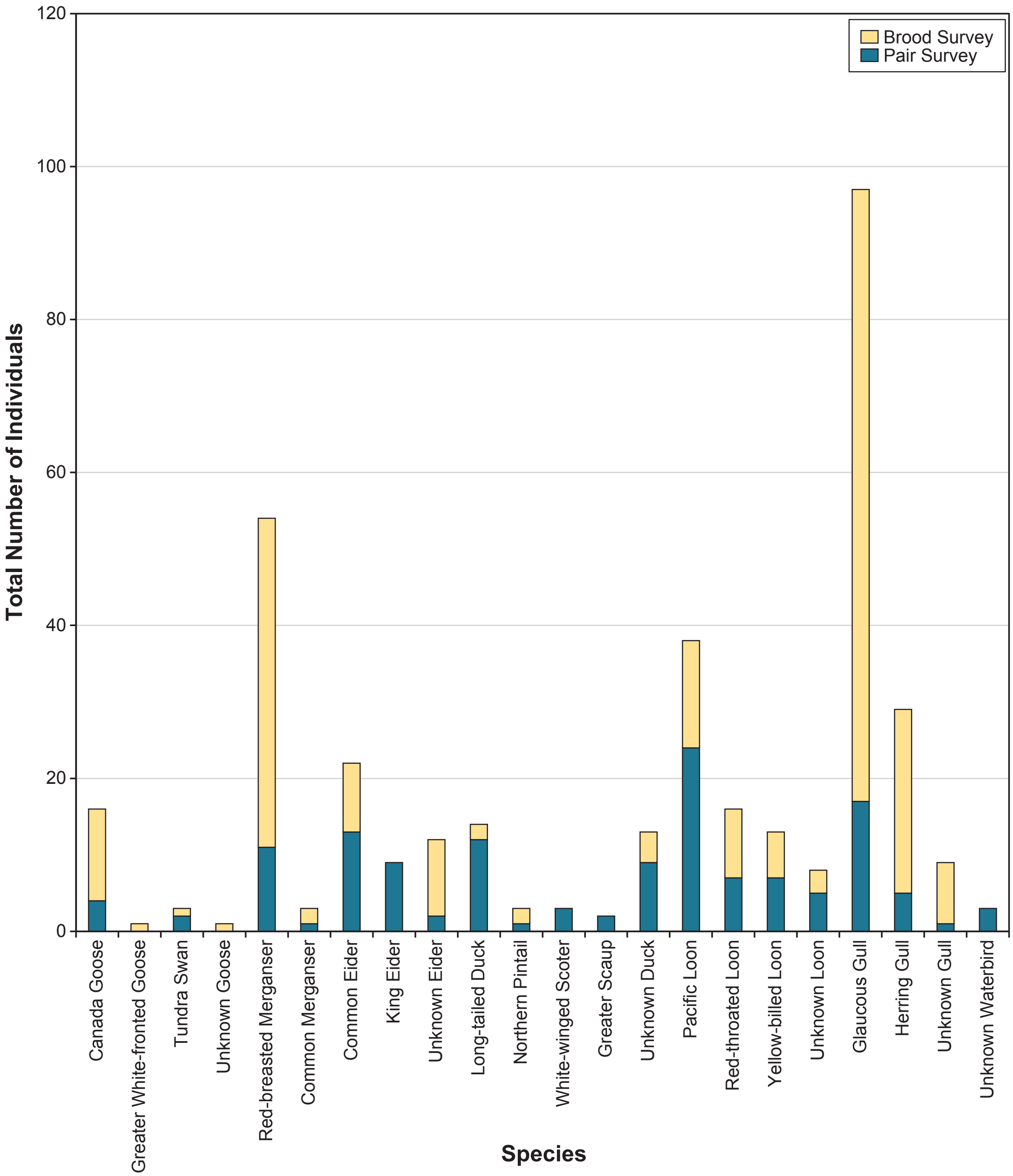
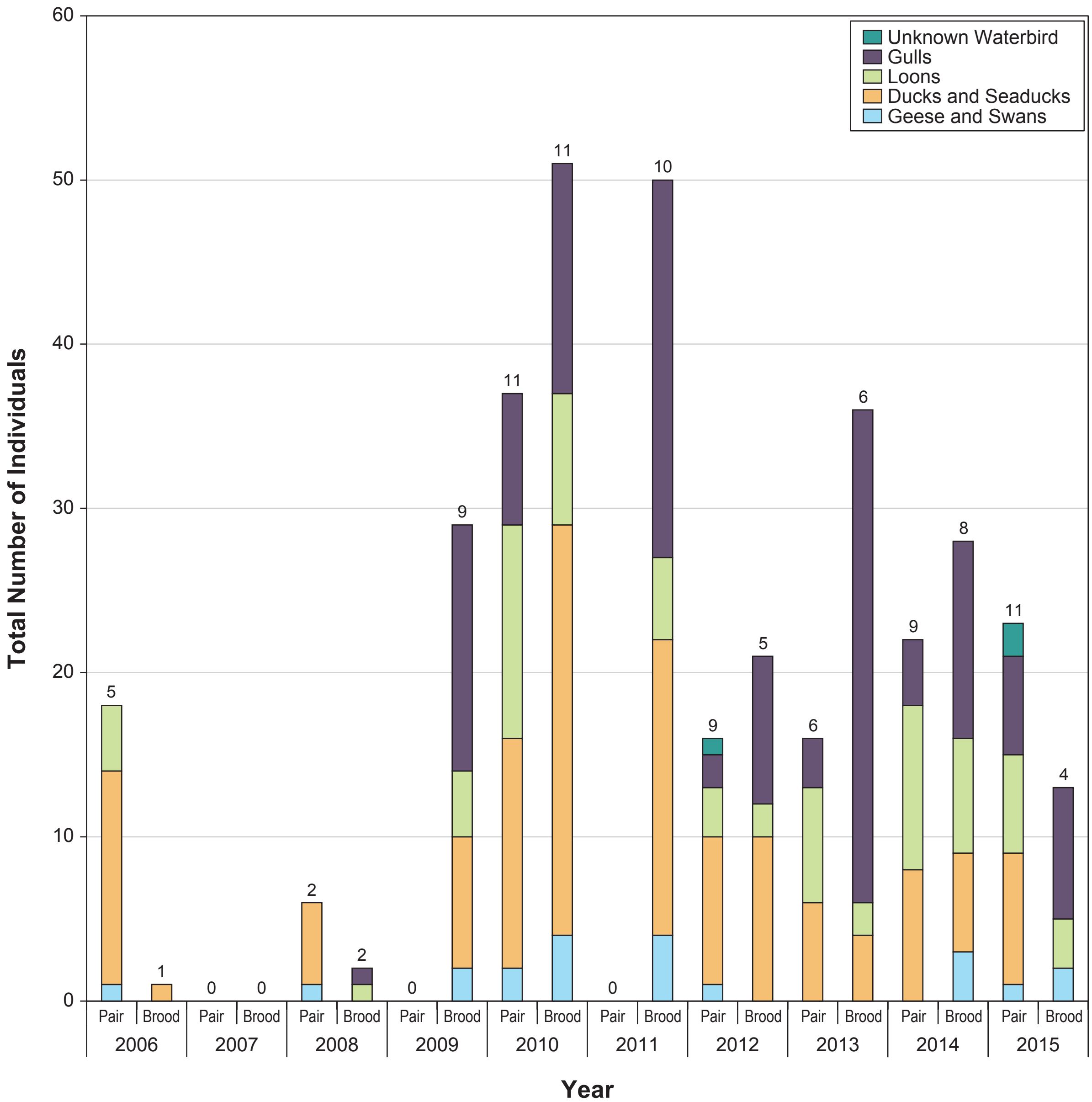


Figure 11.2-8

Annual and Seasonal Variation in Seabird Abundance and Species Richness, 2006 to 2015



Surveys were timed to coincide with two important periods: the northern migration/establishment of nesting territories in July (early summer) and the brood rearing/fall staging period in August (late summer). In 2009, one survey was conducted during the early summer period on July 13, and five surveys were conducted during the late summer period on August 15, 18, 21, 22, and 23. In 2010, three surveys were conducted during the early summer period on July 10, 11, and 28, and four surveys were conducted during the late summer period on August 14, 17, 21, and 24.

During the early summer seabird survey conducted in 2009, ten species of seabirds totalling 246 individuals were observed (Table 11.2-9). The most abundant seabirds were: long-tailed ducks (85 individuals), Pacific loons (56 individuals), common eiders (44 individuals), and red-breasted mergansers (26 individuals; Table 11.2-9). The majority of these seabirds were observed in close proximity to islands or the mainland. In 2010, eight species of seabirds totalling 346 individuals were observed (Table 11.2-9). The most abundant species observed during these surveys were: herring gull (94 individuals), red-breasted merganser (78 individuals), glaucous gull (56 individuals), common eider (42 individuals), and Pacific loon (36 individuals; Table 11.2-9). While a greater total number of individuals were observed during the 2010 surveys relative to 2009, the average number of birds per survey was higher (1.5 times higher; Table 11.2-9) in 2009 as the average number of birds detected during the surveys conducted in 2010 was 108 ± 27.4.

During the late summer seabird survey conducted in 2009, a total of 10 species (average of 5.8 species per survey) totalling 367 individuals (average of 73.4 individuals per survey) were detected (Table 11.2-9). The most abundant species observed were: Pacific loon (117 individuals), red-breasted merganser (82 individuals), glaucous gull (50 individuals), long-tailed duck (34 individuals) and common eider (27 individuals; Table 11.2-9). In 2010, a total of eight species (average of 7.3 species per survey) totalling 624 individuals (average of 156 individuals per survey) were detected (Table 11.2-9). The most abundant species observed were: herring gull (222 individuals), glaucous gull (125 individuals), red-breasted merganser (125 individuals), common eider (106 individuals) and Pacific loon (31 individuals). No broods were observed during any of the surveys conducted in either 2009 or 2010.

During both years of dedicated seabird surveys, temporal and spatial differences were observed in seabird observations. During the early summer surveys, Roberts Bay had the highest abundance of waterbirds relative to Hope Bay and Roberts Bay, and abundance was greater in 2009 relative to 2010 (Table 11.2-9). During the late summer surveys, abundance was highest in Reference Bay in 2009 (30.8 ± 15.7) and Hope Bay in 2010 (110 ± 15.4) and overall abundance was greater in 2010 (156 ± 23.1) relative to 2009 (69.4 ± 26.4). The total number of birds in Hope Bay ranged from 72 to 208 in July, and from 138 to 440 in August. In Reference Bay, the number of individual birds ranged from 41 to 71 in July and from 150 to 154 in August. Roberts Bay had the most variable number of birds recorded: from 45 to 133 in July and from 34 to 75 in August.

In 2010, mean species richness was consistently highest in Hope Bay (5.7 ± 0.7 in July and 5.3 ± 0.8 in August); species richness was more variable at Reference Bay (3.0 ± 0.6 in July and 5.0 ± 0.7 in August), and Roberts Bay (6.0 ± 0.8 in July and 3.3 ± 1.0 in August). The numbers of species observed in each inlet in August, 2010 are similar to those recorded in August, 2009. However, in July 2009, both the average number of birds recorded per survey and richness of Roberts Bay was higher than those recorded in either Reference Bay or Hope Bay.

Flocks of Seabirds Observed During Aerial Surveys

During both the pair and brood coastal surveys and the dedicated seabird surveys, flocks of seabirds were mapped within the RSA to identify potential staging areas used by seabirds during the summer months (Figure 11.2-5). Flock of seabirds were identified as groups of birds consisting of greater than 10 individuals, and categorized as small sized flocks (11 – 24 individuals), medium sized flocks (25 – 49 individuals), medium-large sized flocks (50 – 100 individuals) and large sized flocks (> 100 individuals).

The majority (94%, n=64) of flocks observed (n=68) consisted of small flocks (11 to 24 birds) and medium flocks (25 to 49 birds). Larger flocks of birds (>50 individuals) were rarely observed during surveys conducted within the marine RSA, accounting for only 6% of the flocks observed. Large flocks that were observed consisted of a flock of long-tailed duck (85 individuals) observed in mid-July of 2009 off the northern tip of the peninsula separating Hope Bay and Roberts Bay, a flock of herring gulls (50 individuals) observed in both mid-July and mid-August of 2010 off an island north of Hope Bay and a flock of common eider (172 individuals) observed in late June of 2014 in a small patch of open water on the northern tip of the peninsula separating Hope Bay and Roberts Bay (Figure 11.2-9). In general, flocks of seabirds were concentrated around the shoreline and islands within the marine RSA.

<u>Summer Seabird Barge Survey</u>

A seabird barge survey was conducted in conjunction with the summer marine mammal survey aboard the *Sea Commander* vessel from September 10 to 12, 2010 (see Section 11.2.6.5 for survey details). Surveys were conducted on a barge following a single transect in the marine wildlife RSA (Figure 11.2-10).

During the barge survey, relatively few seabird and seaduck species were observed in the water (Figure 11.2-10). Two seabird species were recorded in the water during the summer seabird barge survey in September 2010; common murres and Pacific loons along with one seaduck; long-tailed duck (Figure 11.2-10). In addition, unknown loons and unknown gulls were observed. These unknown birds could belong to the several gull and loon species known to occur in the area.

Two common murres were observed near the narrow entrance into Melville Sound (Figure 11.2-10). Two Pacific loons were observed in the same general area as the common murres. A third Pacific loon was observed in upper Bathurst Inlet, along with the unknown species of gulls (Figure 11.2-10). Additional seabirds including common murre, Pacific loon, Thayer's Gull, glaucous gull and unidentified species of loon and gulls were observed flying in the RSA during the survey.

<u>Seabird Nest Surveys</u>

Ground-based searches for nesting seabirds were conducted in July 2006, July 2009, and July 2010 on islands smaller than 20 ha (Golder 2007; Rescan 2010, 2011a). Past surveys conducted in the region reported that common eider nest colonies with the greatest number of nests occurred on small islands less than 5 ha in size (Cornish and Dickson 1997). Thus, islands less than 20 ha were determined to have the greatest potential for supporting eider nests. A total of 13 islands were surveyed in 2006; 12 in Hope Bay and 1 in Roberts Bay. In 2009 and 2010, all three inlets were surveyed. Out of a possible 91 islands under 20 ha in size in the inlets, 41 and 87 islands were surveyed in 2009 and 2010, respectively. A map of the islands in the Madrid-Boston Project area is presented in Figure 11.2-11.

In 2006, two people spaced approximately 10 m apart systematically searched the entire area of each island and recorded nests, species, and clutch size. During the 2009 and 2010 surveys, all islands were accessed by helicopter from July 10 to July 15 (2009) and July 19 to July 23 (2010), except when the topography or small size of the island prevented a safe landing. When safe landing was possible, two or three people spaced approximately 20 m apart walked transects until the entire island was covered. A final transect of the perimeter of each surveyed island was also conducted and all vegetation patches were thoroughly examined. All nests, species, and clutch sizes were noted and additional incidental observations of birds in flight or on the water were also recorded. When landing was not possible, the perimeter of the island was circled by helicopter and seabird observations were recorded.

Table 11.2-9. Marine Bird Abundance and Species Richness during Seabird Bird Surveys, 2009 to 2010

Species	July 2009[1]				August 2009[1]				July 2010[1]				August 2010[1]			
	Hope Bay	Reference Bay	Roberts Bay	Total	Hope Bay	Reference Bay	Roberts Bay	Total	Hope Bay	Reference Bay	Roberts Bay	Total	Hope Bay	Reference Bay	Roberts Bay	Total
Geese and Swans																
Canada Goose	0	0	0	0	0	0	18	18	0	0	0	0	0	0	0	0
Tundra Swan	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0
Diving Ducks																
Common Eider	39	0	5	44	8	11	8	27	32	9	1	42	70	31	5	106
King Eider	0	0	0	0	0	0	0	0	8	0	0	8	0	3	0	3
Greater Scaup	0	0	3	3	0	0	0	0	0	0	0	0	0	0	0	0
Long-tailed Duck	0	0	85	85	4	30	0	34	0	0	0	0	0	0	0	0
Red-breasted Merganser	16	8	2	26	61	17	4	82	34	17	27	78	80	42	3	125
White-winged Scoter	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Loons																
Pacific Loon	13	24	19	56	27	64	26	117	21	7	8	36	11	17	3	31
Red-throated Loon	0	0	1	1	3	0	0	3	2	2	0	4	5	0	2	7
Yellow-billed Loon	0	2	0	2	1	2	3	6	0	6	0	6	2	2	1	5
Gulls																
Glaucous Gull	1	1	12	14	18	21	11	50	20	28	8	56	82	36	7	125
Herring Gull	0	5	5	10	7	9	3	19	91	2	1	94	190	19	13	222
Unidentified Waterbird	2	1	1	4	9	0	0	9	0	0	0	0	0	0	0	0
Total Birds	72	41	133	246	138	154	75	367	208	71	45	324	440	150	34	624
Avg. # Birds / survey	72.0	41.0	133.0	246.0	27.6 ± 8.1	30.8 ± 15.7	11.4 ± 3.0	69.4 ± 26.4	69.3 ± 16.8	23.7 ± 3.5	15.0 ± 7.2	108.0 ± 27.4	110.0 ± 15.4	37.5 ± 14.5	8.5 ± 3.5	156.0 ± 23.1
Species Richness	5	5	8	10	8	7	8	10	7	7	5	8	7	7	7	8
Avg. Species Richness	5	5	8	10	4.6 ± 0.4	3.6 ± 1.0	2.8 ± 0.6	5.6 ± 0.7	5.7 ± 0.7	3.0 ± 0.6	6 ± 0.8	3.5 ± 0.4	5.3 ± 0.8	5.0 ± 0.7	3.3 ± 1.0	7.3 ± 0.5

[1] *A total of one survey was conducted in July 2009, five surveys in August 2009, three surveys in July 2010 and four surveys in August 2010.*

Figure 11.2-9

Flocks of Seabirds and Seaducks Observed in the Marine Wildlife Regional Study Area, 2006 to 2015

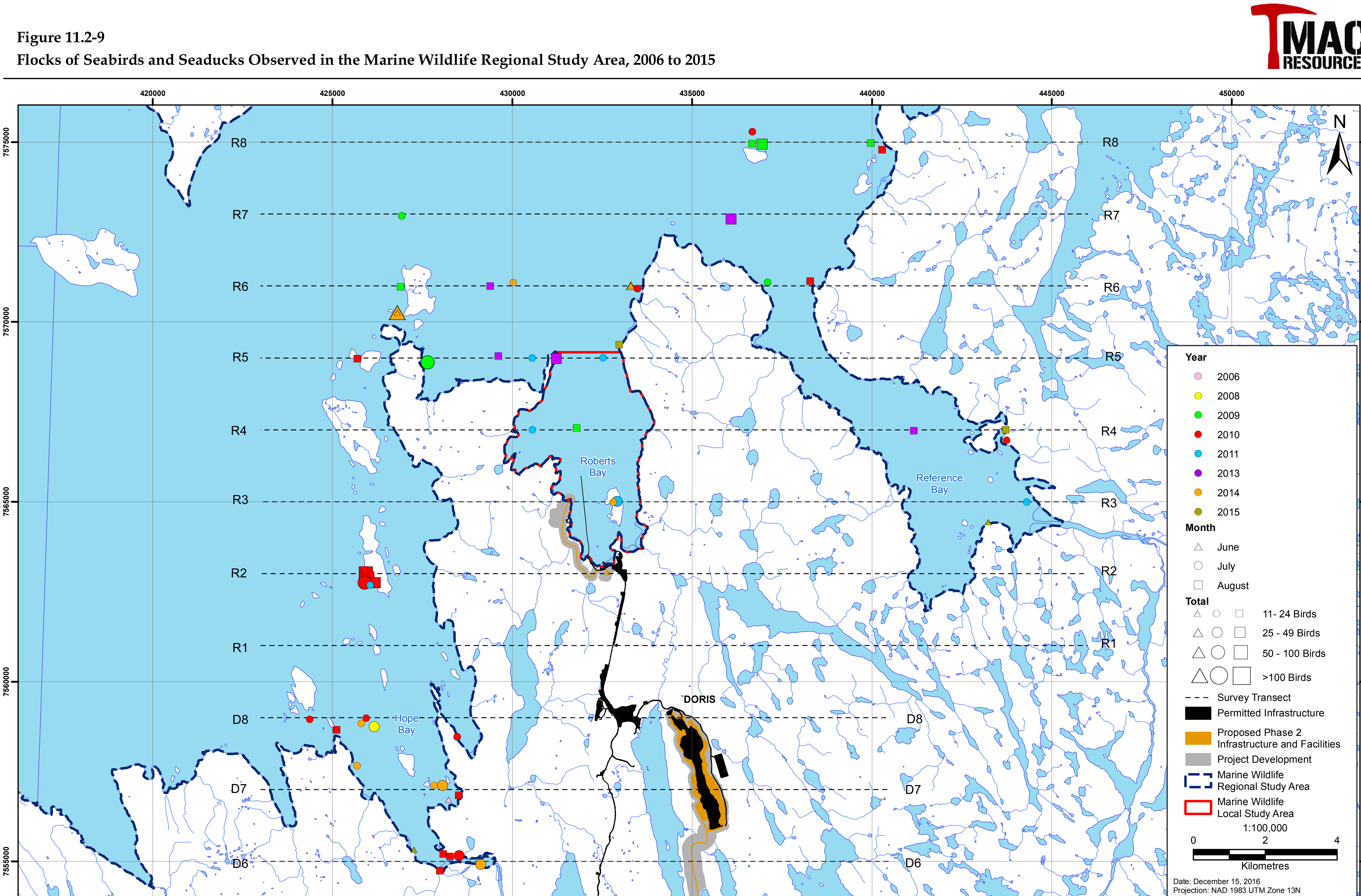


Figure 11.2-10
Seabird Observations Recorded during the Barge Survey, September 2010

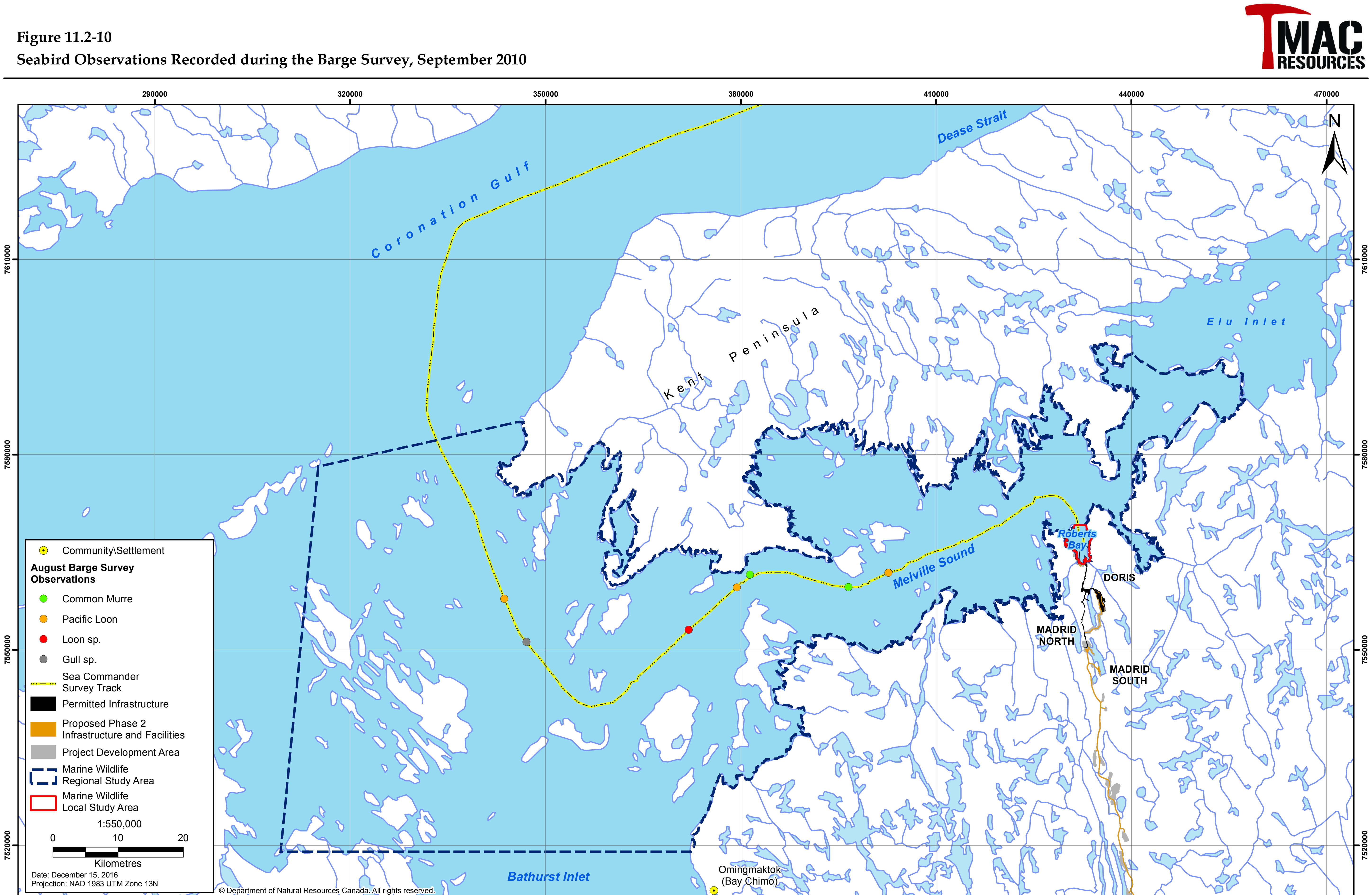
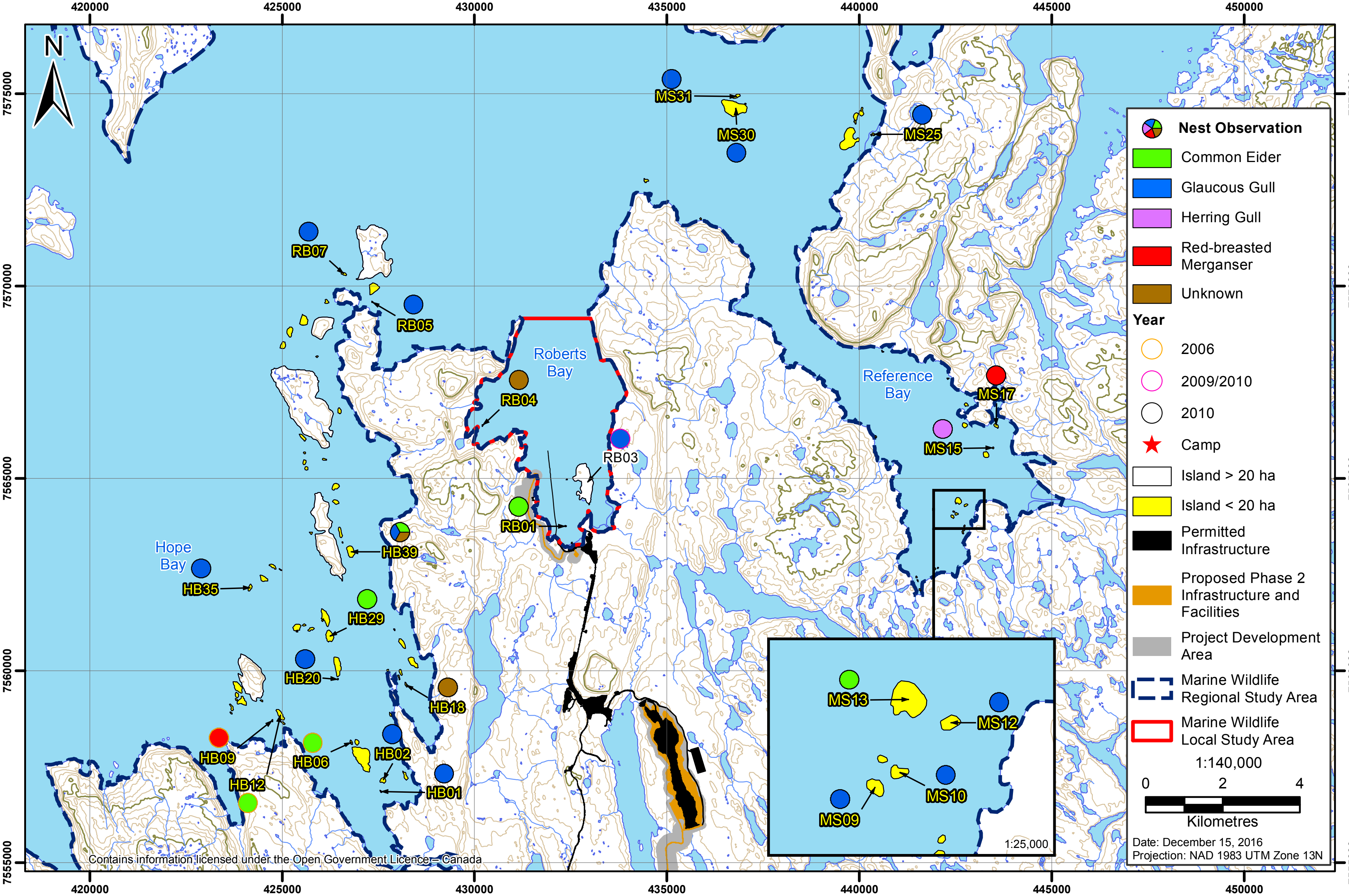


Figure 11.2-11

Island with Nests of Seabirds Observed during Nest Search Surveys, 2006, 2009, and 2010



In July 2006, searches of 13 islands in Hope Bay and Roberts Bay yielded three seabird nests were found (Golder 2007). All nests were located in Hope Bay. Two common eider nests were found on island HB24 (Figure 11.2-11) with clutch sizes of six and three, respectively, while the red-breasted merganser nest had a clutch size of seven. Despite the low nest count, common eiders were often seen in the area while red-breasted merganser sightings were less frequent (Golder 2007).

In 2009, of the 41 islands surveyed in the RSA, only two glaucous gull nests were found on island RB03 (Figure 11.2-11), each with a clutch size of three eggs. However, many old, empty nests in moss or grass depressions were found on several islands (likely old gull nests) and occasional aggregations of sticks on the shorelines were probably old red-breasted merganser nests. There was no evidence of recent nest building, occupation or predation of any seabird nests, nor were any down-lined depressions found. On only one occasion were birds flushed from the near-shore habitat during the walking surveys, in this case a male and female common eider. No nesting activity was found at the point of flushing. From the air, mixed groups of common eiders and red-breasted mergansers were observed on island beaches, but reconnaissance of these areas after landing revealed no nesting activity. The absence of seabird nests in 2009 was attributed to the poor weather, late spring, and amount of ice coverage in mid-July.

In July 2010, of the 87 islands surveyed in the RSA, twenty-eight active nests were found including, five belonging to seabirds: 4 common eider, and 1 red-breasted merganser. Twenty-two glaucous gull nests were found and one herring gull nest. Many seabirds, including common eider and red-breasted merganser were recorded near the surveyed islands during the nest search surveys (Rescan 2011a).

11.2.7.3 Doris Project

Between 1996 and 2004, exploration occurred in the Hope Bay Belt. In 2005, the FEIS for the Doris Project was submitted and a certificate for a two year underground mine was issued in 2006 (Miramar 2005). Construction of the Doris Project began in 2009, but was put into care and maintenance following changes in market conditions in 2010, and was re-opened for additional construction and resource exploration in 2015. To date, the Roberts Bay laydown has disturbed an area of marine beach of approximately 100 m in length, through the use of the area as a barge and boat landing.

The Wildlife Mitigation and Monitoring Plan (WMMP) for the Doris Project included monitoring of seabirds for possible disturbance resulting in avoidance of the Doris Project site, and for potential incidents and mortality.

<u>Disturbance</u>

The potential for sensory disturbance to result in waterbird species (both terrestrial waterbirds and marine birds) avoiding the Doris Project site was evaluated through the ongoing WMMP. Aerial survey have been collected as described in Section 11.2.5 since 1996. In 2016, a comprehensive analysis was conducted of these data and described in detail in the terrestrial wildlife assessment (Volume 4, Section 9.2.11.3). This analysis reported no avoidance of the Doris Project by waterbirds (including marine birds). It was therefore concluded that to date there has been no effect of sensory disturbance on waterbirds and marine birds due to the Doris Project.

<u>Direct Mortality</u>

Any mortality of wildlife, including marine birds observed by onsite personnel is required to be reported immediately to the ESR Department and the annual WMMP report. Mortality of VECs or larger fauna, or mortality resulting from potential interaction with Project activity is reported directly to GN DOE, Environment Canada, and KIA, as necessary.

In the nine years that personnel have been at the Doris Project site (2007-2016), there have been no reports of any waterbird mortality due to vehicle or aircraft strikes (Rescan 2010, 2011a, 2011b, 2013c; ERM Rescan 2014; ERM 2015b, 2016). During this time period, there has been one report of a non-vehicle/aircraft related mortality; one gull was discovered dead from unknown causes in November, 2011 (Rescan 2011c). One loon was caught in a fishing net on Reference Bay but was rescued and set free (Rescan 2011c). The very low frequency of marine bird mortality at the Doris Project indicates that there has been no effect of direct mortality on marine birds.

11.3 VALUED COMPONENTS

11.3.1 Potential Valued Components and Scoping

Potential marine wildlife Valued Ecosystem Components (VECs) were identified through a scoping process to identify those with potential interactions with the Project. The candidate marine wildlife VECs were identified based on:

- The potential interactions with the Project and issues or concerns raised during consultation activities and the input of regulators, Inuit and other stakeholder groups, scientific knowledge, past experience on other northern projects (particularly in Nunavut) and professional judgment.
- Legislative or regulatory requirement or government management priority.
- The availability of data and analytical tools to measure effects on marine wildlife VECs.
- Practicality of measuring and monitoring.

11.3.1.1 The Scoping Process and Identification of Marine Wildlife VECs

The scoping of marine wildlife VECs followed the process outlined in the Assessment Methodology (Volume 2, Section 4). The EIS guidelines (NIRB 2012b) propose the following marine wildlife VECs to be considered for inclusion in the marine wildlife effects assessment (Section 8.1.14, Marine Wildlife):

- marine wildlife (which includes species such as whales and seals);
- associated habitat; and
- marine Species at Risk.

The EIS guidelines (Section 8.1.12, Birds and Bird Habitat) identify the following VECs:

- marine birds; and
- their associated habitat.

For purposes of this document, marine birds reported will include species using marine habitat for such purposes as nesting and moulting. Therefore, there will be overlap between species reported in this section and waterbird species reported in Volume 4, Section 9.

The identified marine wildlife VECs represent an appropriate starting point to guide the identification and scoping of VECs (NIRB 2012b). The selection of marine wildlife VECs began with those proposed in the EIS guidelines and was further informed through consultation with communities, regulatory agencies, available TK, professional expertise, the CRI reports, and the NIRB's final scoping report (Appendix B of the EIS Guidelines).

For an interaction to occur there must be spatial and temporal overlap between a marine wildlife VEC and Project component and/or activities. The determination of VECs and potential effects for inclusion in this effects assessment considered and was informed by:

- and the Kitikmeot Inuit Association (KIA) TK Report (Banci and Spicker 2012);
- marine wildlife baseline studies conducted for the Phase 2 Project;
- ongoing wildlife effects monitoring of the Doris Project;
- consultation and engagement with local and regional Inuit groups (for example, the KIA);
- the Environmental Impact Statement (EIS) guidelines and appendices (NIRB 2012b);
- the public, during public consultation and open house meetings held in the Kitikmeot communities in May, 2016 (see Volume 2, Section 3, Public Consultation and Engagement);
- review of the marine wildlife sections of recently completed Nunavut EAs (e.g., Back River, Meliadine); and
- the Draft Nunavut Land Use Plan (NPC 2014), the NIRB reference and guidance documents (NIRB 2013a, 2013b, 2013c), topics discussed during community meetings, focus groups, interviews, and other meetings with the KIA and relevant government bodies were integrated within specific VECs for further examination in the assessment process.

11.3.1.2 NIRB Scoping Sessions

Scoping sessions hosted by NIRB (NIRB 2012c) with key stakeholders and local community members (i.e., the public) focused on identifying the wildlife species and habitats that are important to local residents, as related to the Project. Comments made during these sessions were compiled and analysed as part of VEC scoping.

11.3.1.3 TMAC Consultation and Engagement Informing VEC Selection

Community meetings for the Project were conducted in each of the five Kitikmeot communities as described in Section 3 of Volume 2. The meetings are a central component of engagement with the public and an opportunity to share information and seek public feedback. Overall, the community meetings were well attended. Public feedback (questions, comments, and concerns) about the proposed Project was obtained through open dialogue during Project presentations, through discussions that arose during the presentation of Project materials and comments provided in feedback forms.

11.3.2 Valued Components Included in the Assessment

The marine wildlife VECs selected to guide the assessment of the potential effects of the Project on marine wildlife are those:

- that have potential to interact with the activities and components of the Project;
- identified as important by local communities, Inuit organizations, governments, regulators, and other stakeholders during consultation and engagement;
- informed by Inuit TK (Volume 2, Section 2) and professional judgement;
- species at risk or of conservation concern;
- species or focal groups requiring enhanced consideration under the mandates of regulatory agencies such as the Government of Nunavut Department of Environment, or the Canadian Wildlife Service;

- o species or populations identified for assessment in the NIRB Guidelines (NIRB 2012); and/or
- o species identified as having a strong biological importance for the functioning of the ecosystem in the Madrid-Boston Project area, including importance as keystone, indicator, and/or umbrella species.

Table 11.3-1 summarizes the marine wildlife VECs included in the marine wildlife and habitat assessment.

Table 11.3-1. Wildlife Valued Ecosystem Components Included in the Marine Wildlife Assessment

Species or Group	Identified by: TK	Identified by: NIRB Guidelines	Identified by: Regulation/ Regulators	Rationale for Inclusion
Ringed Seal (represents Marine Mammals)	X	X	X	Ringed seals were chosen as the representative species for marine mammals. Seals are the only regularly observed marine mammal in the assessment area. Ringed seal are much more abundant relative to other seals, including bearded seal in the assessment area. TK identified ringed seals as a key component of the environment for Inuit historically, currently, and for the future (KIA 2015). Marine mammals were identified as a candidate VEC in the NIRB guidelines for the Phase II development (NIRB 2012).
Marine Birds	X	X	X	Marine birds were identified as a candidate VEC in the NIRB guidelines for the Phase II development (NIRB 2012). Waterbirds are identified by Inuit TK as an important food source (KIA 2015).

11.3.3 Valued Components Excluded from the Assessment

This section lists the candidate marine wildlife VECs that have been excluded from the assessment. Marine mammals were excluded because their range does not overlap with the Project RSA (Table 11.3-2).

11.4 SPATIAL AND TEMPORAL BOUNDARIES

The spatial and temporal boundaries for the Project are common to all marine wildlife VECs, with a Project Development Area (PDA), Local Study Area (LSA), and Regional Study Area (Figure 11.4-1). Effects are considered for the life of the Project, and where relevant, are identified by Project phase. The spatial boundaries selected to shape this assessment are determined by the Project's potential impacts on marine wildlife.

Temporal boundaries are selected that consider the different phases of the Project and their durations. The Project's temporal boundaries reflect those periods during which planned activities will occur and have potential to affect a marine wildlife VEC.

The determination of spatial and temporal boundaries also takes into account the development of the entire Hope Bay Greenstone Belt. The assessment considers both the incremental potential effects of the Project as well as the total potential effects of the additional Project activities in combination with the existing and approved Projects including the Doris Project and advanced exploration activities at Madrid and Boston.

Table 11.3-2. Wildlife Valued Ecosystem Components Excluded from the Marine Wildlife Assessment

Species or Group	Identified by: TK	Identified by: NIRB Guidelines	Identified by: Regulation/ Regulators	Rationale for Exclusion
Polar bear	X	X	X	Polar bear were identified as a candidate VEC in the NIRB guidelines for the Phase II development (NIRB 2012a). TK information indicates that polar bear have been observed rarely in the northern islands of Bathurst Inlet during winter. However, the current range of polar bear does not appear to overlap the Project marine regional study area (MRSA). No polar bears have been observed in the MRSA during the 10 years of construction and care and maintenance of the Doris North Project. Both Inuit TK and baseline studies indicate that polar bear are not present on the southern shore of Melville Sound. Moreover, all Project shipping will be occurring in the open water season, when TK and baseline studies indicate that polar bears are not present in the MRSA. As a consequence, is was determined that there is no potential overlap between the landward components of the Project or with the marine components of the Project (shipping) and polar bears were excluded from the assessment.
Other marine mammals	X	X		Whales were identified as a candidate VEC in the NIRB guidelines for the Phase II Development (NIRB 2012a). TK information indicates that whales occur rarely in the MRSA. Marine surveys in Melville Sound have not recorded any whales in this area. Elders and land users who participated in the caribou workshops conducted resource mapping of the Project study area, including the marine study area for harvesting resources. These Elders and land users did identify seals as a resource in the marine study area, but did not identify that whales occur in this area or are harvested in this area.

11.4.1 Project Overview

The Madrid-Boston Project consists of proposed mine operations at the Madrid North, Madrid South and Boston deposits. The Madrid-Boston Project is part of a staged approach to continuous development of the Hope Bay Project, comprised of existing operations at Doris and bulk samples followed by commercial mining at Madrid North, Madrid South, and Boston deposits. The Madrid-Boston Project would use and expand upon the existing Doris Project infrastructure.

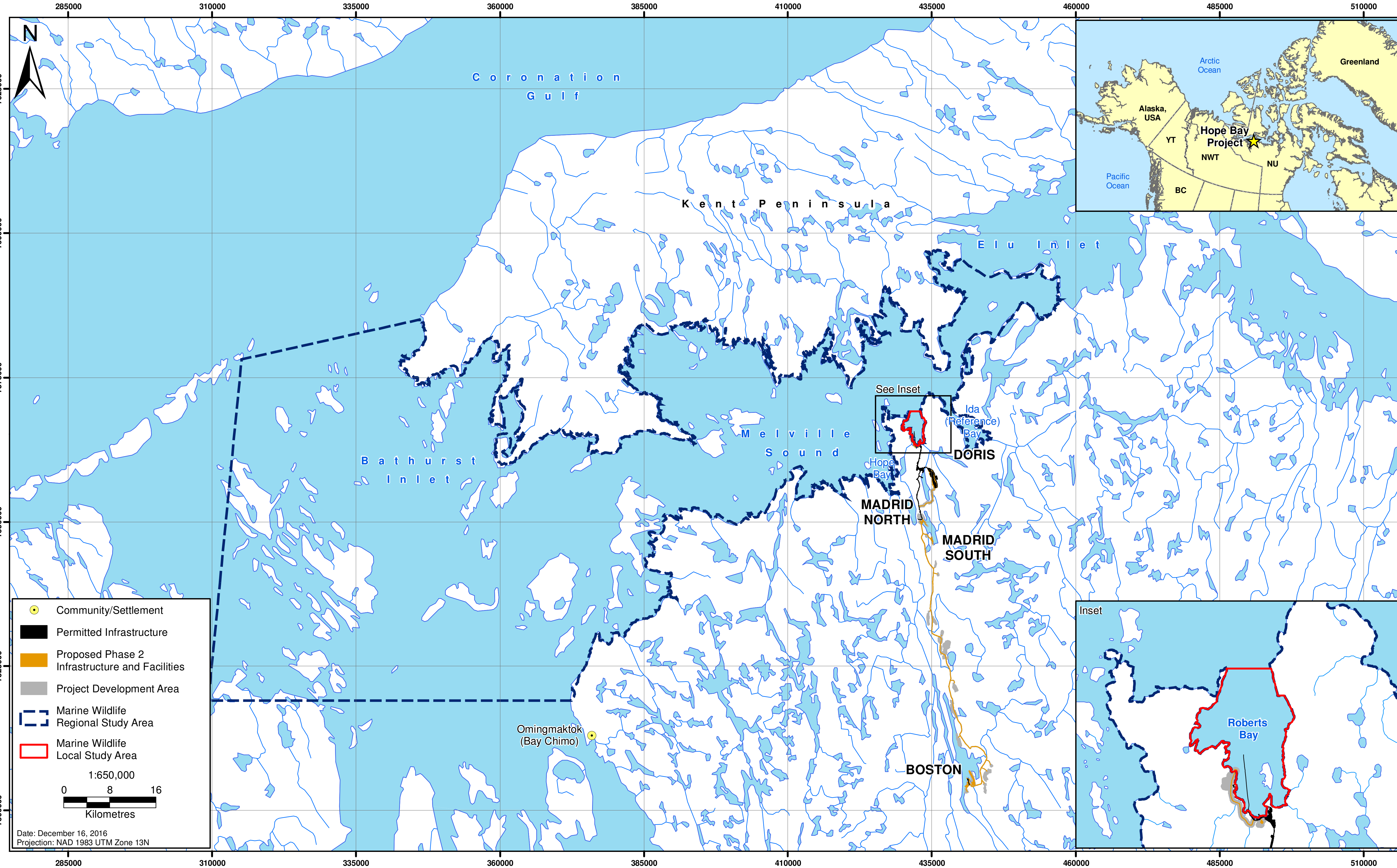
The Madrid-Boston Project is the focus of this application. Because the infrastructure of existing and approved projects will be utilized by the Madrid-Boston Project, and because the existing and approved projects have the potential to interact cumulatively with the Madrid-Boston Project, existing and approved project are described below.

11.4.1.1 Existing and Approved Projects

Existing and approved projects include:

- the Doris Project (NIRB Project Certificate 003, NWB Type A Water Licence 2AM-DOH1323);
- the Hope Bay Regional Exploration Project (NWB Type B Water Licence 2BE-HOP1222);
- the Madrid Advanced Exploration Program (NWB Type B Water Licence 2BB-MAE1727); and
- the Boston Advanced Exploration Project (NWB Type B Water Licence 2BB-BOS1727).

Figure 11.4-1
Project Development Area and Local Study Area and Regional Study Area for Marine Wildlife VECs



The Doris Project

The Doris Project was approved by NIRB in 2006 (NIRB Project Certificate 003) and licenced by NWB in 2007 (Type A Water Licence 2AM-DOH0713). The Type A Water Licence was amended in 2010, 2011 and 2012 and received modifications in 2009, 2010, and 2011.

Construction of the Doris Project began in early 2010. In early 2012, the Doris Project was placed into care and maintenance, suspending further Project-related construction and exploration activity along the Hope Bay Greenstone Belt. Following TMAC's acquisition of the Hope Bay Project in March of 2013, NWB renewed the Doris Project Type A Water Licence (Type A Water Licence 2AM-DOH1323), and TMAC advanced planning, permitting, exploration, and construction activities. In 2016, NIRB approved an amendment to Project Certificate 003 and NWB granted Amendment No. 1 to Type A Water Licence 2AM-DOH1323, extending operations from two to six years through mining two additional mineralized zones (Doris Connector and Doris Central zones) to be accessed via the existing Doris North portal. Amendment No. 1 to Type A Water Licence 2AM-DOH1323 authorizes a mining rate of approximately 2,000 tonnes per day of ore and a milling throughput of approximately 2,000 tonnes per day of ore. The Doris Project began production early in 2017.

The Doris Project includes the following components and facilities:

- The Roberts Bay offloading facility: marine jetty, barge landing area, beach laydown area, access roads, weather havens, fuel tank farm/transfer station, waste storage facilities and incinerator, and quarry;
- The Doris site: 280 person camp, laydown areas, service complex (e.g., workshop, wash bay, administration buildings, mine dry), two quarries (mill site platform and solid waste landfill), core storage areas, batch plant, brine mixing facilities, vent raise (3), air heating units, reagent storage, fuel tank farm/transfer station, potable water treatment, waste water treatment, incinerator, landfarm and handling/temporary hazardous waste storage, explosives magazine, and diesel power plant;
- Doris Mine works and processing: underground portal, overburden stockpile, temporary waste rock pile, ore stockpile, and ore processing plant (mill);
- Tailings Impoundment Area (TIA): Schedule 2 designation for Tail Lake with two dams (North and South dams), sub-aerial deposition of flotation tailings, emergency tailings dump catch basins, pump house, and quarry;
- All-season main road with transport trucks: Roberts Bay to Doris site (4.8 km, 150 to 200 tractor and 300 fuel tanker trucks/year);
- Access roads from Doris site used predominantly by light-duty trucks to: the TIA, the explosives magazine, Doris Lake float plane dock (previously in use), solid waste disposal site, and to the tailings decant pipe,from the Roberts Bay offloading facility to the location where the discharge pipe enters the ocean; and
- All-weather airstrip (914 m), winter airstrip (1,524 m), helicopter landing site and building, and Doris Lake float plane and boat dock.

Water is managed at the Doris Project through:

- freshwater input from Doris Lake for mining, milling, and associated activities and domestic purposes;
- freshwater input from Windy Lake for domestic purposes;

- process water input primarily from the TIA reclaim pond;
- surface mine contact water discharged to the TIA;
- underground mine contact water directed to the TIA or to Roberts Bay via the marine outfall mixing box (MOMB);
- treated waste water discharged to the TIA; and
- water from the TIA treated and discharged to Roberts Bay via a discharge pipeline, with use of a MOMB.

Hope Bay Regional Exploration Project

The Hope Bay Regional Exploration Project has been renewed several times since 1995. The current extension expires in June 2022. Much of the previous work for the program was based out of Windy Lake and Boston camps. These camps were closed in October 2008 with infrastructure either decommissioned or moved to the Doris site. All exploration activities are now based from the Doris site. Components and activities for the Hope Bay Regional Exploration Project include:

- operation of helicopters from Doris; and
- the use of exploration drills, which are periodically moved by roads and by helicopter as required.

Madrid Advanced Exploration

In 2017, the NWB issued a Type B Water Licence (2BB-MAE1727) for the Madrid Advanced Exploration Program to support continued exploration and a bulk sample program at the Madrid North and Madrid South sites, located approximately 4 km south of the Doris site. The program includes extraction of a bulk sample totaling 50 tonnes from each of the Madrid North and South locations, which will be trucked to the mill at the Doris site for processing and placement of tailings in the tailings impoundment area (TIA). All personnel will be housed in the Doris camp.

The Madrid Advanced Exploration Program includes the following components and activities.

- Use of existing infrastructure associated with the Doris Project:
  - camp facilities to support up to 70 personnel as required to undertake the advanced exploration activities;
  - mill to process ore;
  - TIA;
  - landfill and hazardous waste areas, particularly if closure and remediation becomes required for the Madrid Advanced Exploration Program infrastructure;
  - fuel tank farms; and
  - Doris airstrip and Roberts Bay facility for transport of personnel and supplies.
- Use of existing infrastructure at the Madrid and Boston areas:
  - borrow and rock quarry facilities: existing Quarries A, B, and D along the Doris-Windy all-weather road (AWR);
  - AWR between Doris and Windy Lake for transportation of personnel, ore, waste, fuel, and supplies; and
  - future mobilization of existing exploration site infrastructure, should it become necessary.

- Construction of additional facilities at Madrid North and South:
  - access portals and ramps for underground operations at Madrid North and at Madrid South;
  - 4.7 km extension of the existing AWR originating from the Doris to the Windy exploration area (Madrid North) to the Madrid South deposit, with branches to Madrid North, Madrid North vent raise, and the Madrid South portal;
  - development of a winter road route (WRR) from Madrid North to access Madrid South until AWR has been constructed;
  - borrow and rock quarry facilities; two quarries referenced as Quarries G and H;
  - waste rock and ore stockpiles;
  - water and waste management structures; and
  - additional site infrastructure, including compressor building, brine mixing facility, saline storage tank, air heating facility, four vent raises, workshop and office, laydown area, diesel generator, emergency shelter, fuel storage facility/transfer station.
- Undertaking of advanced exploration access to aforementioned deposits through:
  - continue field mapping and sampling, as well as airborne/ground/downhole geophysics;
  - diamond drilling from the surface and underground; and
  - bulk sampling through underground mining methods and mine development.

Boston Advanced Exploration

The Boston Advanced Exploration Project Type B Water Licence No. 2BB-BOS1217 was renewed as Water Licence No. 2BB-BOS1727 in July 2017 and includes:

- the Boston camp (65 person), maintenance shops, workshops, laydown areas, water pumphouse, vent raise, warehouse, site service roads, sewage and greywater treatment plant, fuel storage and transfer station, landfarm, solid waste landfill and a heli-pad;
- mine works, consisting of underground development for exploration drilling and bulk sampling, waste rock and ore stockpiles;
- potable water and industrial water from Aimaokatalok Lake; and
- treated sewage and greywater discharged to the tundra.

11.4.1.2 The Madrid-Boston Project

The Madrid-Boston Project includes: the Construction and Operation of commercial mining at the Madrid North, Madrid South, and Boston sites; the continued operation of Roberts Bay and the Doris site to support mining at Madrid and Boston; and the Reclamation and Closure and Post-closure phases of all sites. Excluded from the Madrid-Boston Project for the purposes of the assessment are the Reclamation and Closure and Post-closure components of the Doris Project as currently permitted and approved.

Construction

Madrid-Boston construction will use the infrastructure associated with Existing and Approved Projects. This may include:

- an all-weather airstrip at the Boston exploration area and helicopter pad;
- seasonal construction and/or operation of a winter ice strip on Aimaokatalok Lake;

- Boston camp with expected capacity for approximately 65 people during construction
- Quarry D Camp with capacity for up to 180 people;
- seasonal construction/operation of Doris to Boston WRR;
- three existing quarry sites along the Doris to Windy AWR;
- Doris camp with capacity for up to 280 people;
- Doris airstrip, winter ice strip, and helicopter pad;
- Roberts Bay offloading facility and road to Doris; and
- Madrid North and Madrid South sites and access roads.

Additional infrastructure to be constructed for the proposed Madrid-Boston Project includes:

- expansion of the Doris TIA (raising of the South Dam, construction of West Dam, development of a west road to facilitate access, and quarrying, crushing, and screening of aggregate for the construction);
- construction of a cargo dock at Roberts Bay (including a fuel pipeline, mooring points, beach landing and gravel pad, shore manifold);
- construction of an additional tank farm at Roberts Bay (consisting of two 10 ML tanks);
- expansion of Doris accommodation facility (from 280 to 400 person), mine dry and administrative building, water treatment at Doris site;
- expansion of the Doris mill to accommodate concentrate handling on the south end of the building facility and rearrangement of indoor crushing and processing within the mill building;
- complete development of the Madrid North and Madrid South mine workings;
- incremental expansion of infrastructure at Madrid North and Madrid South to accommodate production mining, including vent raise, access road, process plant buildings;
- construction of a 1,200 tpd concentrator, fuel storage, power plant, mill maintenance shop, warehouse/reagent storage at Madrid North;
- all weather access road and tailings line from Madrid North to the south end of the TIA;
- AWR linking Madrid to Boston (approximately 53 km long, nine quarries for permitting purposes, four of which will likely be used);
- all-weather airstrip, airstrip building, helipad and heliport building at Boston;
- construction of a 2,400 tpd process plant at Boston;
- all infrastructure necessary to support mining and processing activities at Boston including construction of a new 300-person accommodation facility, mine office and dry and administration buildings, additional fuel storage, laydown area, ore pad, waste rock pad, diesel power plant and dry-stack tailings management area (TMA);
- infrastructure necessary to support ongoing exploration activities at both Madrid and Boston; and
- wind turbines near the Doris (2), Madrid (2), and Boston (2) sites.

Operation

The Madrid-Boston Project Operation phase includes:

- mining of the Madrid North, Madrid South, and Boston deposits by way of underground portals and Crown Pillar Recovery;
- operation of a concentrator at Madrid North;
- transportation of ore from Madrid North, Madrid South, and Boston to the Doris process plant, and transporting the concentrate from the Madrid North concentrator to the Doris process plant;
- extending the operation at Roberts Bay and Doris;
- processing the ore and/or concentrate from Madrid North, Madrid South, and Boston at the Doris process plant with disposal of the detoxified tailings underground at Madrid North, flotation tailings from the Doris process plant pumped to the expanded Doris TIA, and discharge of the TIA effluent to the marine environment;
- operation of a concentrator at Madrid North and disposal of tailings at the Doris TIA;
- operation of a process plant and wastewater treatment plant at Boston with disposal of flotation tailings to the Boston TMA and a portion placed underground and the detoxified leached tailings placed in the underground mine at Boston;
- operation of two wind turbines for power generation; and
- on-going maintenance of transportation infrastructure at all sites (cargo dock, jetty, roads, and quarries).

Reclamation and Closure

Areas which are no longer needed to carry out Madrid-Boston Project activities may be reclaimed during Construction and Operation.

At Reclamation and Closure, all sites will be deactivated and reclaimed in the following manner (see Volume 3, Chapter 2, Section 5.5):

- Camps and associated infrastructure will be disassembled and/or disposed of in approved non-hazardous site landfills.
- Non-hazardous landfills will be progressively covered with quarry rock, as cells are completed. At final closure, the facility will receive a final quarry rock cover which will ensure physical and geotechnical stability.
- Rockfill pads occupied by construction camps and associated infrastructure and laydown areas will be re-graded to ensure physical and geotechnical stability and promote free-drainage, and any obstructed drainage patterns will be re-established.
- Quarries no longer required will be made physically and geotechnically stable by scaling high walls and constructing barrier berms upstream of the high walls.
- Landfarms will be closed by removing and disposing of the liner, and re-grading the berms to ensure the area is physically and geotechnically stable.
- Mine waste rock will be used as structural mine backfill.

- The Doris TIA surface will be covered waste rock. Once the water quality in the reclaim pond has reached the required discharge criteria, the North Dam will be breached and the flow returned to Doris Creek.
- The Madrid to Boston AWR and Boston Airstrip will remain in place after Reclamation and Closure. Peripheral equipment will be removed. Where rock drains, culverts or bridges have been installed, the roadway or airstrip will be breached and the element removed. The breached opening will be sloped and armoured with rock to ensure that natural drainage can pass without the need for long-term maintenance.

A low permeability cover, including a geomembrane, will be placed over the Boston TMA. The contact water containment berms will be breached and the liner will be cut to prevent collecting any water. The balance of the berms will be left in place to prevent localized permafrost degradation.

11.4.2 Spatial Boundaries

11.4.2.1 Project Development Area

The Project Development Area (PDA) is shown in Figure 11.4-1 and is defined as the area which has the potential for infrastructure to be developed. The PDA includes engineering buffers around the footprints of structures. These buffers allow for refinement in the final placement of a structure through detailed design and necessary in-filed modifications during construction phase. Areas with buildings and other infrastructure in close proximity are defined as pads with buffers whereas roads are defined as linear corridors with buffers. The buffers for pads varied depending on the local physiography and other buffered features such as sensitive environments or riparian areas. The average engineering buffer for roads is 100 m on either side.

The buffers for pads varied depending on the local physiography and other buffered features such as sensitive environments or riparian areas. The average engineering buffer for pads was 250 m surrounding infrastructure and 100 m surrounding roads. Since the infrastructure for the Doris Project is in place, the PDA exactly follows the footprints of these features. In all cases, the PDA does not include the Project design buffers applied to potentially environmentally sensitive features. These are detailed in Volume 3, Section 2 (Project Description).

11.4.2.2 Local Study Area

The boundary of the marine local study area (LSA) for marine wildlife was set to encompass Roberts Bay and is bounded by the shoreline around Roberts Bay (Figure 11.4-1). The marine LSA is 1,459 ha and includes the marine shoreline area where Project infrastructure is proposed in the south end of Roberts Bay. The marine LSA was designed to reflect the scale at which direct, immediate, and localized disturbances to marine wildlife species typically occur.

11.4.2.3 Regional Study Area

The marine regional study area (MRSA) for marine wildlife encompasses the marine wildlife LSA, and is bounded by the shoreline encompassing Melville Sound to the mouth of Elu Inlet, at the chain of islands on the west side of Elu Inlet, and extends into the northern portion of Bathurst Inlet including the islands at the mouth of Bathurst Inlet on the eastern side (Figure 11.4-1). The marine wildlife MRSA is 551,000 ha. The MRSA includes wildlife with larger home range sizes that could potentially come into contact with, or may be affected by the workings at the Project Development Area.

11.4.3 Temporal Boundaries

The Project represents a significant development in the mining of the Hope Bay Greenstone Belt. Even though this Project spans the conventional Construction, Operation, Reclamation and Closure, and Post-closure phases of a mine project, Madrid-Boston is a continuation of development currently underway. The Madrid-Boston Project has four separate operational sites: Roberts Bay, Doris, Madrid (North and South), and Boston and three mine sites: Madrid North, Madrid South and Boston. Development, operation and closure of the Madrid-Boston Project will overlap mining and post-mining activities at the existing Doris mine. As such, the temporal boundaries of this Project overlap with a number of Existing and Approved Authorizations (EAAs) for the Hope Bay Project and the extension of activities during Madrid-Boston.

Distinct phases of the Project are defined (Table 11.4-1). Construction, operation, and closure activities will overlap among sites; this is outlined in Table 11.4-1 and further described in Volume 3, Section 2 (Project Description).

The assessment also considers a temporary closure phase should there be a suspension of Madrid-Boston activities during periods when the Project becomes uneconomical due to market conditions. During this phase, the Project would be under care and maintenance. This could occur in any year of construction or operation with an indeterminate length (one to two year duration would be typical).

Table 11.4-1. Temporal Boundaries for the Effects Assessment for Marine Wildlife

Phase	Project Year	Calendar Year	Length of Phase (Years)	Description of Activities
Construction	1 - 4	2019 - 2022	4	• **Roberts Bay:** construction of access road (Year 1), marine dock and additional fuel facilities (Year 2 – Year 3); • **Doris**: expansion of the Doris TIA and accommodation facility (Year 1); • **Madrid North:** construction of concentrator and road to Doris TIA (Year 1 – Year 2); • **All-weather Road**: construction (Year 1 – Year 3); • **Boston**: site preparation and installation of all infrastructures including process plant (Year 2 – Year 5).
Operation	5 - 14	2023 - 2032	10	• **Roberts Bay**: shipping operations (Year 1 – Year 14) • **Doris**: processing and infrastructure use (Year 1 – Year 14); • **Madrid North:** mining (Year 1 – 13); ore transport to Doris process plant (Year 1 -13); ore processing and concentrate transport to Doris process plant (Year 2 – Year 13); • **Madrid South:** mining (Year 11 – Year 14); ore transport to Doris process plant (Year 11 – Year 14); • **All-weather Road**: operational (Year 4 – Year 14); • **Boston**: winter access road operating (Year 1 – Year 3); mining (Year 4 – Year 11); ore transport to Doris process plant (Year 4 – Year 6); and processing ore (Year 5 – Year 11).

Phase	Project Year	Calendar Year	Length of Phase (Years)	Description of Activities
Reclamation and Closure	15 - 17	2033 - 2035	3	• **Roberts Bay**: facilities will be operational during closure (Year 15 – Year 17); • **Doris**: camp and facilities will be operational during closure (Year 15 – Year 17); mine, process plant, and TIA decommissioning (Year 15 – Year 17); • **Madrid North:** all components decommissioned (Year 15 – Year 17); • **Madrid South:** all components decommissioned (Year 15 – Year 17); • **All-weather Road**: road will be operational (Year 15 – Year 16); decommissioning (Year 17); • **Boston**: all components decommissioned (Year 15 – Year 17).
Post-Closure	18 - 22	2036 - 2040	5	• **All Sites:** Post-closure monitoring.
Temporary Closure	NA	NA	NA	• **All Sites:** Care and maintenance activities, generally consisting of closing down operations, securing infrastructure, removing surplus equipment and supplies, and implementing on-going monitoring and site maintenance activities.

11.5 PROJECT-RELATED EFFECTS ASSESSMENT

11.5.1 Methodology Overview

This assessment was informed by a methodology used to identify and assess the potential environmental effects of the Project and is consistent with the requirements of Section 12.5.2 of the Nunavut Agreement and the EIS Guidelines. The effects assessment evaluates the potential direct and indirect effects of the Project on the environment and follows the general methodology provided in Volume 2, Section 4 (Effects Assessment Methodology). It comprises a number of steps that collectively assess the manner in which the Project will interact with VECs defined for the assessment (Section 11.3).

To provide a comprehensive understanding of the potential effects for the Hope Bay Development, the Project components and activities are assessed on their own as well as in the context of the Approved Projects (Doris and exploration) within the Hope Bay Greenstone Belt. The effects assessment process is summarized as follows:

1. Identify potential interactions between the Project and the VECs or VSECs;
2. Identify the resulting potential effects of those interactions;
3. Identify mitigation or management measures to eliminate or reduce the potential effects;
4. Identify residual effects (potential effects that would remain after mitigation and management measures have been applied) for Madrid-Boston in isolation;
5. Identify residual effects of Madrid-Boston in combination with the residual effects of Approved Projects; and
6. Determine the significance of combined residual effects.

11.5.2 Identification of Potential Effects

Potential effects were identified by Inuit TK, through scoping meetings conducted by TMAC with community members, scoping meetings conducted by the NIRB and the subsequent NIRB guidelines (NIRB 2012a), a review of scientific literature of the effects of developments on marine wildlife, review of similar mining projects in Nunavut, the Northwest Territories and the Arctic, and professional judgement.

Potential effects and the efficacy of mitigation and management practices at the Project site have been monitored at the existing Doris Project (Rescan 2010, 2011a, 2011b, 2013c; ERM Rescan 2014; ERM 2015b, 2016) . The effects of mining developments in the Arctic have also been documented through monitoring programs at the Baffinland project (Baffinland Iron Ore Corporation 2012).

These scoping processes identified seven potential effects on marine wildlife:

1. habitat loss and alteration;
2. disturbance;
3. disruption of movement;
4. attraction to the Madrid-Boston Project;
5. direct mortality;
6. increased access and harvest; and
7. changes in environmental media quality.

Some areas of marine wildlife habitat may be lost and altered through the construction of the Project footprint. Expansion of the Roberts Bay facility may result in loss of some beach habitat used by ringed seals and marine birds. The potential effect of **habitat loss** was evaluated in this assessment.

Disturbances in Roberts Bay, including visual and auditory stimuli, could cause marine wildlife to alter their regular behavioural patterns, avoiding the disturbance and resulting in indirect habitat loss. Shipping may also result in disturbance to marine wildlife. Infrequent Project ship traffic including tankers and bulk carriers will report to Roberts Bay within the Construction, Operations, and potentially Reclamation and Closure phase. Therefore, the potential effect of **disturbance** is included in this assessment.

It is not expected that shipping or the Roberts Bay facility will result in **disruption of movement** or attraction to the Project site for marine wildlife because shipping will be infrequent and the moving vessels are unlikely to form a barrier to movement.

Marine wildlife could interact with the Project and suffer mortality or injury from shipping vessel strikes, entanglement, or other factors. While the rate of wildlife mortality at many projects is very low, the potential effect of **direct mortality** was evaluated for the Project.

It is not anticipated that **increased access** to the site will result in increased hunting of marine mammals. TK indicates that there are better places to hunt both ringed seals and marine birds elsewhere in the MRSA therefore an increase in human immigration and hunting is unlikely in the MRSA. The Project is not expected to cause in increase in marine wildlife mortality due to facilitation of hunter access and thus the effect is not evaluated for the Project.

It is not anticipated that Madrid-Boston or the Hope Bay Project will result in changes in media quality (i.e., water quality) in the marine environment. Fuels and hazardous chemicals will be strictly managed and any spills will be addressed immediately as described in the Oil Pollution Prevention Plan (OPPP)/Oil Pollution Emergency Plan (OPEP; Volume 8, Annex V8-1); and the Hope Bay Project Spill Contingency Plan (SCP; Volume 1, Annex V1-7, Package P4-3).

As part of Madrid-Boston and the Hope Bay Project, water from the TIA will be treated and discharged into Roberts Bay. Potential effects of Madrid-Boston and the Hope Bay Project on marine water quality are discussed in detail in the Marine Water Quality Assessment (Volume 5, Chapter 8) which concluded that change in marine water quality will be Not Significant. Therefore, **no change to environmental media quality** is therefore expected due to the Project and is not considered further for marine mammals or marine birds.

The NIRB guidelines for the Madrid-Boston Project (NIRB 2012a) identified a variety of potential effects to be evaluated. These guidelines and the corresponding potential effect evaluated in this assessment are listed in Table 11.5-1.

Table 11.5-1. NIRB Guidelines for Marine Wildlife and Identified Potential Effects for the Assessment

NIRB Guidelines	Potential Effect
Potential loss to or deterioration in the habitat of marine wildlife VECs due to shipping route(s). Special consideration should be given to Species at Risk listed on Schedule 1 of the federal SARA, species with designations by the COSEWIC, species having significant ecological functions, and/or of importance for Inuit life and culture.	Habitat loss
Potential direct and indirect impacts to marine wildlife, marine fish, and marine habitat from marine shipping activities including increased noise levels.	Disturbance
Potential spills, malfunctions and other accidents associated with shipping operations and any resulting impacts to marine wildlife, marine habitat, and marine fish.	Changes in environmental media quality
Risk assessment of the potential introduction of non-native aquatic species due to ballast water discharge, ship wash and hull fouling.	Habitat loss. Addressed in Marine Fish Section (Volume 5, Section 10)
Potential interactions, accidental injuries and mortality of marine wildlife directly or indirectly from proposed shipping (open water and potential ice breaking during break-up in the spring and following freeze-up in the fall) activities, in particular those marine wildlife which congregate in areas where the shipping routes would pass through.	Direct mortality
Potential direct and indirect effects on marine wildlife behaviour, distribution, abundance, migration patterns, species health and reproduction from marine shipping activities.	Habitat Loss, Disturbance, Disruption of Movement
Evaluation of the potential for contaminants to be released to the environment and taken up by VECs as a result of the Project.	Changes in environmental media quality
Assessment of potential residual and cumulative effects on marine wildlife VECs resulting from escalated marine traffic in the RSA over the mining lifecycle (and including the potentially extended mine operation period). Consideration should be given to the possible significant increase of marine vessel traffic along shipping routes.	Habitat loss, Disturbance, Disruption of Movement, Direct mortality, Increased hunting and access, attraction, Changes in environmental media and quality

The Project will include discharge of water as part of the Roberts Bay Discharge System. The water quality of this discharge and Roberts Bay has been modeled and is not expected to change compared to the water quality present as part of the Approved Project. Effects on the marine environment are assessed in the Marine Water Quality Assessment (Volume 5, Section 8), the Marine Sediment Quality

Assessment (Volume 5, Section 9) and the Marine Fish Assessment (Volume 5, Section 10), all of which have determine no significant effect of the Project or the Hope Bay Development. Therefore, potential effects due to water discharge are not considered further for marine mammals or marine birds. Marine water quality and sediment quality will be monitoring through the Aquatic Effects Monitoring Plan (Package P4-18).

11.5.2.1 Ringed Seal

Potential Project-related effects on ringed seals were considered for the locations where they may interact with ringed seals - shipping within the MRSA and activities at the Roberts Bay facility. Potential effects on ringed seal and its habitat were included based on Traditional Knowledge, community concerns, professional judgement, experience at other similar projects in Nunavut and the scientific literature.

The potential effects on ringed seals were also evaluated temporally over project phases (construction, operation and reclamation/closure) and within the year (e.g., open water vs. sea-ice periods). Interactions of ringed seals with Project components were evaluated to determine which of the following potential effects may occur (Table 11.5-2):

- habitat loss;
- disturbance;
- disruption of movement;
- attraction to the Madrid-Boston Project;
- direct mortality;
- increased access and harvest; and
- changes in environmental media quality.

Table 11.5-2. Potential Project-related Effects to Ringed Seal

Project Component	Habitat Loss and Alteration	Disturbance	Disruption Movement	Attraction to the Project Site	Direct Mortality	Increased Access and Harvest	Changes in Media Quality
Construction							
Expansion of Roberts Bay facility	X	X					
Expansion of Doris footprint	X	X					
Fuel Handling and Storage							X
Equipment Operation at Roberts Bay facility		X					
Vessel Traffic		X			X		
Operations and Closure							
Operation of Roberts Bay facility		X					
Fuel Handling and Storage							X
Equipment Operation in Roberts Bay facility		X					
Vessel Traffic		X			X		

Expansion of the Roberts Bay facility may result in some loss of beach habitat used by ringed seals for hauling-out or foraging, as well as disturbance of seals. Construction of the new dock structure at Roberts Bay will involve sheet pile vibratory driving and quarry blasts near the marine environment.

Operation of on-site roads at and the handling of equipment in the laydown area at Roberts Bay may result in some disturbance due to noise from vehicles and heavy equipment. The potential for fuel storage to result in changes in media quality in soil and water was also evaluated due to fuel handling and storage.

The Doris Project was permitted for six to eight vessels per year. The Madrid-Boston and Hope Bay Project will be using six to seven vessels per year, which will report to Roberts Bay each year during the construction and operation phases, and potentially for a short duration during reclamation and closure. This represents the same amount of shipping between the Doris and Phase 2 Projects. However, as part of the Madrid-Boston Project, vessel traffic will extend beyond the six-year lifespan of the Approved Project for an additional 11 years. Vessels will originate in Vancouver, Montreal, or the Mackenzie River and transit either the eastern or western commercial shipping routes. The ships will carry cargo and diesel fuel to Roberts Bay and will remove non-combustible and hazardous waste.

Vessel traffic for the Hope Bay Project will be conducted by tankers, bulk carriers, or barges strengthened to Type B to CAC 2 Ice Class. Vessel cruising speed will be approximately 13.5 knots (25 km/h) in the commercial shipping route and considerably slower in Melville Sound and Roberts Bay. Vessel traffic will occur during the open-water period and there will be no ice-breaking, except during emergency situations.

It is not expected that shipping or the Roberts Bay facility will result in disruption of movement for ringed seals because shipping will be infrequent and the moving vessels are unlikely to form a barrier to movement.

It is not expected that increased access to the site will result in increased hunting of ringed seals at the Project site. TK indicates that good hunting locations for seals and other marine mammals are concentrated elsewhere in the MRSA. The socio-economic assessment concluded that an increase in human immigration and hunting is unlikely in the wildlife MRSA and no seal hunting by Project personnel or visitors to the site has been reported at the Doris Site. In addition, hunting will not be permitted by Project employees while on site. Thus, the Project is not expected to cause an increase in ringed seal mortality due to facilitation of hunter access.

11.5.2.2 Marine Birds

Potential Project-related effects on marine birds were considered for the locations where they may interact with marine birds - shipping within the MRSA and activities at the Roberts Bay facility. Potential effects on marine birds and their habitat were included based on Traditional Knowledge, community concerns, professional judgement, experience at other similar projects in Nunavut and the scientific literature.

The potential effects on marine birds were also evaluated temporally over project phases (construction, operation and reclamation/closure) and within the year (e.g., open water vs. sea-ice periods). Interactions of marine birds with Project components were evaluated to determine which of the following potential effects may occur (Table 11.5-3):

- habitat loss;
- disturbance;
- disruption of movement;

- attraction to the Madrid-Boston Project;
- direct mortality;
- increased access and harvest; and
- changes in environmental media quality

Table 11.5-3. Potential Project-related Effects to Marine Birds

Project Component	Habitat Loss and Alteration	Disturbance	Disruption Movement	Attraction to the Project Site	Direct Mortality	Increased Access and Harvest	Changes in Media Quality
Construction							
Expansion of Roberts Bay facility	X	X					
Expansion of Doris footprint	X	X					
Fuel Handling and Storage							X
Equipment Operation at Roberts Bay facility		X					
Vessel Traffic		X			X		
Operations and Closure							
Operation of Roberts Bay facility		X					
Fuel Handling and Storage							X
Equipment Operation in Roberts Bay facility		X					
Vessel Traffic		X			X		

Expansion of the Roberts Bay facility may result in some loss of beach habitat used marine birds, as well as disturbance of marine birds. This habitat loss would occur during construction and continue during operations and into post-closure.

Operation of on-site roads at and the handling of equipment in the laydown area at Roberts Bay may result in some disturbance due to noise from vehicles and heavy equipment. Construction of the new dock structure at Roberts Bay will involve sheet pile driving and blasting of quarries near the ocean. Construction noise will occur during the construction phase. Vehicle-based noise will occur during the construction, operations and closure phases within the Roberts Bay site.

The Doris Project was permitted for six to eight vessels per year. The Madrid-Boston and Hope Bay Project will be using six to seven vessels per year, which will report to Roberts Bay each year during the construction and operation phases, and potentially for a short duration during reclamation and closure. This represents the same amount of shipping between the Doris and Phase 2 Projects. However, as part of the Madrid-Boston Project, vessel traffic will extend beyond the six-year lifespan of the Approved Project for an additional 11 years. Vessels will originate in Vancouver, Montreal, or the Mackenzie River and transit either the eastern or western commercial shipping routes. The ships will carry cargo and diesel fuel to Roberts Bay and will remove non-combustible and hazardous waste.

The potential for shipping to result in disturbance to marine birds was evaluated, as was the potential effect of direct mortality due to vessel strikes. Noise due to shipping will occur during both the construction and operations phases and to a lesser degree during the closure phase.

It is not expected that shipping or the Roberts Bay facility will result in disruption of movement for marine birds because shipping will be infrequent and the moving vessels are unlikely to form a barrier to movement.

It is not expected that increased access to the site will result in increased hunting of marine birds. TK indicates marine birds are predominantly harvested at seabird colonies, which do not occur in the marine LSA. In addition, hunting will not be permitted by Project employees while on site. Thus, the Project is not expected to cause an increase in marine bird mortality due to facilitation of hunter access.

11.5.3 Mitigation for Marine Wildlife VECs

Mitigation and management measures were identified through a review of best management practices from similar mining projects in the Arctic, comments from community members during scoping meetings, formal review by the KIA and GN DOE of the existing Doris Project management plan (the Wildlife Mitigation and Monitoring Plan [WMMP]), scientific literature and professional experience.

Mitigation and management measures are in place to minimize potential effects to air quality, the noise environment, and marine water/sediment quality and described in the following plans in Volume 8 of the EIS:

- Annex V8-2 - Air Quality Management Plan.
- Annex V8-8 - Hope Bay Project Noise Abatement Plan; and
- P4-18 - Hope Bay Project Phase 2 Aquatic Effects Monitoring Plan

Management plans to control non-hazardous, hazardous and food wastes in Volume 8 of the EIS:

- Package P4-13 - Hope Bay Project Interim Non-hazardous Waste Management Plan;
- Package P4-15 - Hope Bay Project Hazardous Waste Management Plan; and
- Package P4-16 - Incinerator Management Plan.

Management plans to manage water quality at each site and ensure that water quality objectives are met in Annex V1-7 of the EIS:

- Package P4-4 - Doris Project Domestic Wastewater Treatment Management Plan;
- Package P4-5 - Hope Bay Project: Boston Sewage Treatment Operations and Maintenance Management Plan.
- Package P4-6 - Hope Bay Project Groundwater Management Plan;
- Package P4-7 - Hope Bay Project Doris-Madrid Water Management Plan;
- Package P4-8 - Hope Bay Project Boston Water Management Plan
- Package P4-11 – Hope Bay Project Waste Rock and Ore Management Plan; and
- Package P4-18 - Hope Bay Project Aquatic Effects Monitoring Plan.

Spill management plans to protect the environment should a spill occur are located in the following sections of the EIS:

- Annex V8-1 - Oil Pollution Prevention Plan (OPPP)/Oil Pollution Emergency Plan (OPEP); and

- Package P4-3 - Hope Bay Project Spill Contingency Plan.

The closure and reclamation plan to minimize long-term effects on wildlife habitat is located in Annex V1-7 of the EIS:

- Package P4-19 - Hope Bay Project Boston Conceptual Closure and Reclamation Plan, November 2017; and
- Package P4-21 - Hope Bay Project Doris-Madrid Interim Closure and Reclamation Plan, November 2017.

Mitigation by Project Design

The Project design includes mitigation for potential effects of the Project on marine wildlife. The most important mitigation included in the Project design is to conduct shipping activities during the open-water season - outside of the sensitive periods for ringed seals and Dolphin and Union (island) caribou. Design mitigation includes:

1. Open-water season shipping only (no ice-breaking).
2. Infrastructure designed to minimize the Project footprint in marine habitat.
3. Project infrastructure designed to avoid, where possible, identified wildlife sensitive areas, such as marine mammal haul-outs and marine bird rookeries.
4. Accommodation barges will not be used.

Best Management Practices

The WMMP (Annex V8-3) includes best management practices intended to address specific potential effects on wildlife, including habitat alteration and mortality or disturbance in the marine environment. These management actions include the following policies applicable to all employees:

- a no feeding of wildlife policy;
- a no littering policy;
- a no hunting policy for all Project staff and contractors while on site; and
- all Project roads will be closed to the public.

The following best management practices will be carried out to minimize potential effects on marine wildlife:

- Ships will avoid the large marine bird colony on Prince Leopold Island by 25 km, except where the safety of the ship dictates otherwise.
- Ships will avoid groups of marine mammals and aggregations of marine birds.
- Aircraft (helicopters) will avoid marine bird colonies by given setback distances.
- Airstrips monitored prior to take-off and landings to ensure marine birds are not present on the landing strip.
- A speed limit will be set and enforced on all Project roads, including the Roberts Bay facility.
- Wildlife given the right-of-way on all roads at all times.

- Wastes will be managed such that they are not introduced into the marine environment.
- Protocols for human-wildlife interactions will be developed to protect both sit personnel and marine wildlife in cases where wildlife may come in contact with Personnel.

Best management practices will be used to manage fuels, hazardous materials to prevent spills, and to contain and clean up any spills that may occur in the marine environment, including:

- The Hope Bay Spill Contingency Plan is designed to protect worker and public safety and minimize any effects of a spill of fuel, soluble solids, liquids like solvents or paint, flammable gases and other hazardous substances on the environment.
- Oil Pollution Prevention Plan (OPPP)/Oil Pollution Emergency Plan (OPEP) describes the responses to oil spill scenarios at the Roberts Bay facility and is a requirement of the *Canada Shipping Act* (2001).
- The Shipboard Oil Pollution Emergency Plan (SOPEP) describes the equipment, training and procedures that the ship must have on board in order to manage and address any fuel spills during shipment or unloading to minimize any effects on the environment and is a requirement of the International Maritime Organization (IMO) for all ships transporting fuel.

Several general methods are available to mitigate the effects of pile driving noise in the marine environment. These range from engineering controls to Project monitoring activities. All mitigation measures included below are designed to provide protection from impacts to fish mortality (Volume 5, Section 10) and marine mammal temporary hearing.

- Marine Mammal Observer Program – have wildlife monitors survey for seals and birds and cease pile driving if wildlife are within a 200 m buffer safety zone.
- Use of vibratory pile driving instead of impact pile driving.
- Acoustic monitoring of pile driving activity.
- Establish underwater noise thresholds within 25 m of piling activities, which trigger additional mitigation measures.
- Soft Start Procedures – Prior to initiating any noise generating activity mechanical operations should undergo a "*soft start*" procedure. Where bubble curtains are to be used, this entails generation of a bubble curtain for at least 10 minutes prior to initiation of activity. Noise generating equipment such as the vibratory hammer will then slowly ramped to a maximum to allow marine wildlife to avoid the area.
- Stop work - When sound levels breach the newly recommended maximum threshold of 22.4 kPa (207 dB re: 1 µPa) or a maximum of 3.2 kPa (190 dB re: 1 µPa) for marine mammals outside of the 200 m exclusion zone this should be reported to the contractor for implementation of any additional mitigation measures.
- Additional mitigation - Should thresholds presented above be exceeded, the implementation of an attenuation device (e.g., bubble curtain) will be considered when pile driving is occurring to reduce peak underwater noise. Bubble curtains can reduce underwater noise impacts up to 20 dB through attenuation of sound energy using air bubbles suspended in the water column (Vagle 2003). Bubble curtains will be installed to completely surround each site of pile driving activity for entire duration of noise generation. Alternatively, the size of the safety zone may be expanded from 200 m to a greater distance where the noise levels drop below guidelines.

Proposed Monitoring Plans and Adaptive Management

The Project will conduct marine wildlife monitoring to evaluate the effectiveness of mitigation and test the predictions of the EIS. Potential effects on marine wildlife will be adaptively managed, and plans will be reviewed periodically to meet current standards, in response to unexpected monitoring results, in response to scientific findings, or due to a significant change in the Project activities.

Marine water quality and sediment quality will be monitored as part of the Aquatics Effects Monitoring Plan (Package P4-18).

The following monitoring will be conducted at Project facilities to evaluate management actions:

- footprint monitoring to monitor habitat loss;
- noise monitoring;
- recording any hunters using the Project site;
- waste management monitoring;
- recording any collisions between vehicles and wildlife; and
- recording incidental marine wildlife observations to help identify unexpected interactions with marine wildlife.

Monitoring will also be conducted for marine wildlife VECs to evaluate the predictions of the EIS, including:

- continued monitoring of waterbirds and marine birds through helicopter-based surveys;
- observations by ship's crew of marine mammals and marine birds; and
- monitoring for pile driving will include the best practice measures described in Section 11.6.4.2, and prior to the start of any activity, a marine mammal observer will be stationed to identify any marine mammals and birds within the minimum marine mammal exclusion zone of 200 m.

The following activities are also proposed:

- Hydroacoustic monitoring – During use of the vibratory hammer and any other activities having the potential to create sound energy, sub-surface hydroacoustic monitoring with a hydrophone will be conducted to confirm predictions of sound generation and detect mean and maximum sound energy; and
- Observations for fish kills or impairment throughout the period of sound generation.

11.5.4 Characterization of Potential Effects

11.5.4.1 Ringed Seals

The following sections evaluate the potential effects of habitat loss, disturbance due to noise, and direct mortality on ringed seals.

Habitat Loss

The expansion of the Roberts Bay facility will include the construction of a cargo dock on a rocky section of shoreline. The potential for this cargo dock to result in habitat loss for ringed seals is evaluated in this section.

Preliminary design criteria for the dock facilities include the geometry and load capacity required to support the design vessel(s) and estimated equipment loads. Design environmental criteria include site geotechnical characteristics and loads associated with ice, surge, and wave interaction. Details of the design criteria are presented in Package P5-10. The planned dock will also include mooring points established on shore with rock anchors or large blocks, to fix the temporary containment boom to shore. A dock will be constructed at the Roberts Bay facility to accommodate unloading of supplies directly from ships, rather than through the use of lightering barges. Fuel ships will anchor offshore and unload via a fixed hose.

The Roberts Bay cargo dock will be T-shaped, with a ~150 m long causeway and a 150 x 50 m dock at right angles to the causeway. The dock will meet the shore on exposed bedrock and will alter approximately 50 m of bare rock shoreline. For a detailed description of the dock construction, and the above and below-water habitat types at the dock location, see the Marine Fish assessment (Volume 5, Section 10).

The cargo dock facility will be constructed by vibrating sheet piles into the sediment, filling the resulting box structure with clean quarry material, and a compacting a rock cap. The sheet pile box structure will be surrounded by an embankment of armour rock designed to protect the sheet pile structure from ice scour except on the front face where ships will moor. The amount, angle, and wetted surface area of the armor rock will be designed to largely offset the loss of fish, marine bird, and marine mammal habitat due to the construction of the dock.

A natural beach landing sufficient to land a 5 to 8 m work boat is also required. This can be a natural beach area or run of quarry (ROQ; greater than 1 m) placed in shallow water to create an artificial work boat landing site. Adjacent to the beach landing will be a gravel pad (approximately 30 × 30 m) for vehicle turn-around and spill container storage. Infrastructure will also include a shore manifold with a reel with enough floating hose (approximately 300 m) of six inch diameter for connecting to the tanker.

Baseline surveys indicated that there are no ringed seal haul-outs during the summer in Roberts Bay and the winter density of ice holes for breathing is lower inshore and in Roberts Bay and adjoining Melville Sound than in Bathurst Inlet. This is likely because ringed seals prefer to avoid land-based predators such as grizzly bears and wolverine. Ringed seals typically have their breathing holes and maternal lairs in or along pressure ridges and cracks in the sea ice. The sea ice in Roberts Bay is land-fast, and largely devoid of these features. During the spring seal survey in 2010, seals and breathing holes were more frequently observed in upper Bathurst Inlet and Coronation Gulf in comparison to areas within Melville Sound (Appendix V5-11A).

No high-quality habitat will be lost for marine mammals because seals do not use the exposed rock at the cargo dock site as a haul out. The area of rock that the dock will cover both above and below the water is approximately 0.9 ha, which is 0.1% of Roberts Bay and <0.0001% of the MRSA). The marine fisheries effects assessment concluded that this loss of habitat did not result in a residual effect on fish habitat, and fish are the main prey of ringed seal (Volume 5, Section 10). In summary, Roberts Bay is not considered high quality habitat for ringed seals, very little area will be affected by the cargo dock structure, and effects are not expected on fish, the main food of ringed seals. Hence, habitat loss for ringed seals was **not rated as a residual effect**.

Infrastructure for the Doris Project (part of the Existing and Approved projects) in Roberts Bay includes a 30 m wide and 65 m long jetty. This jetty is used as a landing site for the lightering barges that currently bring equipment and fuel from ships anchored offshore to the Roberts Bay facility. This area is considered lost due to the Existing and Approved projects. As a consequence, the potential effects of habitat loss will go from the current loss of 30 m of shoreline to a total of 100 m of shoreline during Madrid-Boston.

This total area is small (0.1%) of Roberts Bay. Hence the combined habitat loss for the Hope Bay Project is **not rated as a residual effect** for ringed seals and not considered further in the assessment.

Disturbance

The potential for ringed seals to be disturbed by underwater noise from the construction of the Roberts Bay cargo dock and shipping was evaluated.

Construction Activities

Construction of the Roberts Bay Cargo Dock — The construction of the Roberts Bay cargo dock will include vibratory pile driving, which could disturb ringed seals and result in seals avoiding the cargo dock area during construction. This effect would occur during the construction period of the Project.

Sheet piles will be driven into the sea floor during the construction of the new cargo dock in Roberts Bay. Marine mammals generally do not suffer mortality events from underwater noise (Popper et al., 2014); however, data show that temporary hearing impacts can occur at noise levels above 1.0 kPa (180 dB re: 1 µPa).

The United States National Marine Fishery Services (NMFS) recommends that acoustic safety zones be established at 180 dB re: 1 µPa for the protection of temporary hearing injury to whales, porpoises, and dolphins (Vagle 2003; NOAA 2013).This value is more conservative than the threshold for seals and sea lions of 3.2 kPa (190 dB re: 1 µPa) used by NMFS (Vagle 2003). The proposed Project safety zone for the sheet pile driving during construction of the Roberts Bay jetty is 200 m. This safety zone is consistent with that at other industrial projects in the Arctic that have in-water works such as Baffinland.

Trained marine mammal observers (MMO) will survey the safety zone for marine mammals and work will be stopped if/when mammals are observed within the 200 m safety zone.

Noise levels will be monitored with hydrophones will ensure that noise guidelines are being met within the safety zone. Should monitoring indicate that noise is exceeding guidelines, additional mitigation will be applied to reduce noise or the safety zone will be expanded accordingly. With monitoring for marine mammals, work stoppages when marine mammals are observed in the safety zone, noise monitoring and additional noise suppression if required, **no residual effects on marine mammals are expected from sheet pile driving**.

Blasting at Roberts Bay Quarries — As part of the construction of the cargo dock, on-shore blasting is planned in two quarries for borrow material to build laydown pads and the access road. One quarry is located adjacent to the cargo dock and stretches approximately 30 to 500 m from the shoreline. The second quarry is located adjacent to the existing jetty and extends approximately 30 to 250 m from the shoreline. Noise from on-shore blasting was evaluated for potential effects on marine mammals, marine birds (Section 11.5.4), and fish (Volume 5, Section 10).

Mitigation for on-shore quarry blasts will follow that for sheet pile driving, using marine mammal observers to determine if marine mammals are present within a 200 m safety zone of the blast. If marine mammals are within this area, then blasting will cease until the marine mammals move beyond the exclusion zone. Underwater acoustic monitoring will ensure that the blasting noise is meeting noise guidelines within the safety zone. If noise does not meet guidelines, then additional mitigation will be implemented or the safety zone will be expanded accordingly. With these mitigations in-place, **no residual effects on marine mammals are expected from blasting in the Roberts Bay quarries**.

The construction period for the Roberts Bay cargo dock is restricted to a short period during the construction phase. The construction location is in Roberts Bay, which will contain noise from pile driving. Baseline studies have indicated that there are no haul-outs for ringed seals or other marine mammals in Roberts Bay and the density or winter breathing holes in the bay are low compared to Melville Sound. Traditional knowledge indicates that ringed seals are not harvested in Roberts Bay (Banci and Spicker 2016). Therefore, construction activities at Roberts Bay are not anticipated to disturb ringed seals and **no residual effect is anticipated**.

Disturbance to ringed seals due to the existing Roberts Bay laydown, which is part of the Doris Project, is limited to the operation of a lightering barge from ships to the shore and on-shore activities in the Roberts Bay laydown site. The combination of existing and Project activities is not likely to have an effect on ringed seals because the existing use of the lightering barges and the lightering barge landing site will be discontinued and replaced with the Madrid-Boston dock. The Madrid-Boston jetty has already been assessed as **not a residual effect** and is not assessed further.

Vessel Traffic

Between six and seven vessels will report annually to the Roberts Bay facility during construction and operations and potentially during closure. This is the same level of vessel traffic per year compared to the Approved Project. As part of the Madrid-Boston Project, vessel traffic will be extend beyond the six-year lifespan of the Approved Project for an additional 11 years. Average vessel cruising speed is estimated at 13.5 knots (25 km/h), but slower in Roberts Bay.

Commercial vessels cruising in open water emit low-frequency underwater noise from 10 to 100 Hz (NRC 2003; Hildebrand 2009; McKenna et al. 2012). Open-water shipping during the construction and operations phases were used to assess the effects of disturbance to ringed seals because these are the phases with the most shipping activity.

Seals do not appear to respond strongly to ships and, in some areas, are commonly observed close to vessels (Harris, Miller, and Richardson 2001; Miller and Davis 2002; Miller and Moulton 2003). Some seals are likely to avoid approaching vessels by a few metres to tens of metres, whereas some curious seals are likely to swim toward vessels.

Hearing limits for seal species have been estimated to be 75 Hz to 30 kHz in air and 75 Hz to 75 kHz in water which has minimal overlap with the range produced by ships (75 to 100 Hz) (Mohl 1968; Terhune and Ronald 1971, 1972; Kastak and Schusterman 1999; Reichmuth 2008; Kastelein et al. 2009). Data on the hearing of ringed seals was supplemented by data on harbour seals (Richardson et al. 1995) because these species are close relatives (Árnason et al. 1995).

No minimum exposure criteria for underwater noise levels exist for the protection of marine mammals in Canada. Continuous sounds with noise sensation levels between 80 dB re: 1 µPa and 100 dB re: 1 µPa cause an avoidance response in seals (Davis and Malme 1997). Some seals are assumed to exhibit minor behavioural responses (e.g., changes in swim speed) at 70 dB re: 1 µPa sensation levels. Avoidance responses are anticipated to be temporary, returning to normal conditions with the cessation of the noise source.

Noise modelling conducted for the Mary River Project (Baffinland Iron Ore Corporation 2012) reported that noise would attenuate to 70 dB within approximately 200 m from the vessel. For a large vessel of 190 m x 30 m, the area where noise would exceed 70 dB would be approximately 0.21 km^2. Using an estimated ship speed of 25 km/h, a seal that does not move away from the ship would be exposed to noise above 70 dB for approximately 1.4 minutes, which would be the incremental increase in noise disturbance due to the single additional ship associated with the Project development.

Any disturbance to ringed seals along the shipping route would be transitory. Given the estimated source levels, infrequency of traffic, and seal distributions, the disturbance will be minor or brief, lasting less than 20 minutes per year on the shipping route and affecting only those seals within 250 m of the ship. As ringed seal density is anticipated to be low in the marine wildlife MRSA during the summer when shipping will occur, seals are generally anticipated to avoid ships, and the area and duration of disturbance to ringed seals is both small and short. Therefore the effect of disturbance on ringed seal for both the Madrid-Boston and Hope Bay Projects is not expected to adversely affect seals and **no residual effect is anticipated**.

<u>Direct Mortality</u>

The potential for ship strikes to result in direct mortality of ringed seals was evaluated. The majority of mortality and injury due to vessel strikes are reported for large whales (Jensen, Silber, and Calambokidis 2003), although evidence of vessel strikes have recently been reported for seals in the UK (Thompson et al. 2010).

Management to prevent direct mortality on ringed seals (and other marine mammals) includes avoiding known haul-outs and rookeries in the MRSA and along the shipping route by greater than 5 km, and avoiding marine mammals whenever they are observed.

In general, incidences of vessel strikes on seals are rare. There has been some evidence from the UK and Atlantic Canada that mortalities can occur due to ducted propellers, which are common on tugs, self-propelled barges, and offshore support vessels, but uncommon on commercial shipping vessels (Thompson et al. 2010). The Madrid-Boston and Hope Bay Project represent the same level of shipping as the Approved Project and there are few ringed seals in Roberts Bay and Melville Sound in general. Given the short duration of noise disturbance for seals that may occur along the vessels path and with mitigation and management, the potential for mortality due to shipping for seals from the Madrid-Boston and Hope Bay Projects is **not anticipated to result in a residual effect.**

11.5.4.2 Marine Birds

The potential effects of habitat loss, disturbance, and direct mortality were evaluated for marine birds.

<u>Habitat Loss</u>

The potential for habitat loss and alteration due to the expansion of the Roberts Bay facility was evaluated for marine birds.

Baseline surveys searched for seabird colonies in the MRSA and evaluated the locations and relative densities of seabird nesting within Melville Sound and Roberts Bay. Within Melville Sound and Roberts Bay, there were no seabird colonies, but seabirds were found nesting on the beach and ground surface at low densities. The greatest density of seabird nests in Melville Sound and Roberts Bay were on small islands (< 20 ha), presumably to avoid predation during the nesting period by terrestrial predators such as foxes, wolverines, and weasels. Surveys indicated that the density of nests on the shore of the mainland was extremely low, presumably due to predation risk.

The closest seabird colonies to the Project are on small islands and bays in northern Bathurst Inlet and in Elu Inlet at the east end of Melville Sound. Bathurst Inlet, Melville Sound, and Elu Inlet are designated as a key bird habitat site by the Draft Nunavut Land Use Plan (Environment Canada 2014). In addition, there is a conservation area, the Queen Maud Gulf Migratory Bird Sanctuary, approximately 50 km east of Roberts Bay by air and over 300 km by water. Melville Sound is isolated from the Queen Maud Gulf by the Kent Peninsula.

There were no marine staging areas for marine birds observed during marine baseline surveys or ongoing waterfowl monitoring for the Doris Project. The shipping route in the northern MRSA does transit through a portion of a Key Marine Habitat Sites (KMHS) for Pacific common eider (Bathurst Inlet/Elu Inlet KMHS). Some eider using these island chains within the MRSA for breeding may also use adjacent marine habitats for moulting and staging from mid-July through early October. However, Parry Bay and Melville Sound within Elu Inlet, well to the northeast of the MRSA, appears to be the principle moulting and staging area for male and female eiders breeding in northern Bathurst Inlet and Elu Inlet (Dickson 2012b).

The Roberts Bay cargo dock will be T-shaped, with a ~150 m long causeway and a 150 x 50 m dock at right angles to the causeway. The dock will meet the shore on exposed bedrock and will alter approximately 50 m of bare rock shoreline. This exposed rock habitat is considered low quality habitat for marine birds. For a detailed description of the dock construction, and the above and below-water habitat types at the dock location, see the Marine Fish assessment (Volume 5, Section 10).

The loss and alteration of habitat for seabirds was calculated by comparing the area of potential nesting habitat lost due to the new Roberts Bay Project Development Area (PDA) to the shoreline area available for nesting in the LSA and RSA.

The planned Madrid-Boston Roberts Bay infrastructure is surrounded by an averaged buffer of 250 m. This footprint plus buffered area (the PDA) is 96.7 ha. The area of the Madrid-Boston Project PDA within 100 m of the shoreline that could serve as nesting habitat for seabirds is 0.6 ha. This accounts for approximately 0.014% of the 4,287 ha of shoreline habitat in Roberts Bay (the marine LSA), and accounts for approximately 0.0023% of the nesting habitat in the MRSA (i.e., 23,500 ha of habitat within 100 m of the coastline).

The existing infrastructure in the Roberts Bay laydown that is within 100 m of the shoreline is 4.3 ha. The total infrastructure for the Hope Bay Development is therefore 4.9 ha within 100 m of the shoreline, which is 0.11% of the marine LSA and 0.021% of the shoreline habitat in the MRSA.

This assumes that all shoreline habitat in the MRSA is of equal quality as nesting habitat. TK and aerial surveys indicate that seabirds predominantly nest on islands of lower than 20 ha to lower predation risk (Dickson 2012b). Therefore the habitat removed for the Roberts Bay laydown can be considered poor quality habitat since it is on the mainland. The alteration of habitat is therefore considered negligible compared to the area available for use and given its poor habitat quality.

Baseline surveys and ongoing compliance monitoring for the Doris Project (the WMMP) did not identify any seabird staging areas in Roberts Bay. Baseline surveys did not identify any staging or moulting areas in Melville Sound. Areas used by seabirds for colony nesting and moulting do occur in Elu Inlet, but that area is outside of the marine shipping route.

As a consequence of the low amount of nesting habitat that will be removed due to Roberts Bay PDA, the very low densities of seabirds that use the mainland coast in Roberts Bay and the lack of migratory staging areas in Roberts Bay, the potential effect of habitat loss and alteration is **not considered a residual effect for the Madrid-Boston Project**.

For the Hope Bay Development, the existing Roberts Bay facility is comprised of the laydown area, landing area for a lightering barge, and fuel tank farm, and as removed 7.1 ha of near-shore habitat that could be used by marine birds for nesting. The existing and planned PDA areas total 103.8 ha. As discussed above, the small size of these facilities, low density of seabirds nesting on the mainland shore, and lack of marine staging areas result in this combined habitat loss is **not considered a residual effect on marine birds**.

Disturbance

The potential for disturbance of seabirds due to the construction and operation of the Roberts Bay cargo dock and expansion of the laydown area was evaluated for Madrid-Boston. The potential for disturbance due to noise from ships was also evaluated. Madrid-Boston does not include the use of seaplanes, so aircraft noise was not considered.

Construction of the Roberts Bay Cargo Dock

The construction of the Roberts Bay cargo dock will require driving of sheet piles, which has the potential to disturb marine birds and result in birds avoiding the cargo dock area during construction. This effect would occur during the Construction phase of Madrid-Boston. Studies report that marine birds typically react to project-related noise within a generally localized area (Larsen and Laubek 2005; Ronconi and St. Clair 2006; Schwemmer et al. 2011).

The construction period for the cargo dock is restricted to a short period during the construction phase. The construction location is in Roberts Bay, which will contain noise from pile driving. Baseline studies have indicated that the nearest congregation of nesting areas for marine birds are approximately 800 m away on the islands in the middle of Roberts Bay and the nearest colony nesting areas for birds are in Elu Inlet (more than 25 km away) and northern Bathurst Inlet (approximately 100 km away).

Management to reduce the potential for disturbance on marine birds due to pile driving for the cargo dock will include monitoring of a 200 m safety zone by a MMO and halting pile driving if large aggregations of marine birds occur in the safety zone (Section 11.5.3). These standard mitigation measures will be in place to protect marine mammals (Section 11.5.3) and will likewise protect marine birds. Monitoring using hydrophones will ensure that noise guidelines for marine mammals are met within the safety zone. Should noise levels not meet guidelines, then additional mitigation will be applied (e.g., bubble nets) or the safety zone will be expanded. These measures will also protect marine birds. Therefore, construction activities at the Roberts Bay are not anticipated to disturb marine birds and **no residual effect** is anticipated.

Disturbance to marine birds due to the existing Roberts Bay laydown, which is part of the Doris Project, is limited to the operation of a lightering barge from ships to the shore and on-shore activities in the Roberts Bay laydown site. The combination of existing and Project activities is not likely to have an effect on marine birds because the existing use of the lightering barges and the lightering barge landing site will be discontinued and replaced with the Madrid-Boston dock. The Madrid-Boston dock has already been assessed as **not a residual effect** and is not assessed further. With no significant effects of disturbance on marine birds predicted, there is no potential effect on population health or reproduction.

Vessel Traffic

This section evaluates the potential for seabirds to be disturbed by vessel traffic. Some studies report that seabirds can respond to marine vessels with alert reactions or temporary avoidance of habitats (Brown 1990; Frimer 1994; Ward, Stehn, and Derksen 1994; Mosbech and Boertmann 1999; Schwemmer et al. 2011). Six to seven vessels will report to the Roberts Bay facility per year during the construction and operations phases, and a lower number during the closure phase. Shipping will occur during the open-water season.

Studies in shipping lanes in Norway report that common eider have a median flushing distance of 300 m (Schwemmer et al. 2011), with other species having a longer flushing distance, such as long-tailed duck, white-winged scoter, and black scoter. Large flocks were found to flush at greater distances than smaller flocks. Species capable of sustaining long dives (e.g., scoters, eiders) also commonly dove in response to ship traffic.

A similar study in Denmark reported that wintering seaducks (common eider and black scoter) responded to high speed ferries by flushing or diving when ferries were within 100 to 200 m (Larsen and Laubek 2005). Most birds did not react when ferries were 400 m or further from flocks. Seabirds replace flight feathers during the moulting period and are flightless for up to four weeks. Flightless birds may expend more energy avoiding ships.

Ships from the Project will not transit near any known large colonies of seabirds, or through any known or designated moulting areas. Note that the nearest moulting areas are associated with the small islands and bays in northern Bathurst Inlet and in Elu Inlet at the eastern end of Melville Sound all of which are approximately 5 km from the shipping route (Nunavut Planning Commission 2016). In general, aggregations of seabirds on the water during moulting and staging will occur near land and near colony nesting areas.

Mitigation and management for shipping includes 500 m buffers between ships and any identified seabird colonies, moulting areas and any observed aggregations of seabirds when safe to do so. Ships will also avoid the large colony breeding area on Prince Leopold Island by 25 km, as long as it is safe to do so.

As a consequence, it is not expected that the additional years of vessel traffic due to the Madrid-Boston and Hope Bay Project will disturb and adversely affect marine birds and the potential effect is **not rated as a residual effect**.

Direct Mortality

The potential for shipping to result in direct mortality of seabirds was assessed. Most seabirds will flush (fly away) or dive to avoid disturbances, such as passing ships (Frimer 1994; Larsen and Laubek 2005; Schwemmer et al. 2011). These responses will protect marine birds from the potential for mortality through ship strikes.

As noted above, seabirds replace flight feathers during the moulting period and are flightless for up to four weeks. Mitigation and management for shipping includes buffers between any identified seabird colonies, moulting areas and any observed aggregations of seabirds by 500 m both in the MRSA and the commercial shipping route, and avoidance of Prince Leopold Island by 25 km when safe to do so. As a consequence, ships from the Project will not transit near any known large colonies of seabirds or moulting areas. Note that the nearest moulting areas are associated with the small islands and bays in northern Bathurst Inlet and in Elu Inlet at the east end of Melville Sound all of which are approximately 5 km from the shipping route (Nunavut Planning Commission 2016).

It is therefore not expected that shipping from either the Madrid-Boston or the Hope Bay Development will result in direct mortality for marine birds and the potential effect is **not a residual effect**.

11.5.5 Characterization of Residual Effects

11.5.5.1 Characterization of Residual Effect for Ringed Seal

No residual effects for ringed seal are anticipated due to Project-related activities. Consequently, no potential residual effects were evaluated for significance or carried forward to a cumulative effects assessment. Potential effects of the Madrid-Boston Project and Hope Bay Development on ringed seals are expected to be Not Significant.

11.5.5.2 Characterization of Residual Effect for Marine Birds

No residual effects for marine birds are anticipated as a result of Project-related activities. Consequently, no potential residual effects were evaluated for significance or carried forward to a cumulative effects assessment. Potential effects of the Madrid-Boston Project and Hope Bay Development on marine birds are expected to be Not Significant.

11.6 CUMULATIVE EFFECTS ASSESSMENT

With the conclusion that there are no residual effects of the Madrid-Boston Project, or the Hope Bay Development on ringed seals, no cumulative effects assessment is required.

With the conclusion that there are no residual effects of the Madrid-Boston Project, or the Hope Bay Development on marine birds, no cumulative effects assessment is required.

11.7 IMPACT STATEMENT

11.7.1 Marine Mammals

Marine mammals were included as a marine wildlife VEC based on the NIRB guidelines and because TK identifies marine mammals as a group of species important to the Inuit. Traditional knowledge, species distribution maps and baseline studies indicated that the most common marine mammal in Roberts Bay and Melville Sound is the ringed seal. Other marine mammals such as narwhal, bowhead whale, and polar bear are either not present in the marine RSA, present but rare with only one or two observations, or are not present during the seasons when Madrid-Boston is active.

A review of potential Project interactions with ringed seal identified three potential effects: habitat loss, disturbance, and direct mortality. The assessment described the mitigation and management activities planned to reduce or eliminate potential effects on ringed seal, outlined in the WMMP (Annex V8-3). Fuels and hazardous chemicals will be strictly managed and any spills will be addressed immediately as described in the Oil Pollution Prevention Plan (OPPP)/Oil Pollution Emergency Plan (OPEP; Annex V8-1); and the Hope Bay Project Spill Contingency Plan (SCP; Package P4-3).

Habitat loss was evaluated using TK and baseline studies to determine potential effects of the construction of the cargo dock. Ringed seals, or any other marine mammal, do not have haul-outs or rookeries in Roberts Bay, including the planned cargo dock site. TK indicated that Roberts Bay is not a preferred hunting site for ringed seals, and baseline surveys indicated that the density of winter breathing holes is low in Roberts Bay, compared to the higher densities in northern Bathurst Inlet. With mitigation to minimize the footprint of the cargo dock, habitat loss was not rated as a residual effect.

Scientific studies report that seals are not disturbed by shipping, except when vessels are very close by, and seal populations have remained robust in areas with shipping. Calculations of the period of disturbance indicated that shipping for the Project had the potential to disturb ringed seals within

200 m of the shipping route for approximately 20 minutes per year. Therefore, disturbance was not considered as a residual effect for ringed seal.

Scientific studies report that direct mortality of seals due to collisions with vessels is rare, and unlikely to affect local populations of seals. Therefore, direct mortality was not rated as a residual effect for ringed seals.

With no residual effects identified, a cumulative effects assessment was not required. No potential effects of the Project were rated as residual effects on ringed seal for either Phase 2 or the Hope Bay Belt. Therefore, potential effects of the Madrid-Boston and Hope Bay Projects on ringed seals, used as an indicator for the larger marine mammals community, are rated as **Not Significant**.

11.7.2 Marine Birds

Marine birds were included as a marine wildlife VEC based on the NIRB guidelines and because TK identifies marine birds as a group of species traditionally important to the Inuit for harvest. Traditional knowledge, distribution maps and baseline studies indicated there are important areas for marine birds in Elu Inlet and colonies of marine birds in northern Bathurst Inlet. However, Roberts Bay and the portion of Melville Sound along the shipping route does not support colonies of marine birds. Baseline studies indicate that some marine birds nest on the small islands in Roberts Bay, likely to avoid fox and wolverine predation, but few nest on the mainland shoreline of the bay for this reason.

In many cases, the species of marine birds considered are the same as those assessed as waterbirds in the Terrestrial Wildlife assessment (Volume 4, Chapter 9), but the marine assessment evaluates potential effects in the marine environment and the marine RSA, rather than the terrestrial RSA. A review of potential Madrid-Boston interactions with marine birds identified three potential effects: habitat loss, disturbance, and direct mortality.

The assessment described the mitigation and management activities planned to reduce or eliminate potential effects on marine birds, outlined in the WMMP (Annex V8-3). Fuels and hazardous chemicals will be strictly managed and any spills will be addressed immediately as described in the Oil Pollution Prevention Plan (OPPP)/Oil Pollution Emergency Plan (OPEP; Annex V8-1); and the Hope Bay Project Spill Contingency Plan (SCP; Package P4-3).

Habitat loss was evaluated using TK and baseline studies to determine potential effects of the construction of the cargo dock on marine birds. Marine birds do nest in Roberts Bay, but predominantly on small islands in the bay. Walking surveys of the islands and mainland shore indicated that the mainland shoreline is rarely used as a nesting site. Ground clearing for construction of the cargo dock will occur outside of the nesting period, and pre-construction surveys and setbacks from nests will be used if construction must occur in summer. Given that the cargo dock site is unlikely to be used as a nesting site and with mitigation to minimize the footprint of the cargo dock and manage risk to active nests, habitat loss was not rated as a residual effect for marine birds.

Scientific studies report that marine birds are not disturbed by shipping, except when vessels are close by, and will flush (fly away) or dive to avoid vessels. To minimize potential disturbance and mortality to marine birds, Project vessels will be avoiding the large marine bird colony on Prince Leopold Island by 25 km and following the guidance in the 2016 draft Nunavut Land Use Plan, and avoiding other identified colonies by 500 m, including the breeding locations for common eiders in Melville Sound and northern Bathurst Inlet and other identified breeding locations along the shipping route. The bridge crew of vessels will also survey for marine birds and avoid groups of marine birds rafted on the ocean surface. With this mitigation in place, both disturbance and direct mortality were not considered as a residual effect for marine birds.

With no residual effects identified, a cumulative effects assessment was not required. No potential effects of the Project were rated as residual effects on marine birds for either Madrid-Boston or the Hope Bay Belt. Therefore, potential effects of the Madrid-Boston and Hope Bay Projects on marine birds are rated as **Not Significant**.

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