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9 MARINE BIRDS

The Marine Birds Valued Ecosystem component (VEC) includes species of birds that typically use the nearshore / coastal marine and offshore environments. The groups considered under the Marine Birds VEC are waterfowl (geese and ducks), cormorants, fulmars and other shearwaters, storm-petrels, gannets, phalaropes and other shorebirds, larids (jaegers, skuas, gulls, and terns), stercorariids (jaegers, skuas), and alcids (e.g., Dovekie (Alle alle), murres, and Atlantic puffin (Fratercula arctica)).

9.1 Environmental Assessment Boundaries

9.1.1 Spatial and Temporal

9.1.1.1 Spatial

The Nearshore and Offshore Study Areas, Project Areas and Affected Areas are defined in the Environmental Assessment Methods Chapter (Section 4.3.2). The Study Areas and Project Areas are illustrated in Figures 9-1 and 9-2, for the nearshore and offshore, respectively. The Affected Areas for several Project activities have been determined by modelling (see AMEC 2010; ASA 2011a, 2011b; JASCO 2010; Stantec 2010b).

9.1.1.2 Temporal

The temporal boundary is defined in the Environmental Assessment Methods Chapter (Chapter 4). The nearshore and offshore temporal boundaries are summarized in Table 9-1.

Table 9-1 Temporal Boundaries of Study Areas

Study Area	Temporal Scope
Nearshore	• Construction: 2011 to 2016, activities will occur year-round
Offshore	• Surveys (geophysical, geotechnical, geological, environmental): 2011 throughout life of Project, year-round • Construction activities: 2013 to end of Project, year-round • Site preparation / start-up / drilling as early as 2015 • Production year-round through to 2046 or longer • Potential expansion opportunities - as required, year-round through to end of Project • Decommissioning / abandonment: after approximately 2046

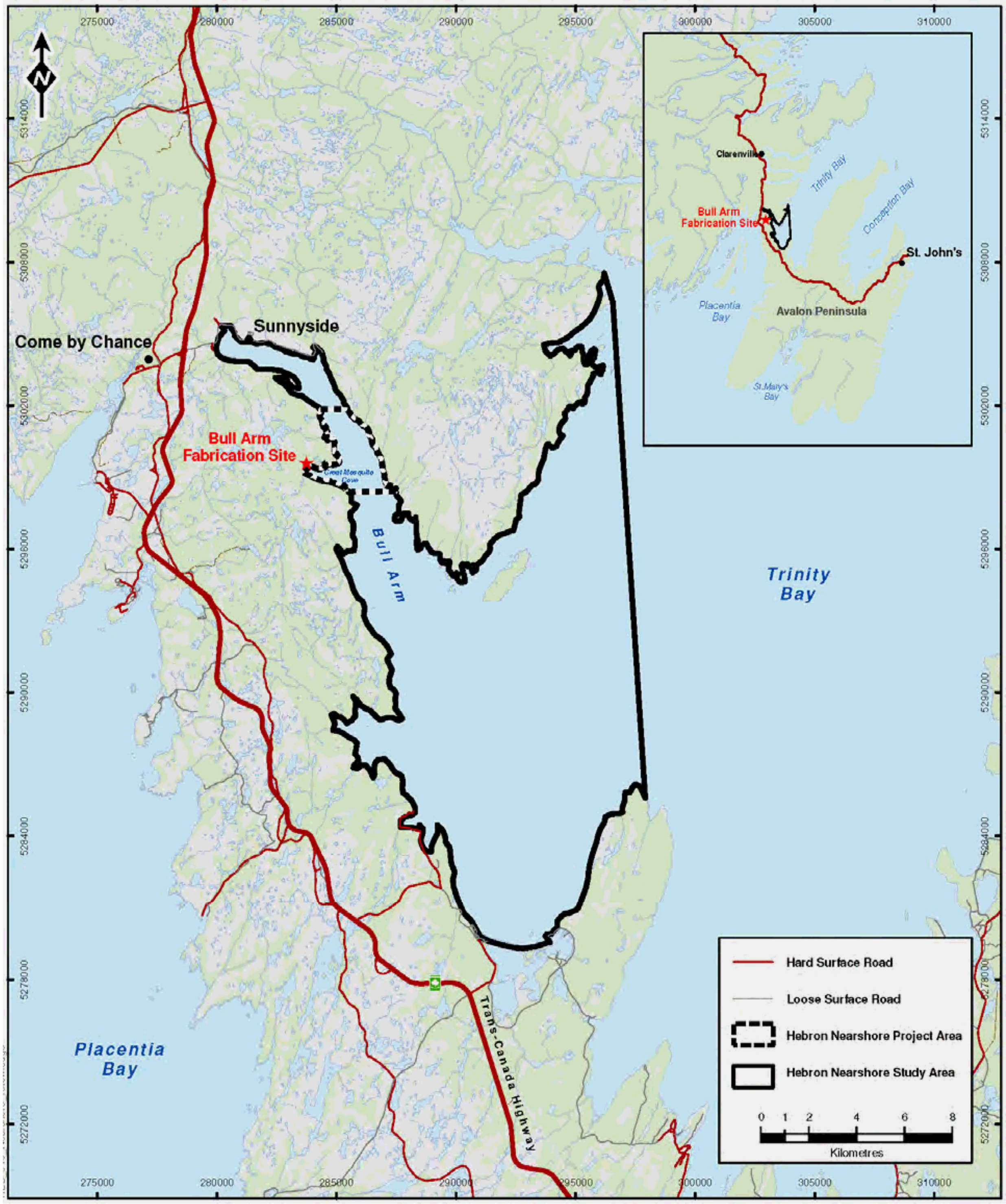

Figure 9-1 Hebron Nearshore Study and Project Areas

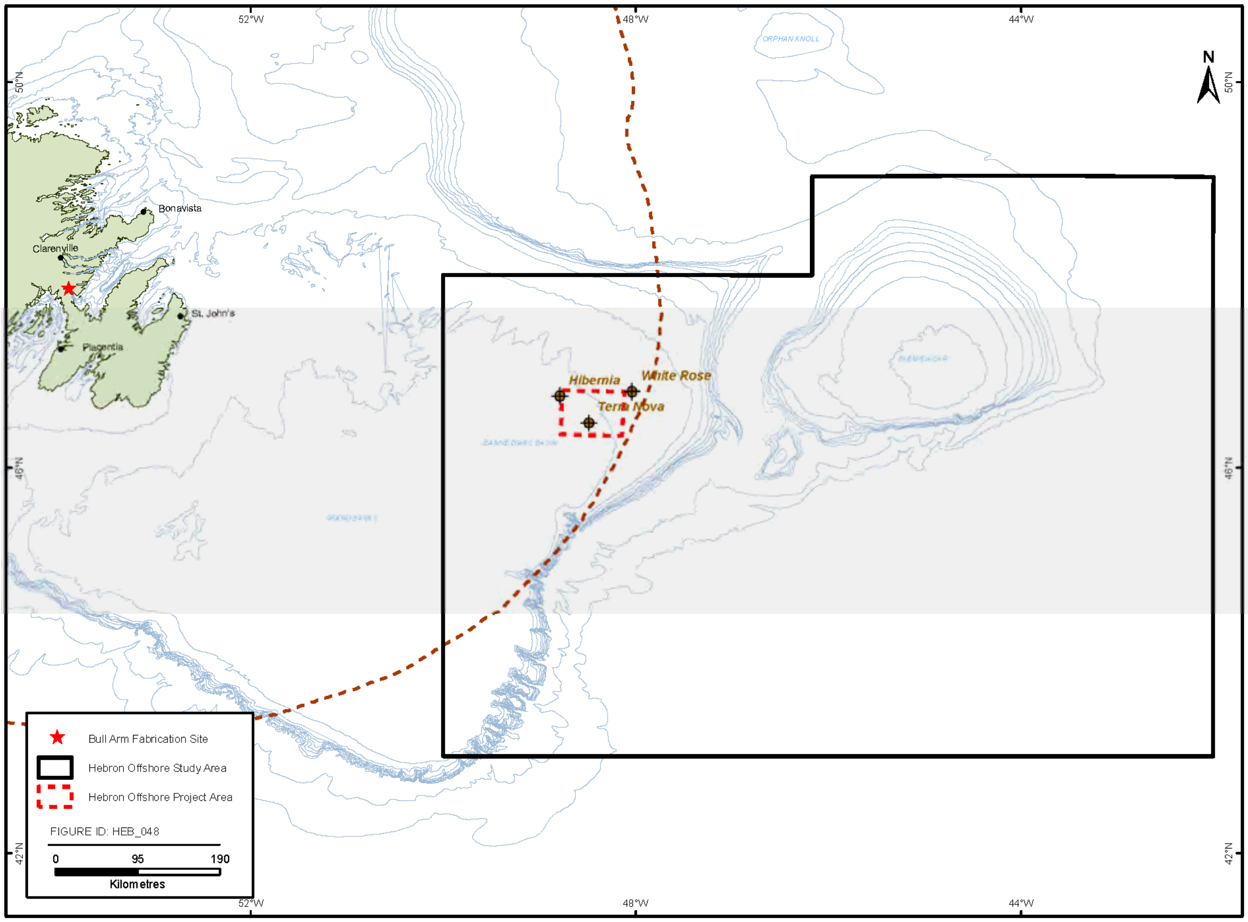

Figure 9-2 Offshore Study and Project Areas

9.1.2 Administrative

Most migratory and many non-migratory bird species are protected under the federal *Migratory Birds Convention Act, 1994*. The *Act* states, in part, that "No person or vessel shall deposit a substance that is harmful to migratory birds, or permit such a substance to be deposited, in waters or an area frequented by migratory birds or in a place from which the substance may enter such waters or such an area." Bird species at risk are protected under the *Species at Risk Act* (SARA) (refer to Section 11.6).

9.2 Definition of Significance

A significant adverse residual environmental effect is one that affects marine birds by causing a decline in abundance or change in distribution of a population(s) over more than one generation within the Nearshore and/or Offshore Study Areas. Natural recruitment may not re-establish the population(s) to its original level within several generations or avoidance of the area becomes permanent.

An adverse environmental effect that does not meet one of the above criteria is evaluated as not significant.

9.3 Existing Conditions

9.3.1 Nearshore

Bull Arm is a steep-sided narrow arm near the bottom of Trinity Bay. Most of the shoreline is rocky and treed to the high tide mark before dropping off into relatively deep water. The tidal zone is mostly narrow and rocky. Habitat for shorebirds (Charadriiformes), such as shoreline deposits of fine sediments and tidal flats, is limited in the Nearshore Study Area. The rocky cliffs could provide nesting habitat for Black Guillemot (*Cepphus grylle*). Bald Eagles (*Haliaeetus leucocephalus*) nest in Trinity Bay and may nest in trees near the shoreline of Bull Arm. Gull and tern species (*i.e.*, Common Tern (*Sterna hirundo*), Arctic Tern (*Sterna paradisaea*), Herring Gull (*Larus argentatus*) and Great Black-backed Gull (*Larus marinus*)) are common throughout coastal Newfoundland, probably include Bull Arm as part of a feeding area and may also nest in small numbers. There are no known concentrations of seaducks (Anatidae) in the winter, summer or during migration in the Nearshore Study Area. Bull Arm is sheltered from the open waters of Trinity Bay, where Dovekie and Thick-billed Murre (*Uria lomvia*) are known to occur in considerable numbers during the winter months (Lock *et al.* 1994).

Bellevue Beach, located at the southern boundary of the Nearshore Study Area, provides important habitat for marine birds. A strong tidal current flowing over a mud flat at the south end of Bellevue Beach creates a rich marine habitat. Gulls, terns, shorebirds and Ospreys (*Pandion haliaetus*) are common here in season. Great Black-backed, Herring and Ring-billed Gulls (*Larus delawarensis*) feed in the tidal currents and on the tidal flats at low tide. There is a nesting colony of gulls and terns on Bellevue Island, 0.5 km from the tidal flats. In 1989, 1,100 nests of Ring-billed Gull were recorded on Bellevue Island (Cairns *et al.* 1989). Smaller numbers of Great Black-backed and Herring Gulls, and Common and Arctic Terns also nest on this island (Cairns *et al.* 1989). Significant numbers of Osprey hunt for fish in the tidal currents; up to 20 Osprey have been observed hovering in the air above the rip tide at one time (B. Mactavish, LGL Ltd., unpublished observations, August 26, 2009). Approximately 15 species of migrating shorebirds, including the Red Knot (*Calidris canutus*), occur regularly on the Bellevue Beach tidal flats during south bound migration (July to October; Table 9-2). The *rufa* subspecies of Red Knot is currently listed as Endangered by the Committee on the Status of Endagered Wildlife in Canada (COSEWIC). This species is described in more detail in Section 11.3.3.1.

Table 9-2 Shorebirds Regularly using Bellevue Beach in the Nearshore Study Area

Species	Scientific Name	Season of Occurrence	Status in Nearshore Study Area
Black-bellied Plover	(*Pluvialis squatarola*)	Aug-Nov	migrant
American Golden-Plover	(*Pluvialis dominica*)	Aug-Oct	migrant
Semipalmated Plover	(*Charadrius semipalmatus*)	Jun-Oct	migrant and summer visitor
Spotted Sandpiper	(*Actitis macularius*)	May-Sep	migrant and local breeder
Greater Yellowlegs	(*Tringa melanoleuca*)	May-Oct	migrant and may breed locally

Species	Scientific Name	Season of Occurrence	Status in Nearshore Study Area
Lesser Yellowlegs	(*Tringa flavipes*)	Aug-Oct	migrant
Hudsonian Godwit	(*Limosa haemastica*)	Aug-Oct	migrant
Ruddy Turnstone	(*Arenaria interpres*)	Jul-Oct	migrant
Red Knot	(*Calidris canutus rufa*)	Aug-Oct	migrant
Sanderling	(*Caldris alba*)	Jul-Oct	migrant
Semipalmated Sandpiper	(*Caldris pusilla*)	Jul-Oct	migrant
Least Sandpiper	(*Caldris minutilla*)	Jun-Sep	migrant
White-rumped Sandpiper	(*Caldris fuscicollis*)	Jul-Nov	migrant
Pectoral Sandpiper	(*Caldris melanotos*)	Aug-Oct	migrant
Short-billed Dowitcher	(*Limnodromus griseus*)	Jul-Sep	migrant

9.3.2 Offshore

The Hebron Offshore Study Area includes portions of the Grand Banks, Flemish Pass and Flemish Cap; however, much of the Study Area is off the Grand Banks. Those features include shelf, slope and deep-water habitats, as well as cold Labrador Current and warm Gulf Stream waters, all of which influence the distribution and abundance of marine birds. Marine birds are not spread evenly over the ocean but tend to be concentrated over anomalies such as shelf edges and areas where currents mix. Mixing in the water column at these edges creates a productive environment for plankton, which is the base of marine food webs.

The Grand Banks Shelf and Slope are rich in abundance and diversity of marine birds (Brown 1986; Lock *et al.* 1994) throughout the year. The food resources of the Grand Banks support many locally breeding birds. Several million marine birds nest along the coasts of the Avalon Peninsula and elsewhere along southeastern Newfoundland, and forage on the Grand Banks during and following the nesting season. In addition to local breeding birds, there are many non-breeding marine birds on the Grand Banks during the summer months. Most of the world's population of Greater Shearwater (*Puffinus gravis*) is thought to migrate to the Grand Banks and eastern Newfoundland to moult and feed during summer months after completion of nesting in the Southern Hemisphere. During the winter months, marine birds from the Arctic and subarctic of eastern Canada, and from Greenland, gather on the Grand Banks. All species of marine birds require more than a single year to become sexually mature. Many of those non-breeding sub-adult marine birds, especially Northern Fulmars (*Fulmarus glacialis*) and Black-legged Kittiwakes (*Rissa tridactyla*), are present on the Grand Banks year-round.

Little is known about the occurrence of birds in the deeper waters of the southeastern portions of the Offshore Study Area, away from the shelf and slope. However, such habitats typically are less productive and thus support far fewer numbers and variety of marine birds than the shelf and slope.

9.3.2.1 Data Sources and Survey Effort for Marine Birds in the Study Area

Most data on the occurrence of marine birds in the Offshore Study Area from the Grand Banks Shelf and Slope and Orphan Basin include the June through September period. Marine bird surveys conducted by environmental observers on offshore installations in the Terra Nova field during 1999 to 2009 fill in some of the data gaps for the October to May period. There are data gaps for all seasons for the Flemish Cap, the deep waters east of the Flemish Cap and southeast of the Grand Banks (see below). The principal sources of data in the Offshore Study Area are surveys conducted by the Canadian Wildlife Service (CWS), and by biologists onboard seismic vessels as part of a marine mammal and marine bird monitoring program required by the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB).

Most of the information available up to 2000 was collected by the CWS through PIROP (Programme intégré de recherches sur les oiseaux pélagiques). Those data have been published for 1969 to 1983 (Brown 1986), and up to the early 1990s (Lock *et al.* 1994). The PIROP survey coverage within and around the Offshore Study Area is presented in Figure 9-3, which is derived from maps in Lock et al. (1994). PIROP marine bird data are of birds per linear kilometre. In 2006, the CWS resumed surveying marine bird abundance and distribution and those recent data have become available for the years 2006 to 2009 (Fifield 2009). New survey protocols (see Wilhelm *et al.* in prep.) based on the Tasker survey method (Tasker *et al.* 1984) were used to collect these recent data, which allow for the derivation of density estimates.

Systematic marine bird observations (Tasker surveys; Tasker *et al.* 1984) were conducted on the northern Grand Banks and the adjacent Orphan Basin from 2004 to 2008. The results of those surveys have greatly increased the knowledge base regarding marine bird distribution and diversity in those areas, at least during the warmer months of June through September (Moulton *et al.* 2005, 2006a; Lang and Moulton 2008; Abgrall *et al.* 2008a, 2008b, in prep.). Marine bird data from other sources have been summarized for the period 1999 to 2002 by Baillie *et al.* (2005) and Burke *et al.* (2005). Tasker surveys provide marine bird data as densities (numbers per km^2). The offshore research and seismic-related cruises on which Tasker surveys and other marine bird observations were conducted are listed in Table 9-3. The geographic distribution of Tasker surveys in and around the Offshore Study Area is illustrated in Figure 9-4.

Marine bird surveys conducted from the drill platform in the Terra Nova field from 1999 to 2009 used variable survey methods from 2-minute to 10-minute counts of all birds within a 300 m radius of the drill platform. Relative abundances, as well as spatial and temporal distribution of marine birds were derived from these data (Suncor unpublished data 2009).

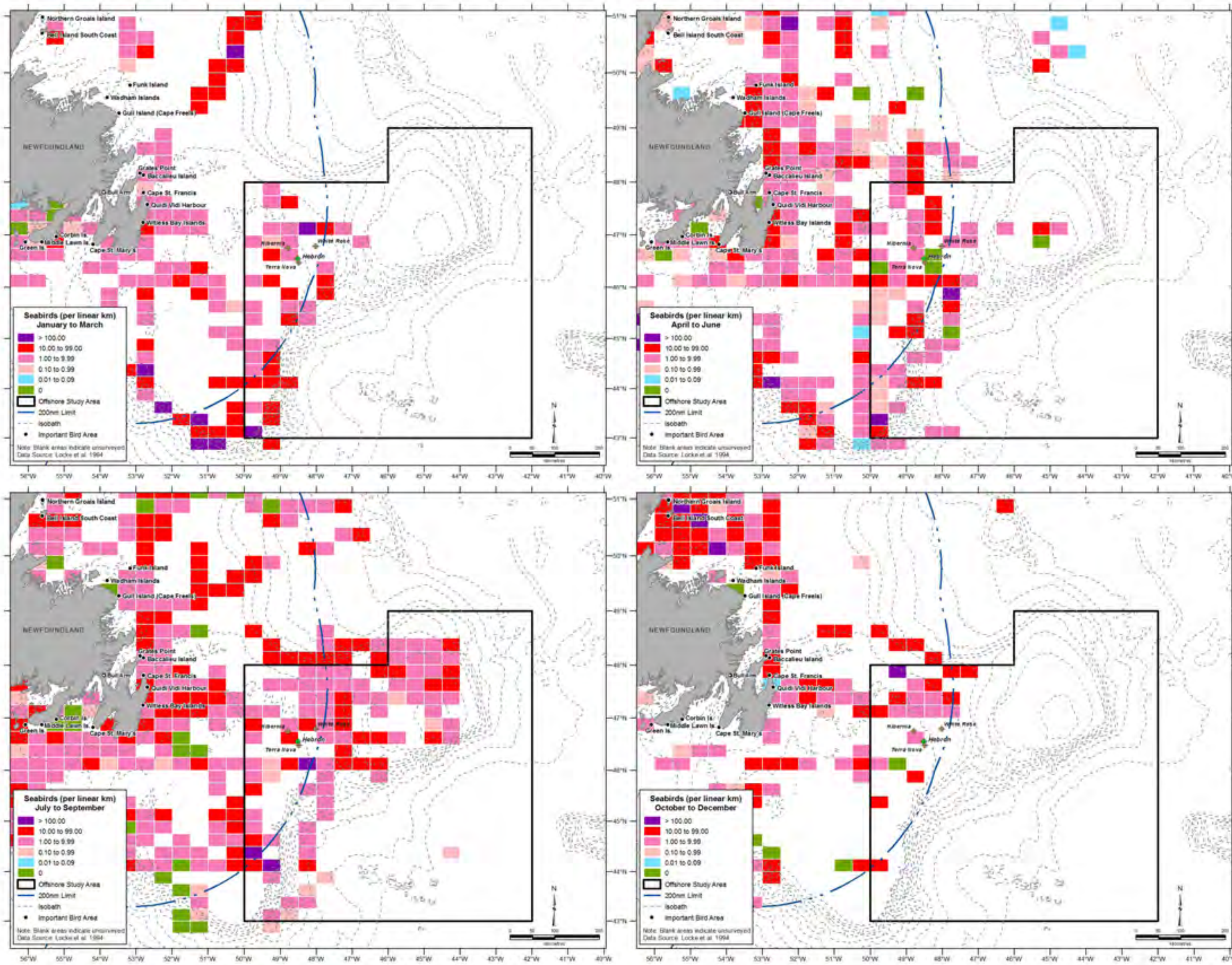

Figure 9-3 Geographic and Seasonal Distribution of Canadian Wildlife Service PIROP Survey Effort and Results in and around the Offshore Study Area

Table 9-3 Recent Seismic, Controlled-source Electromagnetic and Research Cruises in and around the Offshore Study Area during which Marine Bird Observations were Conducted by Biologists (2004 to 2008)

Project	Time Period	Location (Relative to Project Area and/or Study Area)	Approximate Water Depth (m)	Species with Highest Relative Abundances during Observations
CCGS *Hudson* Research Expedition	June 2004	South Grand Banks (southwestern Study Area)	< 100	Greater Shearwater
CCGS *Hudson* Research Expedition	June 2004	Salar Basin (southwestern Study Area)	> 1,000	Greater Shearwater Northern Fulmar
CCGS *Hudson* Research Expedition	June 2004	Western Slope of Southern Flemish Pass (north-central Study Area)	~ 500	Northern Fulmar Greater Shearwater Sooty Shearwater
CCGS *Hudson* Research Expedition	June 2004	Sackville Spur (northeast of Study Area)	~ 1,000	Northern Fulmar Greater Shearwater Great Black-backed Gull
CCGS *Hudson* Research Expedition	June-July 2004	Orphan Basin (north of Study Area)	> 2,000	Northern Fulmar Greater Shearwater Great Black-backed Gull Leach's Storm-Petrel
CCGS *Hudson* Research Expedition	July 2004	North Grand Banks (northwestern Study Area)	200-1,000	Greater Shearwater Manx Shearwater
Seismic Program for Chevron Canada Resources and ExxonMobil Canada Limited	June-September 2004	Orphan Basin (north of Study Area)	1,850-2,500	Northern Fulmar Greater Shearwater Leach's Storm-Petrel Sooty Shearwater Black-legged Kittiwake (Aug-Sept)
Seismic Program for Chevron Canada Resources and ExxonMobil Canada Limited	May-September 2005	Orphan Basin (north of Study Area)	1,108-2,747	Northern Fulmar Leach's Storm-Petrel Greater Shearwater Black-legged Kittiwake, Dovekie, and Thick-billed Murre (May-June) Great Black-backed Gull (Aug-Sept)
Seismic Program for Husky Energy Inc.	October-November 2005	Approximately 75 km northwest of *Terra Nova* FPSO (northwestern Study Area)	68-376	Northern Fulmar Dovekie Black-legged Kittiwake Thick-billed Murre
Petro-Canada`s *Terra Nova* Hull Cleaning	May-June 2006	46 km radius around *Terra Nova* FPSO	65-190	Leach's Storm-Petrel
Seismic Program for Husky Energy Inc.	July-August 2006	1) 95 km north and 2) 15 km east of *Terra Nova* FPSO	86-387	Greater Shearwater Leach's Storm-Petrel
CSEM Program for ExxonMobil Canada Limited	August-September 2006	Orphan Basin (north of Study Area)	2,076-2,603	Greater Shearwater Leach's Storm-Petrel Black-legged Kittiwake Northern Fulmar
Seismic Program for Petro-Canada	June-July 2007	Approximately 17 km northwest of *Terra Nova* FPSO (northwestern Study Area)	61-171	Greater Shearwater Northern Fulmar Leach's Storm-Petrel
CSEM Program for ExxonMobil Canada Limited	July-September 2007	Orphan Basin (north of Study Area)	1,122-2,789	Leach's Storm-Petrel Greater Shearwater Northern Fulmar
Seismic Program for Petro-Canada, StatOil Hydro, and Husky Energy Inc.	May-September 2008	Jeanne d'Arc Basin	66-119	Greater Shearwater Northern Fulmar Leach's Storm-Petrel

Sources: Lang and Moulton (2004, 2008); Moulton *et al.* (2005, 2006a); Lang *et al.* (2006); Lang (2007); Abgrall *et al.* (2008a, 2008b, in prep.)

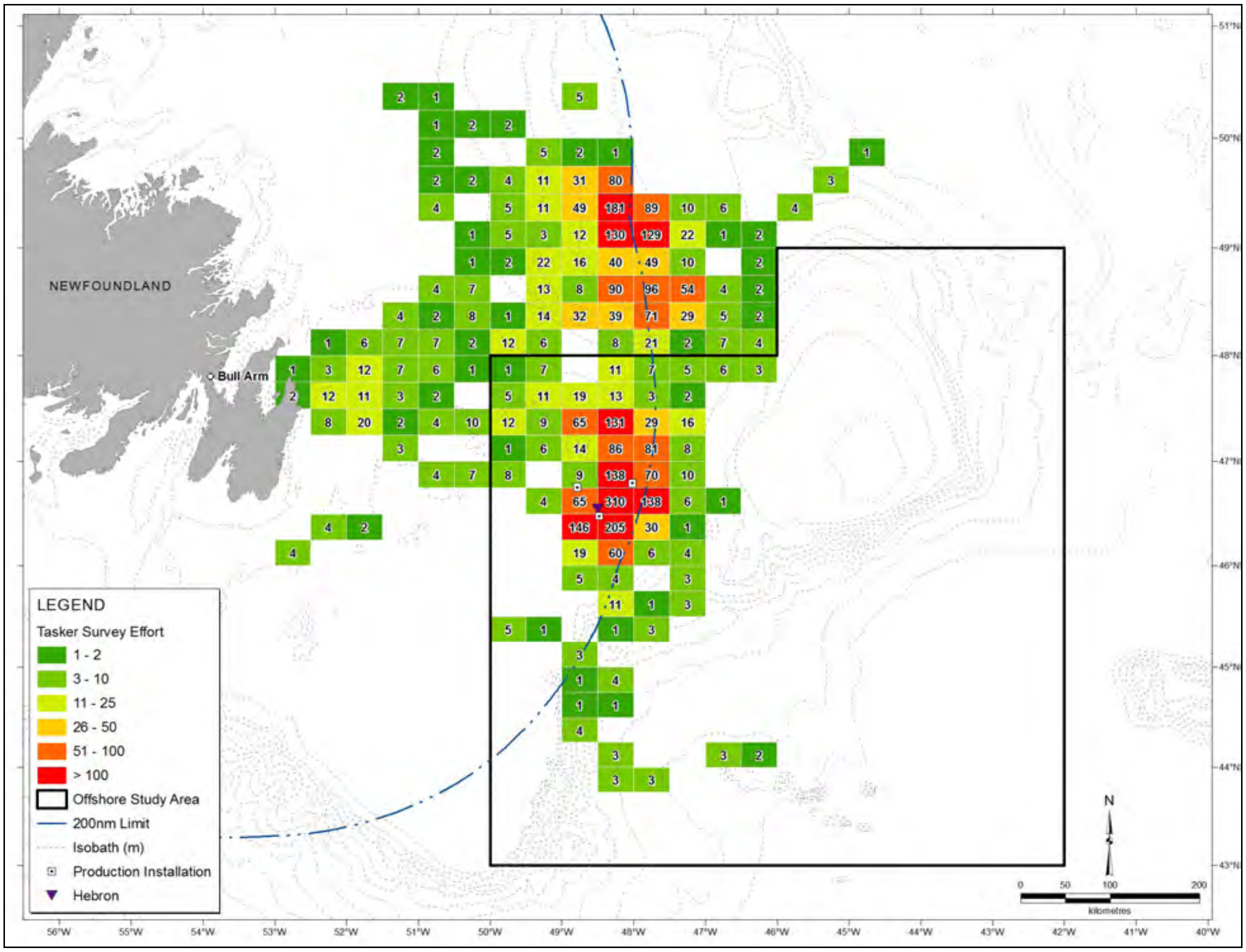

Figure 9-4 Geographic Distribution of Tasker Surveys (number of 10-minute counts) Conducted during 2004 through 2008 in and around the Offshore Study Area

9.3.2.2 General Patterns of Marine Bird Occurrence in the Offshore Study Area

The following description of marine bird occurrence in the Offshore Study Area pertains primarily to the Grand Banks (shelf and slope) and the Orphan Basin. Those are the areas where sufficient survey effort has been conducted to describe patterns of marine bird occurrence with reasonable confidence. Little is known about the distribution and abundance of marine birds in other parts of the Offshore Study Area.

The Grand Banks (shelf and slope) are known to support large numbers and diversity of marine birds at all seasons (Brown 1986; Lock *et al.* 1994). This is likely true of the Flemish Cap and its slopes as well, given that the same factors promoting increased productivity (upwelling and mixing) are present. In all seasons, densities of birds generally are higher along the shelf break. Approximately 27 species of marine birds occur annually on the Grand Banks in at least small numbers. The species and general monthly abundance expected on the Continental Shelf and slope waters of the Offshore Study Area are listed in Table 9-4.

The highest densities and diversity occur during the July to September period (Brown 1986; Lock *et al.* 1994). This is the period when there is the combination of non-breeding summering species (*e.g.*, Greater Shearwater), plus post-breeding local nesters that have moved to the offshore from coastal colonies (*e.g.*, Leach's Storm-petrel (*Oceanodroma leucorhoa*), Black-legged Kittiwake). The lowest densities occur during the winter months, December through March. Nevertheless, the Grand Banks support hundreds of thousands of birds even during winter. Large numbers of Arctic-breeding Thick-billed Murre, Dovekie, Northern Fulmar and Black-legged Kittiwake migrate to eastern Newfoundland, including the Grand Banks, for the winter. During migration periods (April-May; September-November), other marine birds (*e.g.*, jaegers, terns, phalaropes) migrate north in spring and south in autumn over the Grand Banks between breeding sites in the Arctic (Canada and Greenland) and wintering areas in more southern latitudes.

The only species of eastern offshore marine bird that is listed under SARA is the Ivory Gull (*Pagophila eburnea*). This species is currently listed as "Endangered" on Schedule 1. It is likely rare and of less than annual occurrence in the Offshore Study Area (see Section 11.3.3.2 for more details).

9.3.2.3 Marine Bird Nesting Colonies Along Southeastern Newfoundland

Enormous numbers of marine birds nest on the Avalon Peninsula. The marine bird breeding colonies on Baccalieu Island, the Witless Bay Islands and Cape St. Mary's are among the largest in Atlantic Canada. More than 4.6 million pairs nest at these three locations (Table 9-5 and Figure 9-5). That includes the largest Atlantic Canada colonies of Leach's Storm-Petrel (3,336,000 pairs on Baccalieu Island), Black-legged Kittiwake (43,927 pairs on Witless Bay Islands), Thick-billed Murre (1,000 pairs at Cape St. Mary's) and Atlantic Puffin (216,000 pairs Witless Bay Islands). No marine bird nesting colonies are located within either the Nearshore or Offshore Study Areas, so these sites are not discussed within the Sensitive or Special Areas VEC. They are included here as part of the life histories of the species and populations that may occur with the Study Areas.

All these birds feed on the Grand Banks during the nesting and/or post-nesting seasons (May to September). In addition, Funk Island, located 150 km northwest of the Grand Banks, supports the largest colony of Common Murre in Atlantic Canada. Many of these birds would reach the northern Grand Banks during the breeding season.

Table 9-4 Monthly Abundance of Bird Species Occurring on Continental Shelf Waters within and around the Offshore Study Area

Common Name	Scientific Name	Monthly Abundance											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Procellariidae													
Northern Fulmar	*Fulmarus glacialis*	C	C	C	C	C	C	U-C	U-C	C	C	C	C
Greater Shearwater	*Puffinus gravis*					U	C	C	C	C	C	S	
Sooty Shearwater	*Puffinus griseus*					S	S-U	S-U	S-U	S-U	S-U	S	
Manx Shearwater	*Puffinus puffinus*				S	S	S	S	S	S	S		
Hydrobatidae													
Leach's Storm-Petrel	*Oceanodroma leucorhoa*				U-C	U-C	U-C	U-C	U-C	U-C	U-C	S	
Wilson's Storm-Petrel	*Oceanites oceanicus*						S	S	S	S			
Sulidae													
Northern Gannet	*Morus bassanus*				S	S	S	S	S	S	S		
Phalaropodinae (Scolopacidae)													
Red Phalarope	*Phalaropus fulicarius*					S	S	S	S	S	S		
Red-necked Phalarope	*Phalaropus lobatus*					S	S	S	S	S			
Laridae													
Herring Gull	*Larus argentatus*	S	S	VS	VS	VS	VS	VS	VS	S	S	S	S
Iceland Gull	*Larus glaucoides*	S	S	S	S							S	S
Lesser Black-backed Gull	*Larus fuscus*					VS	VS	VS	VS	VS	VS	VS	VS
Glaucous Gull	*Larus hyperboreus*	S	S	S	S						S	S	S
Great Black-backed Gull	*Larus marinus*	U	U	VS	VS	VS	VS	VS	U	U	U	U	U
Ivory Gull	*Pagophila eburnea*	VS VS?	VS	VS	VS								
Black-legged Kittiwake	*Rissa tridactyla*	C	C	C	C	S	S	S	S	S	C	C	C
Arctic Tern	*Sterna paradisaea*					S	S	S	S	S			
Stercorariidae													
Great Skua	*Stercorarius skua*					S	S	S	S	S	S		
South Polar Skua	*Stercorarius maccormicki*					S	S	S	S	S	S		
Pomarine Jaeger	*Stercorarius pomarinus*					S	S	S	S	S	S		
Parasitic Jaeger	*Stercorarius parasiticus*					S	S	S	S	S	S		
Long-tailed Jaeger	*Stercorarius longicaudus*					S	S	S	S	S			

Common Name	Scientific Name	Monthly Abundance											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Alcidae													
Dovekie	*Alle alle*	U-C	U-C	U-C	U-C	S	VS	VS	VS	S	C	C	U-C
Murre spp.	*Uria* spp.	U-C	U-C	U-C	U-C	S-U	S-U	S-U	S-U	U-C	U-C	U-C	U-C
Razorbill	*Alca torda*				S	S	S	S	S	S	S	S	
Atlantic Puffin	*Fratercula arctica*				S-U	S	S	S	S	S-U	S-U	S-U	

Notes: C = Common, present daily in moderate to high numbers; U = Uncommon, present daily in small numbers; S = Scarce, present, regular in very small numbers; VS = Very Scarce, very few individuals or absent. Blank spaces indicate not expected to occur in that month. Predicted monthly occurrences derived from 2004, 2005, 2006 and 2007 monitoring studies in the Orphan Basin and Jeanne d'Arc Basin and extrapolation of marine bird distribution at sea in eastern Canada in Brown (1986) and Lock *et al.* (1994)
Sources: Brown (1986); Lock *et al.* (1994); Baillie *et al.* (2005); Moulton *et al.* (2005, 2006a); Lang *et al.* (2006); Lang (2007); Lang and Moulton (2008); Abgrall *et al.* (2008a, 2008b, in prep.); Fifield 2009

Table 9-5 Numbers of Pairs of Marine Birds Nesting at Marine Bird Colonies in Eastern Newfoundland

Species	Wadham Islands	Funk Island	Cape Freels and Cabot Island	Baccalieu Island	Witless Bay Islands	Cape St. Mary's	Middle Lawn Island	Corbin Island	Green Island
Procellariidae									
Northern Fulmar	-	46[A]	-	12[A]	22[A,F]	Present[A]	-	-	-
Manx Shearwater	-	-	-	-	-	-	13[K]	-	-
Hydrobatidae									
Leach's Storm-Petrel	1,038[D]	-	250[J]	3,336,000[J]	667,086[H,I,J]	-	13,879[H]	100,000[J]	103,833[M]
Sulidae									
Northern Gannet		9,987[L]		2,254[L]	-	14,789[L]	-	-	-
Laridae									
Herring Gull	-	500[J]	-	Present[A]	4,638[e,j]	Present[J]	20[J]	50[L]	Present[M]
Great Black-backed Gull	Present[D]	100[J]	-	Present[A]	166[E,J]	Present[J]	6[J]	25[J]	-
Black-legged Kittiwake	-	100[N]	-	12,975[J]	23,606[F,J]	10,000[J]	-	50[J]	-
Arctic and Common Terns	184[L]	-	250[J]	-	-	-	-	-	-
Alcidae									
Common Murre	-	412,524[C]	10,000[L]	1,697[L]	83,001[F,J]	15,484[J]	-	-	-
Thick-billed Murre		250[J]	-	216[L]	600[J]	1,000[J]	-	-	-
Razorbill	273[D]	200[J]	25[J]	352[L]	676[F,J]	100[J]	-	-	-
Black Guillemot	25[J]	1[J]	-	100[J]	20+[J]	Present[J]	-	-	-
Atlantic Puffin	6,190[D]	2,000[J]	20[J]	30,000[J]	272,729[F,G,J]	-	-	-	-
TOTALS	7,902	426,268	3,145	3,385,080	1,052,546	32,256	13,918	105,075	65,280

Sources: [A] Stenhouse and Montevecchi (1999a); [B] Chardine (2000); [C] Chardine *et al.* (2003); [D] Robertson and Elliot (2002); [E] Robertson *et al.* (2001); [F] Robertson *et al.* (2004); [G] Rodway *et al.* (2003); [H] Robertson *et al.* (2002); [I] Stenhouse *et al.* (2000); [J] Cairns *et al.* (1989); [K] Robertson (2002); [L] CWS (unpublished Data); [M] Russell (2008); [N] Nettleship (1980)

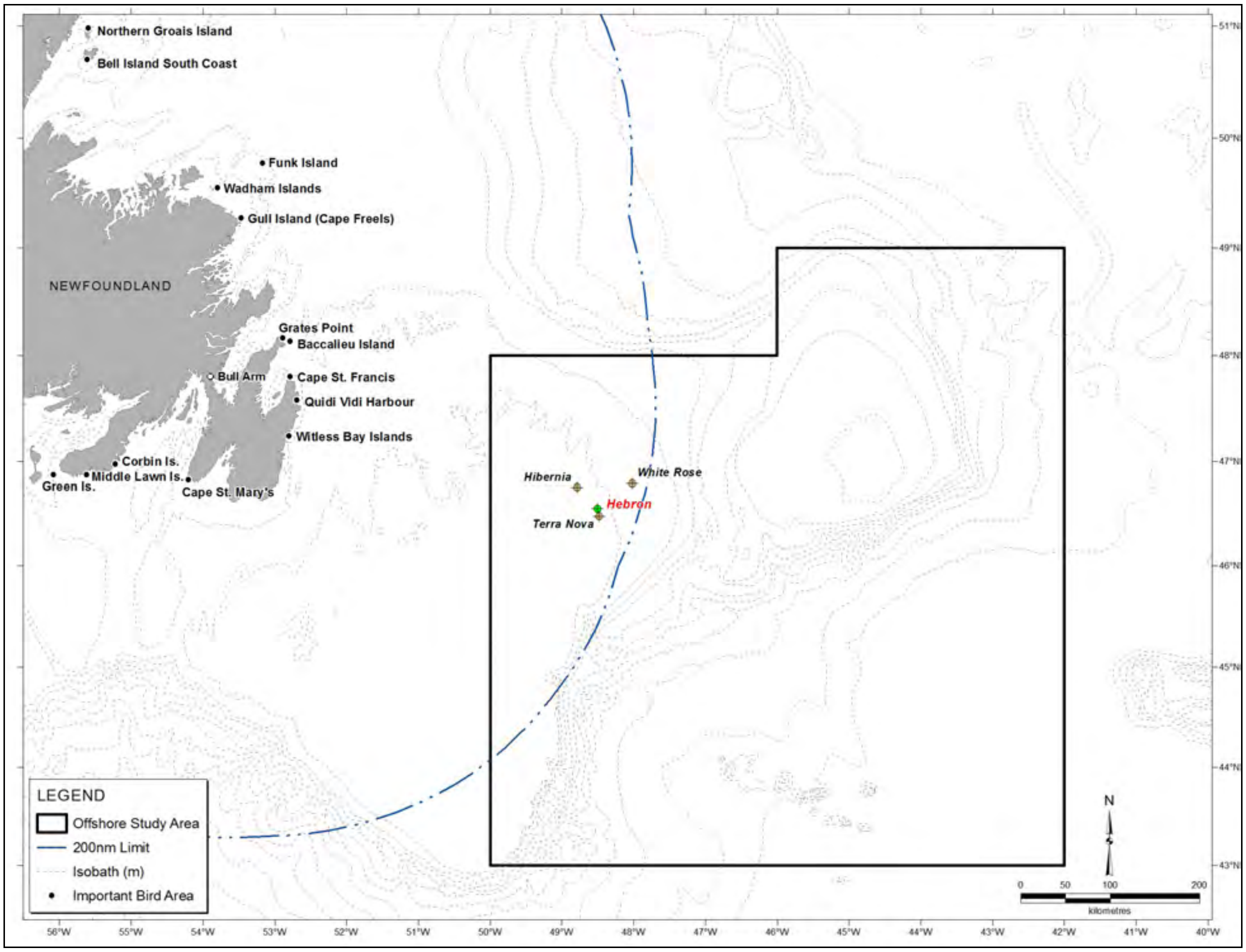

Figure 9-5 Map of Important Bird Areas including Marine Bird Colonies along Southeastern Newfoundland

There are nine marine bird nesting sites on the southeast coast of Newfoundland from Cape Freels to the Burin Peninsula meeting the criteria for an Important Bird Area (IBA) (an IBA is a site that provides essential habitat for one or more species of breeding or non-breeding birds) (Figure 9-5). In addition, Grates Point, Mistaken Point and Placentia Bay qualify as IBAs because of important wintering populations of Common Eider (*Somateria mollissima*). A total of 5.2 million pairs of birds breed at these sites. The Study Area is well beyond the foraging range of breeding birds during the breeding season, approximately May to August. At Witless Bay, Common Murres forage up to 200 km from the breeding site but usually only 50 to 100 km (Cairns *et al.* 1990, in Gaston and Jones 1998). However, during post-breeding dispersal, the Study Area is within range of all marine birds breeding in eastern Newfoundland and Labrador.

9.3.2.4 Species Profiles

The world range, and seasonal occurrence and abundance of marine birds in the Study Area are described in this section. The monthly abundance status for each species is summarized in Table 9-4. Information was derived primarily from Brown (1986), Lock *et al.* (1994), Baillie *et al.* (2005), and Abgrall *et al.* (2008a, 2008b, in prep.).

Procellariidae (Fulmars and Shearwaters)

Northern Fulmar and the four species of shearwaters that are expected to occur in the area feed on a variety of invertebrates, fish and zooplankton at or very near the surface. Capelin is an important food source for shearwaters. Shearwaters secure their prey by swimming on the surface and picking at items on the surface, or dipping their heads under the water. They are also capable of diving a short distance under the surface, probably no more than 1 m or so. They may do this by flying low over the water and then plunging into the water with enough force to get them below the surface for a few seconds, or dive from a sitting position.

Northern Fulmar

Northern Fulmar is common in the Offshore Study Area all year. The Northern Fulmar breeds in the North Atlantic, North Pacific and Arctic oceans. In the Atlantic Ocean, it winters south to North Carolina and southern Europe (Brown 1986; Lock *et al.* 1994). Through band recoveries, it is known that most individuals in Newfoundland waters are from Arctic breeding colonies. Adults and sub-adult birds are present in the winter with sub-adults remaining through the summer. Fewer than 100 pairs breed in eastern Newfoundland (Cairns *et al.* 1989). Fulmars were found to be most numerous during spring and autumn 1999 to 2002 on the northeast Grand Banks, based on observations from drill rigs (Baillie *et al.* 2005).

Results from seismic monitoring programs indicate that Northern Fulmar is much less common on the Jeanne d'Arc Basin during spring and summer than during fall and winter, or in deep water areas such as Orphan Basin at all times of the year (Tables 9-6 to 9-8) (Lang 2007; Abgrall *et al.* 2008a, 2008b, in prep.; Suncor unpublished data).

Cory's Shearwater

Cory's Shearwater (*Calonectris diomedea*) is rare in the Offshore Study Area and is present during the July to September period. Cory's Shearwater is a subtropical species breeding in the eastern Atlantic Ocean on Azores Island and the Cape Verdes Islands, the Mediterranean and western Indian Ocean. In late summer, small numbers reach the waters off southern Nova Scotia. A few occur in southern Newfoundland waters, including the Grand Banks. Cory's Shearwater was recorded from drill platforms on the northeast Grand Banks, but because of the Cory's similarity in appearance to the abundant Greater Shearwater, the actual numbers of Cory's observed is unclear (Baillie *et al.* 2005; Suncor unpublished data).

Cory's Shearwater was not identified during seismic or controlled-source electromagnetic (CSEM) monitoring programs in the Jeanne d'Arc Basin or Orphan Basin.

Table 9-6 Average Densities of Marine Birds by Week Recorded during 10-minute Marine Bird Counts

Species	Average Density (number of individuals per km²) per 10-minute Observation Period						
	1-7 Oct.	8-14 Oct.	15-21 Oct.	22-28 Oct.	29 Oct. - 4 Nov.	5-8 Nov.	All weeks combined
Northern Fulmar	3.07	25.57	4.35	34.17	10.00	10.77	14.72
Dovekie	1.53	5.07	10.14	13.58	7.07	4.16	7.09
Black-legged Kittiwake	1.16	8.38	11.76	8.97	4.29	5.78	6.57
Thick-billed Murre	0	1.86	5.01	4.16	7.41	9.58	4.11
Greater Shearwater	11.82	1.71	0.45	0	0	0	2.87
Atlantic Puffin	0.86	1.73	2.37	1.34	1.65	0.51	1.46
Common Murre	1.05	0.88	1.52	0.83	0.05	0.20	0.81
Great Black-backed Gull	0.25	1.59	0.65	0.67	0.51	0.46	0.68
Leach's Storm-Petrel	1.02	0.39	0.46	0.54	0.04	0	0.47
Sooty Shearwater	0.19	1.03	0.50	0.61	0	0	0.40
Glaucous Gull	0	0	0.06	0.50	0.04	0.48	0.16
Herring Gull	0.04	0.05	0.00	0.06	0.20	0.76	0.13
Pomarine Jaeger	0.21	0	0	0	0	0	0.04
Jaeger sp.	0.08	0	0	0.07	0	0	0.03
Murre sp.	0	0.05	0.04	0.08	0	0	0.03
Northern Gannet	0.07	0	0	0	0.09	0	0.03
Razorbill	0.14	0	0	0	0	0	0.03
Iceland Gull	0	0	0	0	0.05	0.09	0.02
Lesser Black-backed Gull	0	0.12	0	0	0	0	0.02
Parasitic Jaeger	0	0.05	0	0.04	0	0	0.02
Red Phalarope	0.07	0	0	0.04	0	0	0.02
Skua sp.	0	0.05	0.05	0	0	0	0.02
Great Skua	0	0	0.05	0	0	0	0.01
Manx Shearwater	0	0	0	0.04	0	0	0.01
South Polar Skua	0.03	0	0	0	0	0	0.01
All species	**21.7**	**48.6**	**37.4**	**65.7**	**31.4**	**32.8**	**39.8**

Source: Abgrall *et al.* (2008a)
Note: Recorded in the Seismic Analysis Area and adjacent areas where the *Western Neptune* sailed, October 1 to November 8, 2005, arranged in order of decreasing density

Table 9-7 Average Densities of Marine Birds by Week Recorded during 10-minute Marine Bird Counts

Species	Average Density (number of individuals per km²) per 10-minute Observation Period						
	9-16 July	**17-23 July**	**24-30 July**	**31 July - 6 Aug.**	**7-13 Aug.**	**14-16 Aug.**	**All Weeks Combined**
Greater Shearwater	2.54	7.04	4.33	8.90	1.57	0.62	5.06
Leach's Storm-Petrel	1.15	0.17	0.24	0.41	0.42	0.10	0.60
Northern Fulmar	0.15	0.05	0.05	0	0	0.05	0.07
Sooty Shearwater	0.07	0	0.05	0.02	0.03	0	0.04
Atlantic Puffin	0.12	0	0	0	0	0	0.03
South Polar Skua	0	0	0.05	0.05	0	0	0.02
Common Murre	0.08	0	0	0	0	0	0.02
Skua sp.	0	0	0.05	0	0	0	0.01
Red Phalarope	0	0	0.10	0	0	0	0.01
Pomarine Jaeger	0	0	0.05	0	0.03	0	0.01
Northern Gannet	0	0	0	0.02	0	0	0.01
Murre sp.	0	0.05	0	0.03	0	0	0.01
Manx Shearwater	0.02	0	0	0.03	0	0	0.01
Great Black-backed Gull	0	0	0	0	0	0.03	0.01
Dovekie	0	0	0	0.03	0	0	0.01
Black-legged Kittiwake	0	0	0	0	0	0.05	0.01
All Species	**4.14**	**7.32**	**4.91**	**9.49**	**2.03**	**0.85**	**5.93**

Source: Abgrall *et al.* (2008a)
Note: Recorded in the Seismic Analysis Area and adjacent areas where the *Western Regent* sailed, July 9 to August 16, 2006, arranged in order of decreasing density

Table 9-8 Average Densities of Marine Birds Bi-monthly Recorded during 10-minute Marine Bird Counts

Species	Average Density (number of individuals per km²) per 10-minute Observation Period									
	21-31 May	1-15 June	16-20 June	1-15 July	16-31 July	1-15 Aug.	16-31 Aug.	1-15 Sept.	16-29 Sept.	Grand Total
Greater Shearwater	0.05	2.11	15.07	26.65	19.93	24.27	9.81	9.04	3.18	11.92
Sooty Shearwater	0	0.33	1.04	0.25	0.1	0.07	0.53	6.06	3.98	1.65
Northern Fulmar	0.08	0.18	3.54	0.15	0.26	0.57	1.02	1.41	3.03	1.24
All murres	1.1	0.25	0.46	0.31	0.29	0.02	0.88	1.61	3.57	1.02
Leach's Storm-Petrel	0.22	0.13	0.21	0.21	0.97	0.57	0.49	1.49	2.92	0.9
Common Murre	0.72	0.09	0.28	0.31	0.24	0	0	1.51	3.42	0.84
Unidentified Murre	0.38	0.12	0.18	0	0.03	0.02	0.88	0.08	0.15	0.18
Great Black-backed Gull	0	0	0	0	0	0	0.03	0.55	0.52	0.15
Atlantic Puffin	0	0.02	0.13	0.14	0.02	0	0	0.02	0.59	0.11
Manx Shearwater	0	0	0.06	0.14	0.21	0.07	0	0	0	0.05
Pomarine Jaeger	0	0	0	0	0	0.02	0.06	0.12	0.14	0.04
South Polar Skua	0	0	0	0.14	0.03	0.03	0.06	0.04	0	0.03
Great Skua	0	0	0	0.03	0	0	0.03	0.06	0.04	0.02
Northern Gannet	0	0	0	0	0	0	0.16	0.03	0	0.02
Dovekie	0.03	0	0.02	0	0	0	0	0	0.07	0.02
Black-legged Kittiwake	0	0.02	0.07	0	0	0	0.03	0.03	0.02	0.02
Thick-billed Murre	0	0.04	0	0	0.03	0	0	0.02	0	0.01
Red Phalarope	0	0	0	0	0	0	0	0.05	0	0.01
Long-tailed Jaeger	0	0	0	0	0	0	0	0.03	0.02	0.01
Unidentified phalarope	0	0	0	0	0	0	0	0.03	0	0.005
Parasitic Jaeger	0	0	0	0	0	0	0	0.005	0.02	0.003
Wilson's Storm-Petrel	0	0	0	0	0	0	0	0.02	0	0.003
Herring Gull	0	0	0	0	0	0	0	0.02	0	0.002
Unidentified Skua	0	0	0	0	0	0	0.03	0	0	0.002
Unidentified Jaeger	0.03	0	0	0	0	0	0	0	0.02	0.002
Lesser Black-backed Gull	0	0	0	0	0	0	0	0	0.02	0.002
Arctic Tern	0	0	0	0	0	0	0	0	0.02	0.002
All Birds	**1.51**	**3.03**	**20.6**	**31.03**	**21.82**	**25.63**	**13.14**	**20.59**	**18.12**	**17.23**

Note: Recorded in the Seismic Analysis Area and adjacent areas where the *Veritas Vantage* sailed, May 21 to September 29, 2008, arranged in order of decreasing density

Greater Shearwater

The Greater Shearwater breeds on the Tristan de Cunha Islands in the South Atlantic Ocean from October to March. It spends its non-breeding season on the North Atlantic. Greater Shearwater has an important presence on the Grand Banks. A considerable portion of the entire population of approximately 5,000,000 migrate from the Southern Hemisphere breeding sites to feed and moult on the Grand Banks and offshore eastern Newfoundland in June and July (Lock *et al.* 1994). After moulting, birds remain in the area until early November. Greater Shearwater was the most numerous species observed from drill platforms on the northeast Grand Banks 1999 to 2002 (Baillie *et al.* 2005). Numbers increased through the summer to a peak in September then decreased rapidly with stragglers into November. Median flock size was usually less than 50 but occasionally up to 1,200.

Results from seismic monitoring programs in the Jeanne d'Arc Basin also indicate that Greater Shearwater is quite abundant during the summer period, with numbers declining in early fall (Tables 9-6 to 9-8) (Lang 2007; Abgrall *et al.* 2008a, 2008b, in prep). It was among the most numerous species observed by environmental observers on offshore installations on the Terra Nova oil field during June to September from 1999 to 2009 (Suncor unpublished data).

Sooty Shearwater

Sooty Shearwater (*Puffinus griseus*) is predicted to be present in the Study Area from May to early November. It is expected to be scarce in May, uncommon from June to October and scarce in early November.

Sooty Shearwater breeds in the south Atlantic and south Pacific Oceans. It spends most of the non-breeding season in the Northern Hemisphere. Some Sooty Shearwaters follow the same migration pattern as Greater Shearwater by migrating north to Canadian waters in spring. Sooty Shearwater is usually outnumbered by Greater Shearwater in eastern Canada (Brown 1986). Numbers peaked at 2.5 birds/day at one drill platform on the northeast Grand Banks 2000 and 2001 (Baillie *et al.* 2005).

Sooty Shearwater was the second most abundant marine bird species over the course of the 2008 seismic monitoring program in the Jeanne d'Arc Basin; increased densities in September may reflect staging prior to southward migration (Tables 9-6 to 9-8) (Lang 2007; Abgrall *et al.* 2008a, 2008b, in prep).

Manx Shearwater

Manx Shearwater (*Puffinus puffinus*) is scarce in the Offshore Study Area during the April to October period. Manx Shearwater breeds in northeast Atlantic Ocean. It is uncommon in the northwest Atlantic, and has only recently begun nesting in North America. The only known established breeding colony in North America is at Middle Lawn Island off the Burin

Peninsula, Newfoundland, where less than 100 pairs breed (Cairns *et al.* 1989). Other nest sites in Newfoundland have not been confirmed. Most Manx Shearwater observed in North American waters are probably non-breeding sub-adults and post-breeding birds from European breeding colonies. Manx Shearwater winters in middle latitudes of the Atlantic Ocean. A total of 39 were observed on drill platforms on the northeast Grand Banks 1999 to 2002 (Baillie *et al.* 2005); this represents <0.1 percent of all the birds recorded.

Manx Shearwater densities averaged <0.1 birds/km^2 per month from May to October during seismic monitoring programs on the Jeanne d'Arc Basin in 2005, 2006 and 2008 (Tables 9-6 to 9-8) (Lang 2007; Abgrall *et al.* 2008a, 2008b in prep).

Hydrobatidae (Storm-Petrels)

Leach's and Wilson's (*Oceanites oceanicus*) Storm-Petrels feed on small crustaceans, various small invertebrates, and zooplankton. These storm-petrels usually feed while on the wing, picking small food items from the surface.

Leach's Storm-Petrel

Leach's Storm-Petrel is common in the Offshore Study Area between April and early November. Leach's Storm-Petrel breeds in the north Pacific and North Atlantic Oceans. It winters at the middle latitudes and south of the equator in both oceans. It is a very abundant breeder in eastern Newfoundland, with more than 4,000,000 pairs nesting on islands off the eastern Avalon Peninsula. The largest breeding colony in the world is at Baccalieu Island on the northeast Avalon Peninsula, where over 3.3 million pairs nest (Lock *et al.* 1994). They range far from breeding colonies to feed. Many non-breeding sub-adults remain at sea through the breeding season. An average of less than one Leach's Storm-Petrel per day was recorded from the drill platforms on the northeast Grand Banks 1999 to 2002 (Baillie *et al.* 2005). This number is low compared to the numbers of Leach's Storm-Petrels seen from ships in the same area, and may have been a result of the tall height of observers off the water and the lack of persistent use of binoculars for scanning (Ballie *et al.* 2005). Storm-Petrels are difficult to see because they are dark and fly very low over the water (Ballie *et al.* 2005).

During seismic monitoring programs on the Jeanne d'Arc Basin in 2005, 2006 and 2008 densities ranged from 0.1 to 1.1 birds/km^2 (Tables 9-6 to 9-8) (Lang 2007; Abgrall *et al.* 2008a, 2008b, in prep).

Wilson's Storm-Petrel

Wilson's Storm-Petrel is scarce in the Offshore Study Area between June and September. The Wilson's Storm-Petrel breeds in the south Atlantic Ocean and Antarctic. In their non-breeding season (May to October), they migrate north to waters off southern Nova Scotia and Newfoundland. This species is uncommon in Newfoundland waters June to September (Brown 1986).

During seismic monitoring programs on the Jeanne d'Arc Basin in 2005, 2006 and 2008 very few were detected (Tables 9-6 to 9-8) (Lang 2007; Abgrall *et al.* 2008a, 2008b, in prep).

Sulidae (Gannets)

Northern Gannets (*Morus bassanus*) feed on cephalopods and small fish including capelin, mackerel, herring and Atlantic saury. They secure prey in spectacular fashion by plunging from a height of up to 30 m above the water and reaching depths of up to 10 m. They pop back to the surface within a few seconds of entering the water.

Northern Gannet is scarce in the Offshore Study Area between April and October, and generally absent from the Offshore Study Area outside that period. The Northern Gannet breeds in the North Atlantic from Canada to Iceland and the British Isles. The species winters at sea south of their breeding range but north of the equator. Approximately 12,000 pairs nest on three colonies in the eastern Newfoundland. Gannets are common near shore and scarce beyond 100 km from shore. The Offshore Project Area is farther off shore than the range of most Northern Gannets.

During seismic monitoring programs on the Jeanne d'Arc Basin in 2005, 2006 and 2008 very few were detected (Tables 9-6 to 9-8) (Lang 2007; Abgrall *et al.* 2008a, 2008b, in prep).

Phalaropodinae (Phalaropes)

Red-necked (*Phalaropus lobatus*) and Red (*Phalaropus fulicarius*) Phalaropes eat zooplankton at the surface of the water. They secure food by swimming and rapidly picking at the surface of the water. These phalarope species are scarce in the Offshore Study Area during the May to October period, and generally absent outside that period.

Both species breed in the Arctic and subarctic of North America and Eurasia. They winter at sea mostly in the Southern Hemisphere. They migrate and feed offshore, including Newfoundland offshore waters during spring and autumn migrations. The two phalaropes are often difficult to distinguish at sea. Red Phalarope usually outnumbers Red-necked Phalarope in Newfoundland waters (Brown 1986). Phalaropes seek out areas of upwelling and convergence where rich sources of zooplankton are found. They are locally numerous along the shelf edges off Newfoundland and Labrador.

During seismic monitoring programs on the Jeanne d'Arc Basin in 2005, 2006 and 2008 very few phalaropes were detected (Tables 9-6 to 9-8) (Lang 2007; Abgrall *et al.* 2008a, 2008b, in prep.).

Laridae (Skuas, Jaegers, Gulls and Terns)

Skuas and jaegers feed by chasing other species of birds until they either drop food or disgorge the contents of their stomachs. This method of securing food is called kleptoparasitism. The Long-tailed Jaeger (*Stercorarius longicaudus*), the smallest member of this group, also feeds on small invertebrates and fish that it catches by dipping to the surface of the water while remaining on the wing.

Great Skua and South Polar Skua

These two skua species occur in the Offshore Study Area during the May to October period; they are usually scarce during this period.

The Great Skua (*Stercorarius skua*) breeds in the North Hemisphere, in Iceland and northwestern Europe. The South Polar Skua (*Stercorarius maccormicki*) breeds in the Southern Hemisphere from November to March and migrates to the Northern Hemisphere where it is present May to October. Both species occur in Newfoundland waters from May to October. Identifying skuas to species is very difficult at sea. Skuas usually occur where other marine birds are numerous, particularly along shelf edges.

Skuas occurred in such low densities that they were infrequently recorded during systematic surveys on the Jeanne d'Arc Basin in 2005, 2006 and 2008 (Tables 9-6 to 9-8) (Lang 2007; Abgrall *et al.* 2008a, 2008b, in prep.).

Pomarine Jaeger, Parasitic Jaeger and Long-tailed Jaeger

These three jaeger species are scarce in the Offshore Study Area during the May to October period. All three species of jaeger nest in the subarctic and Arctic in North America and Eurasia. They winter at sea in the Pacific Ocean and Atlantic Ocean. Pomarine (*Stercorarius pomarinus*) and Parasitic (*Stercorarius parasiticus*) Jaegers winter mainly south of 35°N, and Long-tailed Jaegers winter mainly south of the equator. The three species of jaeger are relatively easy to identify in adult plumage but very difficult in sub-adult plumages. As a group, their habits are very similar. Adults migrate through Newfoundland waters in spring and fall, while sub-adults often migrate only part way to the breeding grounds and are often present in Newfoundland waters all summer. Like skuas, they are kleptoparasites, primarily targeting the prey of Black-legged Kittiwakes and Arctic Terns. Densities of jaegers, like most predators, are relatively low. Peak numbers occur during migration in May and early June, and September to October.

All three jaeger species were observed in low densities during seismic monitoring programs in the Jeanne d'Arc Basin in 2005, 2006 and 2008 (Tables 9-6 to 9-8) (Lang 2007; Abgrall *et al.* 2008a, 2008b, in prep.).

Herring, Great Black-backed, Lesser Black-backed, Iceland, and Glaucous Gull

The predicted status in the Offshore Study Area for Herring Gull is scarce throughout the year; Great Black-backed Gull is uncommon from August to February and very scarce from March to July; Glaucous Gull (*Larus hyperboreus*) is scarce from late October to April; Iceland Gull (*Larus glaucoides*) is scarce from November to April; and Lesser Black-backed Gull (*Larus fuscus*) is considered very scarce from May to December.

Herring Gull breeds in northern North America, Europe and northeast Russia and winters in the southern part of its breeding range. The breeding range of the Great Black-backed Gull is restricted to areas surrounding the North Atlantic Ocean. It winters in coastal Canada and Europe. Iceland Gull breeds in northeast Canadian Arctic and Greenland and winters on open coastal waters south to the New England states. Glaucous Gull breeds in the subarctic and Arctic of North America, Greenland and Eurasia and winters within its breeding range and south of it. With the exception of the Great Black-backed Gull, these large gulls are generally rare to scarce far from shore on the Grand Banks.

On drill platforms on the northeast Grand Banks during 1999 to 2002, Great Black-backed Gull was common from September to February and nearly absent from March to August (Baillie *et al.* 2005). A similar pattern was observed by environmental observers on offshore installations on the Terra Nova oil field from 1999 to 2009 (Suncor, unpublished data). Herring Gulls were present in consistent numbers throughout the year but in lower numbers than Great Black-backed Gulls. Results from seismic monitoring programs in Jeanne d'Arc Basin in 2005, 2006 and 2008 indicate that large gulls were most numerous from mid August to October (Tables 9-6 to 9-8) (Lang 2007; Abgrall *et al.* 2008a, 2008b, in prep.).

Black-legged Kittiwake

The predicted status of Black-legged Kittiwake in the Offshore Study Area is common from October to May and scarce from June to August and uncommon in September. The Black-legged Kittiwake has a circumpolar breeding range. In Canada, it breeds from the Arctic south to Nova Scotia, and it winters at sea in the northern Pacific Ocean and northern Atlantic Ocean. Black-legged Kittiwake is an abundant marine bird off the Newfoundland coast. Breeding colonies on the Avalon Peninsula and northeast coast of Newfoundland total approximately 77,400 pairs (Cairns *et al.* 1989). Many of the 4,000,000 pairs that breed in the North Atlantic Ocean spend some time off the east coast of Newfoundland (Brown 1986; Lock *et al.* 1994). Black-legged Kittiwake is present in all months of the year on the Grand Banks. Observations from the drill platforms on the northeast Grand Banks during 1999 to 2002 showed Black-legged Kittiwakes were present in October to May, but were most prevalent during November to December (Baillie *et al.* 2005). It was among the most numerous species observed by environmental observers on offshore installations on the Terra Nova oil field during the winter months (Suncor, unpublished data).

During marine bird monitoring programs conducted between May and October, Black-legged Kittiwake was found to be most numerous in October (Tables 9-6 to 9-8) (Lang 2007; Abgrall *et al.* 2008a, 2008b, in prep.).

Arctic Tern

Arctic Tern is a scarce spring and autumn migrant in the Offshore Study Area, occurring between May and September. The Arctic Tern breeds in subarctic and Arctic regions of North America and Eurasia. In the western Atlantic, its breeding range includes Newfoundland and extends south to Nova Scotia. The Arctic Tern winters at sea in the Southern Hemisphere. Arctic Terns are migrants at sea through Newfoundland and Labrador waters in spring and autumn. Small numbers of Arctic Terns have been recorded during 2005, 2006 and 2008 seismic monitoring programs in Jeanne d'Arc Basin (Tables 9-6 to 9-8) (Lang 2007; Abgrall *et al.* 2008a, 2008b, in prep.).

Alcidae (Dovekie, Murres, Black Guillemot, Razorbill and Atlantic Puffin)

Alcids feed by diving and pursuing prey underwater. They eat fish, copepods, amphipods, cephalopods, molluscs, crustaceans and other invertebrates.

Dovekie

The predicted status in the Offshore Study Area is common from October to November and uncommon to common from December to May. Dovekies breed in the North Atlantic, primarily in Greenland and east Nova Zemlya, Jan Mayen and Franz Josef Land in northern Russia. This species winters at sea south to 35°N. The Dovekie is a very abundant bird, with a world population estimated at 30 million (Brown 1986). A large percentage of the Greenland breeding Dovekies winters in the western Atlantic, mainly off Newfoundland (Brown 1986). The low numbers of Dovekies observed from the drill platforms on the northeast Grand Banks 1999 to 2002 was attributed to the difficulty in seeing the small birds from the observation posts (Baillie *et al.* 2005).

During seismic monitoring programs on the Jeanne d'Arc Basin in 2005, 2006 and 2008, Dovekies were most numerous in May and October (Tables 9-6 to 9-8) (Lang 2007; Abgrall *et al.* 2008a, 2008b, in prep.). Dovekies were found to be fairly common during marine bird monitoring of Husky's 2005 seismic program (Abgrall *et al.* 2008a). Densities within the Study Area ranged from 1.0 to 9.9 birds per km^2 in areas where the majority of 10-minute counts were conducted. Dovekies were first observed on October 3, when 500 individuals were counted. This species was observed daily during October in numbers typically ranging from 100 to 300. Maximum daily totals from incidental sightings were 2,000 on October 13, 1,500 on October 28 and 2,500 on November 4 (Abgrall *et al.* 2008a, in prep.).

Common Murre

The predicted status for Common Murre in the Study Area is scarce to uncommon throughout the year. The Common Murre breeds in the North Pacific Ocean and North Atlantic Ocean. In the western Atlantic, it winters from southern Newfoundland to Massachusetts. It is an abundant breeder in eastern Newfoundland, with nearly half a million pairs, 80 percent of those on Funk Island (Table 9-5). During breeding season, the Offshore Study Area is probably too far from breeding sites to be used regularly for foraging. In the non-breeding season between August and March, Common Murres are likely to occur on the northern Grand Banks. Due to low density and high difficulty in detecting murres at sea, surveys generally underestimate their numbers.

Common Murre was seen in small numbers almost daily throughout the May to September 2008 seismic monitoring program in Jeanne d'Arc Basin except during the first half of August (Abgrall *et al.* in prep.). The first adult-chick pair was seen on August 29 and these pairs were common after September 13, with up to 75 individuals (adults and flightless chicks) per day. In October and November 2005, an average density of 0.81 birds/km^2 was observed for Common Murre in Jeanne d'Arc Basin (Abgrall *et al.* 2008a). Weekly densities derived from 10-minute Tasker counts peaked at 7.5 birds/km^2 in the third week of October.

Thick-billed Murre

The predicted status of Thick-billed Murre in the Offshore Study Area is uncommon to common from October to April and very scarce to scarce from May to September. Thick-billed Murres breed in subarctic and Arctic areas in North America and Eurasia. In Atlantic Canada, they breed as far south as Newfoundland, and winters in open water within the breeding range and in the western Atlantic south to New Jersey.

The Thick-billed Murre is the winter murre in eastern Newfoundland. Many of the more than 2,000,000 Arctic Canada and Greenland breeders winter in Newfoundland and Labrador waters. The Grand Banks has been identified as an important wintering area for Thick-billed Murres (Brown 1986; Lock *et al.* 1994). Relatively small numbers (approximately 2,000) breed in eastern Newfoundland (Table 9-5). It is likely that Jeanne d'Arc Basin is part of the main wintering area for Thick-billed Murres in eastern North America.

As expected, only small numbers of Thick-billed Murres were seen on Jeanne d'Arc Basin during the May to September 2008 seismic monitoring program; the birds were primarily seen during May and June (Abgrall *et al.* in prep.). An average density of 0.01 birds/km^2 was derived from quantitative counts over the course of the seismic monitoring program. The authors report that visible northward migration was apparent on May 7 and 21, 2008 (Abgrall *et al.* in prep.). Thick-billed Murre was observed almost daily during the October and November 2005 seismic monitoring program in Jeanne d'Arc Basin (Table 9.6) (Abgrall *et al.* 2008a). The average density was 4.11 birds/km^2 with a peak density of 9.58 birds/km^2 observed during November 5 to 8 (Table 9.6).

Razorbill

The predicted status of Razorbill (*Alca torda*) in the Offshore Study Area is very scarce from April to November, and likely absent in other months. Razorbills breed in the North Atlantic Ocean in Maine, eastern Canada, Greenland, Iceland and Great Britain. They typically winter south to North Carolina and France. Razorbills are relatively scarce compared to the murres. Most of the 20,000 pairs of breeding in Atlantic Canada are in southeast Labrador (Brown 1986). Approximately 710 pairs breed in eastern Newfoundland (Table 9-5).

Razorbills, for the most part, winter south of Newfoundland from Nova Scotia to North Carolina. They are probably rare or uncommon on the northeastern Grand Banks as a migrant. Observations of Razorbills at sea are often obscured because of the difficulty in differentiating them from the murres.

Atlantic Puffin

The predicted status of Atlantic Puffins in the Offshore Study Area is scarce to uncommon from April to November. The Atlantic Puffin breeds in the North Atlantic in Maine, Nova Scotia, Newfoundland and Labrador, Greenland, Iceland and northwest Europe. Atlantic Puffins are abundant in the North Atlantic with approximately 12,000,000 pairs (Brown 1986). Approximately 320,000 pairs nest in Atlantic Canada, mostly in southeast Newfoundland (Brown 1986). In North America, Atlantic Puffins are thought to winter from southern Newfoundland to southern Nova Scotia.

The Offshore Study Area is probably east of the breeding sites used as foraging areas in the summer. Migrants and post-breeders may use the northern Grand Banks in late summer and early autumn. Only one was observed from the drill platforms on the northeast Grand Banks 1999 to 2002 (Baillie *et al.* 2005). This was at least partly due to difficulty in detecting them at sea.

During the October to November 2005 seismic monitoring program in Jeanne d'Arc Basin, Atlantic Puffin was observed on 32 of the 39 days with survey effort, daily counts typically ranged from 20 to 50 individuals, and the average density was 1.46 birds/km^2 (Table 9-6) (Abgrall *et al.* 2008a). Relatively few Atlantic Puffins were reported during summer seismic monitoring programs in Jeanne d'Arc Basin (Tables 9-7 and 9-8) (Abgrall 2008a in prep.).

9.4 Project-Valued Ecosystem Component Interactions

Project activities with similar interactions on Marine Birds have been grouped into four categories to provide a complete and comprehensive environmental effect analysis. Instead of assessing each Project activity separately, the grouping of activities with similar potential effects on Marine Birds, allows for a cumulative assessment of within-Project activities.

The interactions summary categories are:

- Change in Habitat Quantity: Project activities that may result in physical alteration of habitat available to marine birds
- Change in Habitat Quality: Project activities that may result in a change in the biological or physical properties of marine bird habitat
- Change in Habitat Use: Project activities that may result in marine birds changing their behaviour. Some activities may cause avoidance behaviour in birds, whereas other activates may attract some species
- Potential Bird Mortality: Project activities that may result in marine bird mortality

9.4.1 Nearshore

9.4.1.1 Nearshore Project Activities

Nearshore Project activities have the potential to have effects on habitat quantity, habitat quality, and habitat use for marine birds. Bund wall construction can create a limited reduction in habitat quantity by obstructing use. Project emissions including noise and lights can result in reduced habitat quality. Activities with the greatest potential for disturbance (*i.e.*, change in habitat use) include pile driving (bund wall construction), blasting, vessel traffic and dredging. Lighting during periods of darkness may attract marine birds, particularly the Leach's Storm-Petrel, which may strike vessels or infrastructure leading to injury or strandings. Several activities (*e.g.*, blasting, dredging, pile driving and vessel traffic) may also lead to temporary disturbance of marine birds in a localized area. Mortality of marine birds is not expected to be an environmental effect of most routine activities in the Nearshore Study Area, except perhaps from collisions with vessels / infrastructure.

9.4.2 Offshore

9.4.2.1 Offshore Construction / Installation

Offshore construction / installation activities have the potential to result in effects on habitat use, and, to a lesser extent, habitat quality and habitat quantity (*e.g.*, placement of the Hebron Platform structure will obstruct use of a limited area of habitat). Activities with the greatest potential for disturbance (*e.g.*, effects on habitat use) include the operation of helicopters, the operation of vessels, seismic surveys and dredging activities. Lighting at night throughout the Project may attract marine birds, particularly the Leach's Storm-Petrel, which may strike vessels or platform infrastructure leading to injury, strandings, and mortality. It is unknown if there is hearing impairment to marine birds spending considerable amounts of time below the surface of the water and in close proximity to airgun pulses during seismic surveys. Few of the species that occur in the Offshore Study Area spend considerable time below the surface of the water.

In addition, several activities may also lead to temporary disturbance of marine birds in a localized area. With the exception of collisions with infrastructure, mortality of marine birds is not expected to be an environmental effect of activities in the Offshore Study Area during the construction / installation phase.

9.4.2.2 Operations / Maintenance

Operations / maintenance activities have the potential to result in changes to habitat quality and habitat use. Interactions are summarized here:

- Lighting and flaring at night and periods of low visibility for the duration of the Project may attract marine birds, particularly the Leach's Storm-Petrel, which may strike vessels or platform infrastructure leading to injury, strandings, and mortality

- The operation of helicopters, the operation of vessels, and seismic surveys have potential for disturbance
- The discharges of fluids or solids have the potential to foul the feathers of marine birds and possibly lead to ingestion of non-biological substances, which may lead to mortality
- Hearing impairment to marine birds spending considerable amounts of time below the surface of the water and in close proximity to airgun pulses during seismic surveys may be a possibility. However, as mentioned above, there is no evidence to support this

9.4.2.3 Decommissioning / Abandonment

Effects of Project decommissioning / abandonment activities have the potential to affect habitat use by marine birds, similarly to those effects experienced during the construction and operations phases. Lighting during darkness periods may attract marine birds, particularly the Leach's Storm-Petrel, which may strike vessels or platform infrastructure leading to injury, strandings, or mortality. In addition, the operation of helicopters and vessels may also lead to temporary disturbance of marine birds in a localized area.

9.4.2.4 Accidents, Malfunctions and Unplanned Events

The primary accidental event associated with the proposed Project having environmental consequences of concern is the unintentional release of hydrocarbons either during development drilling or production operations. The hydrocarbon products subject to accidental release include crude oil, diesel oil, synthetic drilling muds and/or fluids, synthetic drill (base) fluid, lubricating oils, and hydraulic oils. The main event of concern that can result in a hydrocarbon spill is a loss of well control (blowout). Hydrocarbon spills may also occur as a result of human error or equipment failure during loading / unloading, storage tank overflows, hydraulic system failures, drains system failures and others. An oil spill could potentially occur during the construction, operation and maintenance and/or decommissioning phases of the Project (see Section 14.1.4 for a summary of blowout and spill frequencies). Several accidents, malfunctions and unplanned events could result in mortality for marine birds within the Affected Area (see Section 9.5.4).

Other effects include a change in habitat quality (*i.e.*, effects on habitat that could result in physical and/or physiological effects on marine birds).

9.4.3 Summary

A summary of the potential environmental effects resulting from Project-VEC interactions, including those of past, present, and likely future projects, and accidents, malfunctions and unplanned events is provided in Table 9-9.

Table 9-9 Potential Project-related Interactions: Marine Birds

Project Activities, Physical Works Discharges and Emissions	Potential Environmental Effects			
	Habitat Quantity	Habitat Quality	Habitat Use	Mortality
Construction				
Nearshore Project Activities				
Presence of Safety Zone (Great Mosquito Cove zone followed by a deepwater zone)				
Bund Wall Construction (*e.g.*, sheet / pile driving, infilling)	x		x	
Inwater Blasting		x	x	x
Dewater Drydock / Prep Drydock Area			x	
Concrete Production (floating batch plant)			x	
Vessel Traffic (*e.g.*, supply, tug support, tow, diving support, barge, passender ferry to / from deepwater site)			x	x
Lighting		x	x	x
Air Emissions		x		
Re-establish Moorings at Bull Arm deepwater site			x	
Dredging of Bund Wall and Possibly Sections of Tow-out Route to deepwater site (may require at-sea disposal)			x	
Removal of Bund Wall and Disposal (dredging / ocean disposal)		x	x	x
Tow-out of GBS to Bull Arm deepwater site			x	
GBS Ballasting and De-ballasting (seawater only)			x	
Complete GBS Construction and Mate Topsides at Bull Arm deepwater site			x	
Hook-up and Commissioning of Topsides			x	
Surveys (*e.g.*, geophysical, geological, geotechnical, environmental, ROV, diving)			x	
Platform Tow-out from deepwater site			x	
Offshore Construction / Installation				
Presence of Safety Zone				
OLS Installation and Testing			x	
Concrete Mattress Pads / Rock Dumping over OLS Offloading Lines			x	
Installation of Temporary Moorings			x	
Platform Tow-out / Offshore Installation			x	
Underbase Grouting			x	
Possible Offshore Solid Ballasting			x	
Placement of Rock Scour Protection on Seafloor around Final Platform Location			x	
Hookup and commissioning of Platform			x	
Operation of Helicopters			x	
Operation of Vessels (supply, support, standby and tow vessels / barges / diving / ROVs)			x	x
Air Emissions		x		
Lighting		x	x	x
Potential Expansion Opportunities				
Presence of Safety Zone				
Excavated Drill Centre Dredging and Spoils Disposal			x	
Installation of Pipeline(s) / Flowline(s) and Testing from Excavated Drill Centre(s) to Platform, plus Concrete Mattresses, Rock Cover, or Other Flowline Insulation			x	
Hook-up and Commissioning of Drill Centres			x	

Project Activities, Physical Works Discharges and Emissions	Potential Environmental Effects			
	Habitat Quantity	Habitat Quality	Habitat Use	Mortality
Surveys (*e.g.*, geophysical, geological, geotechnical, environmental, ROV, diving)			x	
Offshore Operations and Maintenance				
Presence of Safety Zone				
Presence of Structures			x	x
Lighting		x	x	x
Maintenance Activities (*e.g.*, diving, ROV)			x	
Air Emissions		x		
Flaring		x	x	x
Wastewater (*e.g.,* produced water, cooling water, storage displacement water, deck drainage)		x		x
Chemical Use / Management / Storage (*e.g.*, corrosion inhibitors, well treatment fluids)		x		
WBM Cuttings		x		
Operation of Helicopters			x	
Operation of Vessels (supply, support, standby and tow vessels / shuttle tankers / barges / ROVs)			x	x
Surveys (*e.g.*, geophysical, 2D / 3D / 4D seismic, VSP, geohazard, geological, geotechnical, environmental, ROV, diving)		x	x	
Potential Expansion Opportunities				
Presence of Safety Zone				
Drilling Operations from MODU at Future Excavated Drill Centres			x	
Presence of Structures			x	x
WBM and SBM Cuttings		x		
Chemical Use and Management (BOP fluids, well treatment fluids, corrision inhibitors)		x		
Geophysical / Seismic Surveys		x	x	
Offshore Decommissioning / Abandonment				
Presence of Safety Zone				
Removal of the Hebron Platform and OLS Loading Points			x	
Lighting		x	x	x
Plugging and Abandoning Wells			x	
Abandoning the OLS Pipeline			x	
Operation of Helicopters			x	
Operation of Vessels (supply, support, standby and tow vessels / ROVs)			x	x
Surveys (*e.g.*, geophysical, geological, geotechnical, environmental, ROV, diving)		x	x	
Accidents, Malfunctions, and Unplanned Events				
Bund Wall Rupture		x	x	
Nearshore Spill (at Bull Arm Site)		x	x	x
Failure or Spill from OLS		x	x	x
Subsea Blowout		x	x	x
Crude Oil Surface Spill		x	x	x
Other Spills (fuel, chemicals, drilling muds or waste materials/debris on the drilling unit, GBS, Hebron Platform)		x	x	x
Marine Vessel Incident (*i.e.*, fuel spills)		x	x	x
Collisions (involving Hebron Platform, vessel, and/or iceberg)		x	x	x

Project Activities, Physical Works Discharges and Emissions	Potential Environmental Effects			
	Habitat Quantity	Habitat Quality	Habitat Use	Mortality
Cumulative Environmental Effects				
Hibernia Oil Development and Hibernia Southern Extension (HSE) (drilling and production)	x	x	x	x
Terra Nova Development (production)	x	x	x	x
White Rose Oilfield Development and Expansions (drilling and production)	x	x	x	x
Offshore Exploration Drilling Activity	x	x	x	x
Offshore Exploration Seismic Activity			x	
Marine Transportation (nearshore and offshore)			x	x
Commercial Fisheries (nearshore and offshore)			x	x

9.5 Environmental Effects Analysis and Mitigation

There is limited information and few detailed studies regarding the environmental effects of construction and offshore industrial activities on marine birds. However, noise and routine discharges have the greatest potential to affect the habitat quality of marine birds, while lighting, vessel traffic and helicopter overflights likely have the greatest potential to affect marine birds by changing habitat use. Blasting and flaring, as well as collisions with infrastructure, may also lead to mortality of marine birds and are discussed at the end of the review.

9.5.1 Construction and Installation

9.5.1.1 Change in Habitat Quantity

Nearshore

In the Nearshore Project Area, construction of the bund wall will result in a limited reduction of available habitat. However, it should be noted that this will represent a relatively small footprint within an area that has previously been disturbed during construction activities of other projects (*i.e.*, does not represent a loss of important marine bird habitat).

Offshore

The placement of the Hebron Platform at the offshore site location will result in minimal habitat loss for pelagic and migratory marine bird species. Given the relatively small footprint of the Hebron Platform within total available habitat and reversibility of the effect once the Platform is removed, this effect is not considered to be significant.

9.5.1.2 Change in Habitat Quality

Nearshore

Blasting

The key nearshore Project activity that could have an effect on habitat quality is inwater blasting. Underwater shock waves resulting from blasts in the Nearshore Study Area during construction activities have the potential to injure (or kill) marine birds that are nearby at the time of the blast. Most species of marine birds that occur off eastern Newfoundland spend little time below the water's surface and, thus, are unlikely to experience injury if they do not occur in very close proximity to the blast.

Stemp (1985) did not mention damage to birds on the water surface when 25 to 125 kg charges were detonated underwater. Marine birds hovering over the explosion sites, apparently attracted to floats, were often stunned by water blasted up into the air. Most recovered and flew away but a small number of these were killed. Blasts at the construction site will likely be sufficiently buried and small that there will be no upward blast of water into the air.

Yelverton *et al.* (1973) conducted controlled tests to quantify the effects of high explosives on ducks 0.6 m underwater (exposed to 0.45 kg charges at slant ranges of 7 to 33.5 m) and at the surface (exposed to 0.45 to 3.63 kg charges at ranges of 3 to 6.4 m). No deaths occurred at 11+ m for ducks exposed to detonations while underwater, but those just beyond the lethal zone (see Section 9.5.1.5) had extensive lung haemorrhage and liver and kidney damage. Those that were 25.3 to 33.5 m away had no eardrum ruptures or other detectable injuries. Ducks that survived the blasts showed no delayed mortality over a 14-day post-blast period. Ducks at the surface were less prone to blast damage. No deaths were observed at distances of 4.6 to 6.4 m from detonations. Based on the Yelverton *et al.* (1973) data, Yelverton (1981) estimated safe ranges for birds on the surface as 8 m, birds at 1 m below the surface as 119 m, and birds at 15 m depth as 262 m.

Most species of marine birds that occur off eastern Newfoundland spend little time below the water's surface and, thus, are unlikely to experience injury if they do not occur in very close proximity to the blast. However, some species of the family Alcidae are known to spend considerable time submerged during foraging. Of the alcids, most species primarily occur nearshore when attending nesting colonies; however, no known major nesting colonies of alcids occur within the Nearshore Study Area. The Black Guillemot is known to forage in nearshore areas throughout eastern Newfoundland and could potentially occur in the Nearshore Study Area. Attraction of birds to blasting operations due to the presence of fish killed during blasts is not expected since the blasting program will be designed to not kill fish (see Chapter 7). It is unlikely that fish will be killed by blasting during the construction activities.

An observer will be placed nearby the blasting site to monitor if diving marine birds occur within a Safety Zone of the blast location. Blasts may cause fish mortality which could attract diving and plunge feeding birds. Blasts should be delayed until birds move outside the designated Safety Zone. The designated Safety Zone will be determined in conjunction with the CWS.

Lighting

In Newfoundland waters, marine birds, mainly Leach's Storm-Petrels, are often attracted to lights at night and/or during darkness-like conditions (*e.g.*, foggy conditions), including coastal lighthouses and ships at sea. Birds may become injured by flying directly into the source of light or associated infrastructure. Alternatively, light-attracted Storm-Petrels may strike infrastructure (including vessels) and strand (or experience mortality). Storm-Petrels have short and weak legs that limit their ability to become airborne from solid, flat surfaces. Furthermore, Storm-Petrels will remain stranded until found and released; thus, without proper release, animals will remain stranded until they starve or die. Stranded marine birds also risk becoming oiled by landing or moving through catchment basins.

Foggy nights seem to attract more birds (Williams and Chardine 1999). Leach's Storm-Petrels breed in large numbers in eastern Newfoundland, with Baccalieu Island at the northeastern tip of Trinity Bay representing the largest breeding colony in the world. Lighting is potentially an issue during Project activities that provide continuous use of lights during darkness or periods of poor visibility.

ExxonMobil Canada Properties (EMCP) will develop protocols for regular searches of birds that may become stranded on all vessels and facilities. Recovered birds will be released in accordance with standard protocols (Williams and Chardine 1999; Husky Energy 2008). A marine bird salvage and release permit under the authority of the Federal Migratory Bird Permit must be applied for and obtained from the CWS. EMCP will evaluate use of shielding and deflectors with directional lighting to minimize attraction by lighting, and may incorporate such features where safety of operations and navigation are not affected.

Air Emissions

Although air emissions could, in theory, affect the health of some resident marine birds, the effects would likely be minimal because emissions of potentially harmful materials will be small and rapidly disperse to undetectable levels. Air emissions are expected to have a negligible effect on the habitat quality of the Marine Bird VEC.

Offshore

Seismic Surveys

The key potential future Project activity during construction in the offshore that is predicted to have an effect on habitat quality is seismic surveys. Birds have good hearing abilities in air (Fay 1988), but their hearing underwater is not well known. The hearing systems of marine birds are most likely best adapted for hearing in air, but likely have some sensitivity in water. Diving birds within a large but unknown radius of an underwater sound source could hear a sound pulse if the birds are underwater at the time the pulse arrives. Potentially, marine birds that are diving in close proximity to a loud underwater sound could be injured.

Seismic sound energy is predominantly directed downward and below the surface of the water. Received sound above the water is significantly reduced from that underwater and is likely to have little or no effect on birds that have their heads above water or are in flight. It is possible that birds on the water at close range would be startled by the sound; however, the presence of the ship and associated gear should have already warned any birds of unnatural visual and auditory stimuli. Received sound levels of airgun pulses in the upper few metres of the water column are also considerably diminished from those at depth due to pressure-release effects and interference phenomena that occur at and near the surface (Richardson *et al.* 1995).

Most species of marine birds that are expected to occur in the Offshore Study Area (see Table 9-4) feed at less than one metre from the surface of the ocean. This includes members of Procellariidae, Hydrobatidae, Phalaropodinae, and Laridae. Northern Gannet plunge dive to a depth of 10 m, but animals remain submerged for only a few seconds in total, so would have minimal chance to receive underwater seismic sound. The only group of marine birds that spends considerable time submerged underwater is the Alcidae (Dovekie, Common Murre, Thick-billed Murre, Razorbill, Black Guillemot (*Cepphus grylle*) and Atlantic Puffin). Alcids secure food by diving under the water and propelling their bodies rapidly through the water with their wings. All are capable of reaching considerable depths and spending prolonged periods of time submerged (Gaston and Jones 1998). Murres regularly dive to a maximum depth of 100 m and have been recorded underwater for up to 202 seconds (Gaston and Jones 1998).

The effects of seismic sounds on Alcidae are unknown. Sounds are probably not important to Alcidae in securing food. However, all six species are quite vocal at breeding sites indicating auditory capabilities are important in that part of the life cycle of Alcidae.

It is thought that the presence of an on-coming seismic vessel may potentially alert alcids (and other marine birds on the water), thereby flushing animals from the area (see assessment of the effect of seismic surveys on habitat use below) prior to being exposed to any airgun sounds or occurring in close proximity to operating airguns. Of the Alcidae found in the Offshore Study Area, the Dovekie is likely common in the fall, the Common Murre is uncommon from fall to spring, the Thick-billed Murre is likely uncommon from fall to spring, the Black Guillemot is scarce year-round, the Razorbill is scarce from Spring to late fall, and the Atlantic Puffin is likely uncommon from spring to late fall.

Seismic surveys should be planned, to the extent possible, to avoid periods of known concentration in the Offshore Study Area for members of the Alcidae.

Thus, it is predicted that there is not likely to be a significant environmental effect on habitat quality in the Offshore Study Area during construction / installation.

Lighting

As described previously in Nearshore, Habitat Quality, marine birds (particularly Leach's Storm-Petrels) and potentially some migrating land birds may be attracted to lights during periods of darkness or poor visibility. Attraction can cause birds to strike lights and associated infrastructure, potentially leading to injury, stranding, and mortality. Foggy nights seem to attract more birds, and Leach's Storm-Petrels are more common in the Offshore Study Area during late summer to early fall. Leach's Storm-Petrels have also been observed in densities ranging from 0.1 to 4.9 birds/km^2 during monitoring from May to September aboard seismic vessels operating in the Jeanne d'Arc Basin (Lang 2007; Abgrall *et al.* 2008a, 2008b, in prep.). Stranded Leach's Storm-Petrels have been recorded during monitoring aboard seismic vessels in the Jeanne d'Arc Basin each summer and/or fall period from 2005 to 2008; June and July / August have the lowest number of birds recovered (2 and 11, respectively) while a total of 130 birds have been recovered over a week-long period in late September and 107 birds have been recovered during a 10-day period in early October (Lang *et al.* 2006; Abgrall *et al.* 2008; Lang and Moulton 2008; Abgrall *et al.* in prep.). The largest Leach's Storm-petrel stranding events that have been recorded from seismic vessels in and near the Study Area have occurred at the time of year when the young have recently fledged (T. Lang, pers. comm., 2010), but the extent of Storm-Petrel susceptibility is unclear. Other marine bird species, as well as migrating land birds, are also known to be attracted to lights on offshore oil and gas platforms at night, especially during foggy or overcast conditions. Birds could potentially injure themselves by flying into structures on the platform (Avery *et al.* 1978). Some accounts also describe birds becoming disoriented and flying aimlessly about the lights for hours, consuming energy and being delayed in their foraging or migration.

On one occasion Dovekies were observed to circle the lighted Hibernia platform for hours (in Wiese et al. (2001)), but EMCP is not aware of any large-scale strandings or mortalities related to such events on the Grand Banks. There have been reports in other regions of strandings involving related species. For example, Dick and Donaldson (1978) interviewed the crew of an Alaskan crab fishing boat that experienced a collision with Crested Auklets (Aethia cristatella), a related species. It was estimated that about 1.5 tons of birds collided and landed on the brightly lit boat. The birds appeared to be disoriented by the bright overhead work deck lights although they only ran into the lower running lights because the birds were all flying close to the water. Poot et al. (2008) examined the use of green spectrum lighting on offshore platforms in the North Sea to reduce or eliminate the disorientation to nocturnally migrating birds normally caused by white and red lights. EMCP will develop protocols for regular searches of birds that may become stranded on all vessels and facilities. Recovered birds will be released in accordance with standard protocols (Williams and Chardine 1999;

Husky Energy 2008). EMCP will evaluate use of shielding and deflectors with directional lighting to minimize attraction by lighting, and may incorporate such features where safety of operations and navigation are not affected.

Air Emissions

Although air emissions could, in theory, affect the health of some resident marine birds, the effects would likely be minimal because emissions of potentially harmful materials will be small and rapidly disperse to undetectable levels. Air emissions are expected to have a negligible effect on the habitat quality of the Marine Bird VEC.

9.5.1.3 Change in Habitat Use

Nearshore

Temporary and localized disturbances are the most likely effects of Project construction activities on marine birds. In coastal regions, varying levels of human disturbance (from human presence to physical substrate disturbance and construction activities) are known to cause minor disturbance of several species. Such disturbance could have important environmental effects on birds if opportunities to forage or breed become limited as a result of the activities.

Burger *et al.* (2007) described the effects of human presence, cars or planes and dog presence on the average number of Herring Gulls, Laughing Gulls (*Leucophaeus atricilla*) and shorebirds that included Red Knot. The responses of gulls and shorebirds differed considerably, with gulls generally returning to pre-disturbance levels within five minutes of a disturbance. All shorebirds responded most strongly to the presence of dogs and did not return to the beach within the 10 minute post-disturbance monitoring period. Red Knots also appeared to be more responsive to humans than to cars or planes, showing moderate signs of recovery to pre-disturbance within 30 seconds of car or plane disturbance relative to periods greater than 10 minutes for human disturbance.

Burger (1988) monitored the abundance of shorebirds (species not provided) and Laughing Gulls and Herring Gulls during pre- and post-activities associated with demolition, beach clean-up and construction for development on a coastal mudflat in New Jersey. Activities included the use of chainsaws, humans picking up and/or piling debris from the mudflat and crane loading from the beach. The overall number of birds using the mudflat was higher during the period prior to coastal activities. Birds also moved away when activity began and returned when activity ceased. Gulls that moved farther out on the mudflat had measurably lower foraging efficiencies, and foraging efficiencies of gulls did not return to previous levels until 60 to 90 minutes after work began. Mitigation measures that restricted human activity to a 100 m stretch of beach at a time succeeded in significantly reducing adverse environmental effects and in allowing birds to rest and feed.

It should be noted that the Nearshore Study Area does not contain important bird habitat and is already an area that has been subjected to disturbance from human activity. Nonetheless, Project activities that have the potential to result in behavioural disturbances, in turn resulting in potential changes in habitat use, are evaluated below.

Pile Driving

Pile driving involved in the construction of the bund wall, produces impulsive sound levels high enough to temporarily disturb marine birds occurring in close proximity at a localized scale. The environmental effects of pile driving on Marine Birds in the Nearshore Study Area are not well known, but these activities will occur in a small area that has been previously disturbed by construction activities associated with other projects. There are no known marine bird nesting colonies located within Bull Arm, Trinity Bay, nor are there any known concentrations of foraging marine birds that could potentially be affected by pile driving activities.

Blasting

Blasting operations may cause temporary and localized behavioural disturbance, potentially resulting in a change in habitat use. However, there are no specific sound levels for blasting activities that are linked with behavioural effects on marine birds. The environmental effects of blasting in the Nearshore Study Area are not well known, but these activities will occur in an area that has been previously disturbed by construction activities associated with other projects. There are no known marine bird nesting colonies located within Bull Arm, Trinity Bay, nor are there any known concentrations of foraging marine birds that could potentially be affected by blasting activities. Therefore any effects would most likely be on individuals that may occur in the area. Blasts that are closely spaced relative to the dive duration of birds could have greater impacts. Widely spaced blasts will likely result in no more than one pulse (if any) being received during a given dive. In general, birds may interrupt their foraging dives and return to the surface. It is possible that some might leave the area, but available evidence suggests that disturbance would be temporary. In contrast, some marine birds, such as gulls or other scavengers, may be attracted to blasting activities if fish are killed as a result of detonation (see Section 7). Blasting activities will be required to adhere to *Guidelines for the Use of Explosives in or Near Canadian Fisheries Waters* (Wright and Hopky 1998). Monitoring of a safety zone, as described above, will also mitigate potential disturbance of Marine Birds.

Lighting

Lighting is an issue during Project activities that provide continuous use of lights during darkness periods in the Nearshore Study Area. Mitigation measures to address the impacts of lighting on marine birds were described previously in Section 9.5.1.2.

Vessel Traffic

Marine birds may be temporarily disturbed by passing vessels associated with Project activities, including construction and survey vessels. Some species are also attracted to vessels and follow them for extended periods. There is concern for vessels passing known concentrations of foraging or nesting marine birds, but no known concentrations are likely to occur within Bull Arm or Trinity Bay that potentially may be affected. Vessels of large size, which are fast-moving, or move with an erratic course, though unlikely to occur, are more likely to disturb birds. However, vessels operating within the Nearshore Study Area will typically be moving at slow speed or will remain stationary for extended periods, and will, therefore, be less likely to affect nearby marine birds. Whenever possible, vessels associated with the Project should maintain a steady course and speed. Concentrations of marine birds, if any occur, should be avoided.

Other Activities

Several other activities associated with the construction phase in the Nearshore Study Area may induce temporary and localized disturbance of marine birds (Table 9-9). However, no nesting or feeding concentrations of marine birds are expected to occur within the small areas associated with these activities, and bird behaviour would likely return to normal shortly after the completion of these activities (if disturbed at all).

Offshore

Temporary and localized disturbances to marine birds in the Offshore Study Area may result in similar behavioural changes and affect bird habitat use. Project activities creating noise, such as vessel traffic, helicopter operations, and seismic surveys, and light emissions are most likely to potentially result in a change in habitat use.

Vessel Traffic

Marine birds may potentially be temporarily disturbed by passing vessels associated with Project activities. However, many bird species are known to have adapted to ship traffic throughout the world. Some species, such as Northern Fulmar and gulls, are attracted to ships and often follow them for extended periods (Wahl and Heinemann 1979; Brown 1986).

While vessels which pass in close proximity to bird colonies may create concern for disturbance, the routing of Project vessels will not take them within 2 km of any nesting marine bird colonies.

Operation of Helicopters

Most marine birds flush or dive in response to low-flying aircraft (*e.g.*, Polar Gas Project 1977; Husky Oil 2000; LGL Ltd. unpublished data). The magnitude of these disturbances is likely low, given infrequent flights at low levels. Of greater concern are flights over large colonies of nesting marine birds. An aircraft flying low near a marine bird colony is capable of causing a panic response by the birds, which can result in eggs and flightless young being accidentally pushed off cliff ledges when the adults suddenly flush, or being unguarded and thus exposed to harsh weather and predators.

As with current regular helicopter servicing of offshore platforms in the Jeanne d'Arc Basin, helicopters used for the Project will likely be based at St. John's Airport and will generally fly "straight" to the Offshore Study Area. Helicopters will be directed to avoid the closest marine bird colonies (*e.g.*, Witless Bay Ecological Reserve) and any known concentrations. *The Wilderness and Ecological Reserves Act* states that no aircraft will fly lower than 300 m or take off or land within the reserve during the period 1 April to 1 September.

Seismic Surveys

Seismic surveys have the potential to affect the habitat quality of marine birds, particularly members of the Alcidae (described above), but seismic surveys also have the potential to disturb marine birds. The main environmental effect of seismic surveys on habitat use by marine birds is that of the operation of vessels, as described above. In general, limited information is available on the behavioural effects of seismic surveys on marine birds.

A study on the effects of underwater seismic surveys on moulting Long-tailed Ducks (*Clangula hyemalis*) in the Beaufort Sea showed no effects on movement or diving behaviour (Lacroix *et al.* 2003). The authors suggested caution in interpretation of these data, however, because they were limited in their ability to detect subtle disturbance effects and recommended studies on other species to fully understand the effects of seismic sounds.

Other Activities

Various other activities associated with the Construction Phase in the Offshore Study Area may induce temporary and localized disturbance of marine birds (refer to Table 9-9). These activities are not expected to occur near any known nesting colonies, so they should not affect that portion of marine bird life cycles. Disturbance is possible for small feeding concentrations of marine birds that are common during summer periods (particularly Greater Shearwater, Sooty Shearwater and Leach's Storm-Petrel), winter periods (particularly Black-legged Kittiwake and Thick-billed Murre), fall (particularly Dovekie), or year-round (particularly Northern Fulmar) in the Offshore Study Area. It is expected that bird behaviour would likely return to normal shortly after the completion of these activities (if disturbed at all).

9.5.1.4 Potential Mortality

One routine Project construction / installation activity that is predicted to potentially result in mortality of marine birds is blasting in the nearshore. Collision with infrastructure is another potential source of mortality. This issue is mostly relevant to offshore operations and is discussed in Section 9.5.2.

Marine birds occurring in close proximity to an explosion can be injured or killed. At a given distance, death is more likely for birds that are below the surface than for those at the surface. For birds at the surface, available information suggests that there is little or no risk of injury or death unless the birds are very close to the explosion. As noted above, most of the marine bird species occurring in the Nearshore Study Area spend very little time submerged; only members of the Alcidae are known to dive to considerable depth and spend substantial periods below water. However, most alcid species will occur farther offshore or near nesting colonies that do not occur within the Nearshore Study Area.

Fitch and Young (1948) described the effects of 73 kg high explosive charges on marine birds occurring nearby. Cormorants (Phalacrocoraciidae) that dove beneath the surface to feed on fish attracted to the blasts were killed consistently; distances of birds to the detonations were not reported. Pelicans were also frequently killed, but only when their heads were below water. A few gulls sustained broken wings when they were struck by a column of water rising into the air.

As evaluated above under effects on Habitat Use (Section 9.5.1.3), Yelverton *et al.* (1973) conducted controlled tests to quantify the effects of high explosives on ducks. Based on the Yelverton *et al.* (1973) data, Yelverton (1981) estimated safe ranges for birds on the surface as 8 m, birds at 1 m below the surface as 119 m, and birds at 15 m depth as 262 m.

Environment Canada cannot authorize by permit or exempt the inadvertent mortality ("incidental take") caused by construction (or other) activities of bird species protected by the *Migratory Birds Convention Act* (Environment Canada 2007). Instead, Environment Canada recommends that proponents adopt migratory bird protection measures and monitor for the presence of migratory birds based on scientifically credible methods before and during the period in which activities are carried out. An observer experienced in marine bird identification and behaviour will be placed nearby the blasting site to monitor if diving marine birds occur within a specified safety zone of the blast location. Blasts should be delayed until birds move outside the designated safety zone. The safety zone will be determined in consultation with the CWS. EMCP will evaluate use of shielding and deflectors with directional lighting to minimize attraction by lighting, and may incorporate such features where safety of operations and navigation are not affected.

The environmental effects of Project construction / installation activities on Marine Birds are summarized in Table 9-10.

Given that Project activities are mostly localized, of low to medium magnitude, and reversible, there are not likely to be significant adverse environmental effects on Marine Birds from construction or installation activities associated with the Project.

Table 9-10 Environmental Effects Assessment: Construction and Installation

Project Activity	Potential Environmental Effect	Mitigation	Evaluation Criteria for Assessing Residual Adverse Environmental Effects[A]				
			Magnitude	Geographic Extent	Duration/ Frequency	Reversibility	Ecological / Socio-economic Context
Nearshore Project Activities							
Bund Wall Construction (*e.g.*, sheet / pile driving, infilling)	• Change in Habitat Quantity • Change in Habitat Use	• Equipment design • Potential use of bubble curtains • Safety zone • monitoring	1	1	3/1	R	2
Inwater Blasting	• Change in Habitat Quality • Change in Habitat Use • Potential Mortality	• Adherence with Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters • Monitor appropriate safety zone for diving birds	1	2	2/1	R	2
Dewater Drydock / Prep Drydock Area	• Change in Habitat Use	• Discharge area and depth designed to reduce suspended sediment	1	1	2/1	R	2
Concrete Production (floating batch)	• Change in Habitat Use	• Washwater from the cleaning of mixers, mixer trucks and concrete delivery systems will be directed to a settling basin • The settling basin will be cleaned on an as required basis to ensure that the retention capacity is maintained at all times	1	1	3/3	R	2
Vessel Traffic (*e.g.,* supply, tug support, tow, diving support, barge)	• Change in Habitat Use • Potential Mortality	• Maintain steady course and speed • Avoid concentrations of marine birds	1	2	3/6	R	2
Lighting	• Change in Habitat Quality • Change in Habitat Use • Potential Mortality	• Proper release of stranded birds per CWS protocol • EMCP will evaluate use of shielding and deflectors with directional lighting to minimize attraction by lighting, and may incorporate such features where safety of operations and navigation are not affected	1	2	3/6	R	2
Air Emissions	• Change in Habitat Quality		N	4	3/6	R	2
Re-establish Moorings at Bull Arm deepwater site	• Change in Habitat Use	• Restrict disturbance to mooring sites	1	1	2/1	R	2
Dredging of Bund Wall and Possibly Sections of Tow-out Route to deepwater site (may require at-sea disposal)	• Change in Habitat Use		1	1	2/1	R	2

Project Activity	Potential Environmental Effect	Mitigation	Evaluation Criteria for Assessing Residual Adverse Environmental Effects[A]				
			Magnitude	Geographic Extent	Duration/ Frequency	Reversibility	Ecological / Socio-economic Context
Removal of Bund Wall and Disposal (dredging / ocean disposal)	• Change in Habitat Quality • Change in Habitat Use • Potential Mortality	• Monitor appropriate safety zone for diving and plunge-feeding birds	1	1	2/1	R	2
Tow-out of GBS to Bull Arm deepwater site	• Change in Habitat Use		1	1	1/1	R	2
GBS Ballasting and De-ballasting (seawater only)	• Change in Habitat Use		1	1	1/1	R	2
Complete GBS Construction and Mate Topsides at Bull Arm deepwater site	• Change in Habitat Use		1	1	2/2	R	2
Hook-up and Commissioning of Topsides	• Change in Habitat Use		1	1	2/2	R	2
Surveys (*e.g.*, geophysical, geological geotechnical, environmental)	• Change in Habitat Use		1	1	2/1	R	2
Platform Tow-out from deepwater site	• Change in Habitat Use		1	1	3/6	R	2
Offshore Construction / Installation							
OLS Installation and Testing	• Change in Habitat Use		1	2	2/1	R	2
Concrete Mattress Pads / Rock Dumping over OLS Offloading Lines	• Change in Habitat Use		1	2	2/1	R	2
Installation of Temporary Moorings	• Change in Habitat Use		1	1	2/1	R	2
Platform Tow-out / Offshore Installation	• Change in Habitat Use		1	1	2/6	R	2
Underbase Grouting	• Change in Habitat Use		1	1	2/1	R	2
Possible Offshore Solid Ballasting	• Change in Habitat Use		1	1	2/1	R	2
Placement of Rock Scour Protection on Seafloor around Platform Location	• Change in Habitat Use		1	1	2/1	R	2
Hook-up and Commissioning of Platform	• Change in Habitat Use		1	1	2/1	R	2

Project Activity	Potential Environmental Effect	Mitigation	Evaluation Criteria for Assessing Residual Adverse Environmental Effects[A]				
			Magnitude	Geographic Extent	Duration/ Frequency	Reversibility	Ecological / Socio-economic Context
Operation of Helicopters	• Change in Habitat Use	• Avoid active marine bird colonies, including Witless Bay Ecological Reserve • Avoid flying at low altitudes, where possible	1	1	3/6	R	2
Operation of Vessels (supply, support, standby and tow vessels / barges / diving / ROVs)	• Change in Habitat Use • Potential Mortality	• Maintain minimum distance of 2 km from active marine bird colonies • Maintain steady course and speed • Avoid concentrations of marine birds	1	2	3/6	R	2
Air Emissions	• Change in Habitat Quality		N	5	3/6	R	2
Lighting	• Change in Habitat Quality • Change in Habitat Use • Potential Mortality	• Proper release of stranded birds • EMCP will evaluate use of shielding and deflectors with directional lighting to minimize attraction by lighting, and may incorporate such features where safety of operations and navigation are not affected	1	2	3/6	R	2
Potential Expansion Opportunities							
Excavated Drill Centre Dredging and Spoils Disposal	• Change in Habitat Use		1	1	2/1	R	2
Installation of Pipeline(s) / Flowline(s) and Testing from Excavated Drill Centre(s) to Platform, plus Concrete Mattresses, Rock Cover, or Other Flowline Insulation	• Change in Habitat Use		1	2	2/1	R	2
Hook-up and Commissioning of Drill Centres	• Change in Habitat Use		1	2	2/2	R	2
Surveys (*e.g.*, geophysical, geological, geotechnical, environmental)	• Change in Habitat Use		1	3	2/1	R	2

Project Activity	Potential Environmental Effect	Mitigation	Evaluation Criteria for Assessing Residual Adverse Environmental Effects[A]				
			Magnitude	Geographic Extent	Duration/ Frequency	Reversibility	Ecological / Socio-economic Context

KEY

Magnitude:
N = Negligible: There may be some environmental effect but it is not considered to be measurable
1 = Low: <10 percent of the population or habitat in the Study Area will be affected
2 = Medium: 11 to 25 percent of the population or habitat in the Study Area will be affected
3 = High: >25 percent of the population or habitat in the Study Area will be affected

Geographic Extent:
1 = <1 km^2
2 = 1-10 km^2
3 = 11-100 km^2
4 = 101-1,000 km^2
5 = 1,001-10,000 km^2
6 = >10,000 km^2

Duration:
1 = < 1 month
2 = 1-12 months.
3 = 13-36 months
4 = 37-72 months
5 = >72 months

Frequency:
1 = <11 events/year
2 = 11-50 events/year
3 = 51-100 events/year
4 = 101-200 events/year
5 = >200 events/year
6 = continuous

Reversibility:
R = Reversible
I = Irreversible

Ecological / Socio-economic Context:
1 = Area is relatively pristine or not adversely affected by human activity
2 = Evidence of adverse environmental effects

A Where there is more than one potential environmental effect, the evaluation criteria rating is assigned to the environmental effect with the greatest potential for harm

9.5.2 Operations and Maintenance

9.5.2.1 Change in Habitat Quantity

None of the Project activities in the Offshore Study Area during the Operations and Maintenance Phase are predicted to result in changes in habitat quantity for marine birds.

9.5.2.2 Change in Habitat Quality

Primary Project activities that could potentially result in changes in habitat quality for marine birds include lighting and flaring, operational discharges and seismic surveys.

Lighting

As described previously for lighting in the Offshore Study Area during the construction / installation phase (Section 9.5.1.2), lighting of infrastructure in the Offshore Study Area will likely attract marine birds (especially Leach's Storm-Petrels) during darkness and low visibility periods. Mitigation measures described in Section 9.5.1.2 will also be applied during operation to limit the potential environmental effects on marine birds.

Flaring

During steady-state operations, it is estimated that the Hebron facility will have reduced flare emissions compared with existing operations. Flaring during platform start-up and early year operations will be greater than steady-state operations. Flare operating practices will be developed for the Operations Authorization and a flaring allowance established in consultation with the C-NLOPB.

Night-migrating or night-active marine birds might be attracted by gas flaring in the Offshore Study Area, similar to the effect described for lighting (above). The Leach's Storm-Petrel is the species most likely to be affected, particularly on foggy nights in late summer to early fall. However, the heat and noise generated by the flare may deter marine birds from the immediate area under most night-time conditions. When attracted to the flare, marine birds may strike infrastructure and become injured or stranded.

As in the case of lighting (described above), EMCP will develop protocols for regular searches of birds that may become stranded on all vessels and facilities. Recovered birds will be released in accordance with standard protocols (Williams and Chardine 1999; Husky Energy 2008). Stranded bird reports will be provided to the CWS.

Operational Discharges

Routine Platform discharges are not expected to produce sheens. Nonetheless, there has been a number of small petroleum spills on the Grand Banks (see Section 14.1.4 of the CSR).

Activities that involve the storage and discharge of fluids and solids that occur during the operations and maintenance phase in the Offshore Study Area have the potential to foul marine birds. Fouling the feathers of marine birds may affect their ability to fly and possibly lead to ingestion of toxic substances. The discharge of some fluids like water-based muds (WBMs) and cuttings could potentially leave a sheen on the water surface, although this effect will be mitigated by discharge at depth and is unlikely to occur. The discharge of any blowout preventer fluid is likely to have minimal environmental effects on marine birds because low-toxicity glycol-water mixes will be used; these fluids are also typically released on a periodic basis near the seafloor. Produced water has the potential to affect birds if sheening occurs on the sea. This effect is considered below in Section 9.5.4.2. Sanitary waste and wastewater generated by the platform and support vessels will be macerated before subsurface discharge. Cooling water will be chlorinated and discharged overboard at an approximate temperature of 30°C, with a residual chlorine level <0.5 ppm. Thus, the volume of entrainment will be low and the area of thermal effects will be small. O'Hara and Morandin (2010) demonstrated that it only requires a small amount of oil (*e.g.*, 10 ml) to affect the feather structure of Common Murre and Dovekie. Such modifications to feather structure cause a loss of insulation, which in turn can result in mortality in the cold Northwest Atlantic environment.

Some marine birds, such as the Leach's Storm-Petrel, are known to feed on naturally-produced oily slicks on the water of biological origin and could possibly be attracted to a slick. However, Leach's Storm-Petrels do not spend much time on the water and would remain on the wing during an investigation of a slick, reducing the chances that feathers will contact the fluid. Some species such as shearwaters, Northern Fulmars and gulls may be attracted to vessels and the platform (discussed below in Presence of Structures); these birds may rest on the water, making them more likely to come in contact with discharges. Some marine birds, particularly gulls, may be attracted to sewage particles, but the small amount discharged below the surface is unlikely to increase the abundance of marine birds in the Offshore Study Area.

To minimize the possibility of fouling marine bird feathers, fluids will be discharged below the water's surface whenever possible. It is predicted that the residual environmental effect of fluid / solid storage or discharge on the habitat quality of marine birds in the Offshore Study Area will affect a limited area and be of low magnitude.

Seismic Surveys

As described above for seismic surveys in the Offshore Study Area during the construction / installation phase, most species of marine birds that are expected to occur in the Offshore Study Area have limited potential to be exposed to underwater sounds produced by airguns during seismic surveys. These species are not expected to experience any hearing impairment as a result of seismic surveys. However, members of the family Alcidae forage under the water's surface to maximum depths of 100 m for up to 202 seconds. It is possible that alcids may experience an unknown level of hearing impairment if exposed at a close proximity to underwater airgun pulses. The environmental effects of seismic sounds on alcids are completely unknown. It is thought that the presence of an on-coming seismic vessel may potentially alert alcids (and other marine birds on the water), thereby flushing animals from the area (see Section 9.5.2.3) prior to being exposed to any airgun sounds or occurring in close proximity to operating airguns. Seismic surveys should be planned, to the extent possible, to avoid periods of known concentration in the Offshore Study Area for members of the Alcidae.

9.5.2.3 Change in Habitat Use

Potential changes in habitat use during Hebron Project operations relate primarily to the presence of the structures (and associated lighting), vessel and helicopter traffic, seismic surveys, and other activities that generate noise / light that could potentially induce temporary and localized disturbance of marine birds.

The physical structure of the platform and support vessels could affect marine birds by attracting them. Additionally, it is possible that the artificial reef affected, created by stationary structures will affect marine bird prey. Shearwaters, Northern Fulmars, and gulls are the species most likely to be attracted to the platform and may rest on the water nearby.

Effects and mitigation associated with lighting, vessel traffic, helicopter traffic and seismic surveys have been discussed under the construction / installation phase (Section 9.5.1.3) and are applicable to the operations and maintenance phase.

Various other activities associated with the operations and maintenance phase (*e.g.*, lighting, flaring) in the Offshore Study Area may induce temporary and localized disturbance of marine birds. These activities are not expected to occur near any known nesting colonies, so will not affect that portion of marine bird life cycles. Disturbance is possible for small feeding concentrations of marine birds that are common during summer periods (particularly Greater Shearwater, Sooty Shearwater and Leach's Storm-Petrel), winter periods (particularly Black-legged Kittiwake and Thick-billed Murre), fall (particularly Dovekie), or year-round (particularly Northern Fulmar) in the Offshore Study Area. It is expected that bird behaviour would likely return to normal shortly after the completion of these activities (if disturbed at all).

9.5.2.4 Potential Mortality

It is possible that marine birds attracted by gas flaring at night might become incinerated, collide with platform structures, or strand on the platform, thereby causing mortality (Russell 2005; Montevecchi 2006). However the heat and noise generated by the flare may deter marine birds from the immediate area under most night-time conditions. Marine birds may also be attracted to the Platform lights. As described above, the Leach's Storm-Petrel is the most likely marine bird species to be affected, particularly on foggy nights in late summer to early fall (Williams and Chardine 1999). It is unknown which seabird species, if any, are susceptible to mortality from flaring. There is currently no known mitigation for the potential environmental effects from flaring, but flaring is expected to have minimal effect on marine birds over the duration of the Project.

Although free oil is usually removed from produced water before discharge, oil sheens are sometimes associated with produced water discharges (*e.g.*, ERIN Consulting Ltd. and OCL Services Ltd. 2003). These sheens are thought to be derived from the dispersed oil or soluble medium- to high-molecular weight hydrocarbons components of produced water (Veil *et al.* 2004). Data on the relationship between sheen thickness and lethality to marine birds are lacking (Hartung 1995). The geographic extent of produced water is usually thought to be 1 km^2 or less (Fraser *et al.* 2006). Fraser *et al.* (2006) modelled the potential effect of produced water on the Grand Banks on alcids. They used published estimates of alcid density and also assumed a daily occurrence of sheens (210 days) and that any contact between birds and sheens causes mortality - these assumptions are considered a worst case scenario. Their modelling suggests a potential negative impact ranging in magnitude from low to high within 1 km^2. The Environmental Studies Research Find (ESRF) commissioned a study on the effects of sheens on marine birds. This laboratory study by O'Hara and Morandin (2010) demonstrated that it only requires a small amount of oil (*e.g.*, 10 ml) to affect the feather structure of Common Murre and Dovekie. However, "there are no data on threshold number of affected feathers before an individual bird would begin to be affected by exposure to oil sheen. Further research quantifying amounts of oil that cause negative impacts in relation to sheen thickness and exposure levels are crucial" (O'Hara and Morandin, 2010). See Section 9.5.4 for a more detailed discussion of the environmental effects of oil exposure on marine birds.

The environmental effects of Project operation / maintenance activities on Marine Birds are summarized in Table 9-11.

Given that project activities are mostly localized, of low to medium magnitude, and reversible, there are not likely to be significant adverse environmental effects on Marine Birds from the operation and maintenance activities associated with the Project.

Table 9-11 Environmental Effects Assessment: Operations and Maintenance

Project Activity	Potential Environmental Effect	Mitigation	Evaluation Criteria for Assessing Residual Adverse Environmental Effects[A]				
			Magnitude	Geographic Extent	Duration/ Frequency	Reversibility	Ecological / Socio-economic Context
Presence of Structures	• Change in Habitat Use • Potential Mortality		1	1	5/6	R	2
Lighting	• Change in Habitat Quality • Change in Habitat Use • Potential Mortality	• Proper release of stranded birds • EMCP will evaluate use of shielding and deflectors with directional lighting to minimize attraction by lighting, and may incorporate such features where safety of operations and navigation are not affected	1	2	5/6	R	2
Maintenance Activities (*e.g.*, diving, ROV)	• Change in Habitat Use	• Use of best practices	1	1	5/3	R	2
Air Emissions	• Change in Habitat Quality		N	5	5/6	R	2
Flaring	• Change in Habitat Quality • Change in Habitat Use • Potential Mortality		1	1	5/6	R	2

Project Activity	Potential Environmental Effect	Mitigation	Evaluation Criteria for Assessing Residual Adverse Environmental Effects[A]				
			Magnitude	Geographic Extent	Duration/ Frequency	Reversibility	Ecological / Socio-economic Context
Wastewater (*e.g.*, produced water, storage displacement water, deck drainage)	• Change in Habitat Quality • Potential Mortality	• Subsurface discharge	1	2	5/6	R	2
Chemical Use / Management / Storage (*e.g.*, corrosion inhibitors, well treatment fluids)	• Change in Habitat Quality		1	1	5/6	R	2
WBM Cuttings	• Change in Habitat Quality	• Subsurface discharge	1	1	5/2	R	2
Operation of Helicopters	• Change in Habitat Use	• Avoid active marine bird colonies, including Witless Bay Ecological Reserve • Avoid flying at low altitudes where possible	1	4	5/6	R	2
Operation of Vessels (supply, support, standby and tow vessels / shuttle tankers / barges / ROVs)	• Change in Habitat Use • Potential Mortality	• Maintain minimum distance of 2 km from active marine bird colonies • Maintain steady course and speed • Avoid concentrations of marine birds	1	4	5/6	R	2
Surveys (*e.g.*, geophysical, 2D / 3D / 4D seismic, VSP, geohazard, geological, geotechnical, environmental, ROV, diving)	• Change in Habitat Quality • Change in Habitat Use	• Maintain steady course & speed • Avoid concentrations of marine birds	1	3	3/2	R	2
Potential Expansion Opportunities							
Drilling operations from MODU at Future Excavated Drill Centres	• Change in Habitat Use		1	1	3/6	R	2
Presence of Structures	• Change in Habitat Use • Potential Mortality		1	1	5/6	R	2
Chemical Use and Management (BOP fluids, well treatment fluids, corrosion inhibitors)	• Change in Habitat Quality		1	1	5/6	R	2
WBM and SBM Cuttings	• Change in Habitat Quality	• Subsurface discharge	1	2	5/6	R	2

Project Activity	Potential Environmental Effect	Mitigation	Evaluation Criteria for Assessing Residual Adverse Environmental Effects[A]				
			Magnitude	Geographic Extent	Duration/ Frequency	Reversibility	Ecological / Socio-economic Context
Geophysical / Seismic Surveys	• Change in Habitat Quality • Change in Habitat Use	• Plan surveys to avoid concentrations of members of Alcidae	1	3	3/2	R	2

KEY

Magnitude:

N = Negligible: There may be some environmental effect but it is not considered to be measurable
1 = Low: <10 percent of the population or habitat in the Study Area will be affected
2 = Medium: 11 to 25 percent of the population or habitat in the Study Area will be affected
3 = High: >25 percent of the population or habitat in the Study Area will be affected

Geographic Extent:
1 = <1 km^2
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Frequency:
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5 = >200 events/year
6 = continuous

Reversibility:
R = Reversible
I = Irreversible

Ecological / Socio-economic Context:
1 = Area is relatively pristine or not adversely affected by human activity
2 = Evidence of adverse environmental effects

A Where there is more than one potential environmental effect, the evaluation criteria rating is assigned to the environmental effect with the greatest potential for harm

9.5.3 Offshore Decommissioning and Abandonment

None of the Project activities in the Offshore Study Area during the decommissioning and abandonment phase are predicted to result in changes in habitat quantity, or mortality for marine birds. Lighting and surveys may affect habitat quality as discussed previously during the construction and operations phases. Changes in habitat use are described below.

Activities associated with the removal of the Hebron Platform and offshore loading system (OLS) loading points may induce temporary and localized disturbance of marine birds. These activities are not expected to occur near any known nesting colonies, so will not affect that portion of marine bird life cycles. Disturbance is possible for small feeding concentrations of marine birds that are common in the Offshore Study Area. It is expected that bird behaviour would likely return to normal shortly after the completion of these activities (if disturbed at all).

Effects and mitigation associated with lighting, vessel traffic, helicopter traffic and surveys, have been discussed under the construction (Section 9.5.1.3) and are applicable to the decommissioning / abandonment phase.

The potential environmental effects of decommissioning activities are expected to be similar (or less than) those of construction or operation; therefore, no significant adverse environmental effects are predicted.

The environmental effects of Project decommissioning / abandonment activities on Marine Birds are summarized in Table 9-12.

Table 9-12 Environmental Effects Assessment: Decommissioning and Abandonment

Project Activity	Potential Environmental Effect	Mitigation	Evaluation Criteria for Assessing Residual Adverse Environmental Effects[A]				
			Magnitude	Geographic Extent	Duration/ Frequency	Reversibility	Ecological / Socio-economic Context
Removal of the Hebron Platform and OLS Loading Points	• Change in Habitat Use		1	2	2/1	R	2
Lighting	• Change in Habitat Quality • Change in Habitat Use • Potential Mortality	• Proper release of stranded birds • EMCP will evaluate use of shielding and deflectors with directional lighting to minimize attraction by lighting, and may incorporate such features where safety of operations and navigation are not affected	1	1	3/5	R	2
Plugging and Abandoning Wells	• Change in Habitat Use		1	1	3/2	R	2
Abandoning the OLS Pipeline	• Change in Habitat Use		1	2	3/1	R	2
Operation of Helicopters	• Change in Habitat Use	• Avoid active marine bird colonies • Avoid flying at low altitudes where possible	1	2	3/6	R	2
Operation of Vessels (supply, support, standby and tow vessels / ROVs)	• Change in Habitat Use • Potential Mortality	• Maintain minimum distance of 2 km from active marine bird colonies • Maintain steady course and speed • Avoid concentrations of marine birds	1	3	3/6	R	2
Surveys (*e.g.*, geophysical, geological, geotechnical, environmental, ROV, diving)	• Change in Habitat Quality • Change in Habitat Use	• Maintain steady course and speed • Avoid concentrations of marine birds	1	2	3/2	R	2

Project Activity	Potential Environmental Effect	Mitigation	Evaluation Criteria for Assessing Residual Adverse Environmental Effects[A]				
			Magnitude	Geographic Extent	Duration/ Frequency	Reversibility	Ecological / Socio-economic Context

KEY

Magnitude:
N = Negligible: There may be some environmental effect but it is not considered to be measurable
1 = Low: <10 percent of the population or habitat in the Study Area will be affected
2 = Medium: 11 to 25 percent of the population or habitat in the Study Area will be affected
3 = High: >25 percent of the population or habitat in the Study Area will be affected

Geographic Extent:
1 = <1 km^2
2 = 1-10 km^2
3 = 11-100 km^2
4 = 101-1,000 km^2
5 = 1,001-10,000 km^2
6 = >10,000 km^2

Duration:
1 = < 1 month
2 = 1-12 months.
3 = 13-36 months
4 = 37-72 months
5 = >72 months

Frequency:
1 = <11 events/year
2 = 11-50 events/year
3 = 51-100 events/year
4 = 101-200 events/year
5 = >200 events/year
6 = continuous

Reversibility:
R = Reversible
I = Irreversible

Ecological / Socio-economic Context:
1 = Area is relatively pristine or not adversely affected by human activity
2 = Evidence of adverse environmental effects

A Where there is more than one potential environmental effect, the evaluation criteria rating is assigned to the environmental effect with the greatest potential for harm

9.5.4 Accidents, Malfunctions and Unplanned Events

Marine birds are the marine biota most at risk from oil spills. Shorebirds (plovers (*Charadriidae)*, and sandpipers (*Scolopacidae*)), sea ducks and other coastal water birds (*e.g.*, loons (*Gaviidae*), grebes (*Podicipedidae*) and cormorants) are also at risk, as they use the marine environment to varying degrees. Reported effects vary with species, type of oil, weather conditions, time of year, and duration of the spill (Gorsline *et al.* 1981). Natural inter-annual variation in other factors that affect populations (*e.g.*, prey availability and weather) reduces the ability of scientists to assess the full effect of oil spills on bird populations (Eppley 1992; White *et al.* 1995; Votier *et al.* 2005).

The following sections assess the effect of an accidental release of hydrocarbons in the nearshore and offshore. Spills in the nearshore would be attributable to vessel malfunctions and similar effects and mitigation discussed for the offshore is applicable to the nearshore scenarios; therefore, nearshore and offshore effects are assessed together. The type and probability of spills (blow-out (surface and subsea) and batch) are discussed in Section 14.1 and spill trajectories on water in the Nearshore Study Area and Offshore Study Area are described in Sections 14.2 and 14.3, respectively. A detailed analysis is included in ASA (2011a, 2011b).

Oil spill response is included as part of the contingency planning undertaken for the Project and additional information regarding spill response planning is found is Section 14.4. Chapter 16 describes the Hebron Project's overall environmental management process.

9.5.4.1 Change in Habitat Quality

Nearshore

Hydrocarbon spills or collisions resulting in hydrocarbon spills may affect habitat quality as described for the Offshore Study Area below.

Offshore

It is possible that birds exposed to oil in the Offshore Study Area may return to nesting sites. Nesting marine birds that have survived oil contamination generally exhibit decreased reproductive success. Nesting marine birds transfer oil from their plumage and feet to their eggs (Albers and Szaro 1978). Very small quantities (1 to 20 μL) of oil on eggs have produced developmental defects and mortality in avian embryos of many species (Albers 1977; Albers and Szaro 1978; Hoffmann 1978, 1979a; Macko and King 1980; Parnell *et al.* 1984; Harfenist *et al.* 1990). The resultant hatching and fledging success of young appears to be related to the type of oil (Hoffman 1979b; Albers and Gay 1982; Stubblefield *et al.* 1995) and the timing of exposure during incubation. Embryos are most sensitive to oil during the first half of incubation (Albers 1978; Leighton *et al.* 1985). Breeding birds that ingest oil generally exhibit a decrease in fertilization (Holmes *et al.* 1978), egg laying and hatching (Hartung 1965; Ainley *et al.* 1981), chick growth (Szaro *et al.* 1978), and survival (Vangilder and Peterle 1980; Trivelpiece *et al.* 1984), as well as a reduction in mean eggshell thickness and strength (Stubblefield *et al.* 1995). Growth was retarded in Herring Gull chicks, Black Guillemot chicks, and Mallard (*Anas platyrhynchos*) ducklings after they ingested oil directly (Peakall *et al.* 1981; Szaro *et al.* 1981).

Oil spills that affect prey availability of a species with low seasonal dietary variation could have a greater effect on that species through an indirect reduction in reproduction and poorer chick condition (Velando *et al.* 2005). Eppley and Rubega (1990) suggested that exposure to an Antarctic oil spill causes changes in the normal parental behaviour of South Polar Skua, thus exposing young to increased predation and contributing to reproductive failure in that population. In another case, abandonment of nesting burrows by oiled adult Leach's Storm-Petrels may contribute to reproductive failure in that population (Butler *et al.* 1988). Therefore, a spill that occurs during the reproductive period could cause mortality of young even if the adults survived the exposure to oil.

Other sublethal effects of oil contamination include reduced feeding rates (Sanderling (*Calidris alba*); Burger and Tsipoura 1998).

9.5.4.2 Change in Habitat Use

Nearshore

Hydrocarbon spills or collisions resulting in hydrocarbon spills will affect habitat use as described for the Offshore Study Area below. A rupture in the bund wall may result in increased sedimentation in the water column. After sediment released by a bund wall rupture settles out of the water column, siltation of fish habitat and benthos may result in lower numbers of prey available to marine birds. Marine birds will learn to avoid silted areas because of low prey densities until benthic fish habitat recovers.

Offshore

There are possible changes in habitat use of oiled areas by both oiled and un-oiled birds. After a large oil spill off the coast of Washington by the *Nestucca* in December 1988, a study of oiled shorebirds suggested that within 10 days of the oil spill they could be found at beach roosting sites, but that after 10 days they tended to remain in the harbour rather than complete their usual return flight to beach roosting sites at high tide (Larsen and Richardson 1990). In June 1979, an oil blow-out occurred from the *Ixtoc I* in the Gulf of Mexico off Mexico, causing shorebirds there to avoid oil-affected foreshores and instead use poorer backshore feeding habitats and freshwater pools (Chapman 1981). Three months after the oil spill, storms cleaned the beaches, but shorebirds failed to return to the foreshore feeding habitats at their pre-spill levels (Chapman 1981).

The greatest decrease in use of contaminated habitats immediately following a spill occurs in species that feed on or close to shore and either breed along the coast or are full-year residents (Wiens *et al.* 1996). Day *et al.* (1995) showed that species lacking clear evidence of recovery tended to be intertidal feeders and residents. However, they also found that other ecologically similar species did not show signs of initial impact or showed rapid recovery.

9.5.4.3 Potential Mortality

Nearshore

Hydrocarbon spills or collisions resulting in hydrocarbon spills can cause mortality as described for the Offshore Study Area below. Within the Nearshore Study Area, Bellevue Beach provides important habitat for marine birds (see Section 9.3.1). Spill modelling at the Bull Arm site shows that there is a 1 to 10 percent probability of a diesel fuel spill reaching Bellevue Beach. This probability increases to 10 to 30 percent for IFO-180 fuel released in summer. These probabilities were based on modelling results in the absence of any spill intervention (ASA 2011a, 2011b). The spill modelling suggests that there is reduced probability (<1 percent or 1 to 10 percent) of a spill affecting marine bird concentration areas such as nesting colonies outside the Nearshore Study Area (*e.g.*, off the Bonavista and Bay de Verde Peninsulas). Once again, these probabilities were based on modelling results in the absence of any spill intervention (ASA 2011a, 2011b). Mitigation measures will likely reduce effects of potential hydrocarbon spills on marine birds in the Nearshore Study Area.

Offshore

Exposure to oil causes thermal and buoyancy deficiencies that typically lead to the deaths of affected marine birds. Although some may survive these immediate effects, long-term physiological changes may eventually result in death (Ainley *et al.* 1981; Williams 1985; Frink and White 1990; Fry 1990). Reported effects vary with bird species, type of oil (Gorsline *et al.* 1981), weather conditions, time of year, and duration of the spill or blowout. Although oil spills at sea have the potential to kill tens of thousands of marine birds (Clark 1984; Piatt *et al.* 1990), some studies suggest that even very large spills may not have long-term effects on marine bird populations (Clark 1984; Wiens 1995).

External exposure to oil occurs when flying birds land in oil slicks, diving birds surface from beneath oil slicks, and swimming birds swim into slicks. The external exposure results in matting of the feathers, which effectively destroys the thermal insulation and buoyancy provided by the air trapped by the feathers. Consequently, oiled birds may suffer from hypothermia and/or drown (Clark 1984; Hartung 1995). Birds living in coldwater environments, such as the Study Area, are most likely to succumb to hypothermia (Hartung 1995; Wiese and Ryan 2003). Most mortalities occur during the initial phase of oil spills when large numbers of birds are exposed to floating oil (Hartung 1995).

Oil spills at sea have the potential to kill tens of thousands of birds (Clark 1984; Piatt *et al.* 1990). However, it is difficult to estimate how many marine birds are oiled during any particular oil-spill, because some birds may not reach shore (dead or alive), and beached carcasses may be scavenged or washed out to sea before being counted (Ford *et al.* 1987). There is also no clear correlation between the size of an oil spill and numbers of marine birds killed, because the density of birds in a spill area, wind velocity and direction, wave action, and distance to shore can have a greater bearing on mortality than the size of the spill (Burger 1993). Accordingly, even small spills can cause cumulative mass mortality of marine birds (Joensen 1972; Carter *et al.* 2003; Hampton *et al.* 2003). In contrast, relatively low mortalities have been recorded from some huge spills. For example, the *Amoco Cadiz* spilled 230,000 tonnes of crude oil along the French coast, causing the recorded deaths of 4,572 birds (Clark 1984). A major spill that persists for several days near a nesting colony could kill a high proportion of pursuit-diving birds (*e.g.*, murres) within the colony (Cairns and Elliot 1987).

Oiled birds that escape death from hypothermia and/or drowning often seek refuge ashore, where they engage in abnormally excessive preening in an attempt to remove the oil (Hunt 1957, in Hartung 1995). The preening leads to the ingestion of significant quantities of oil that, although apparently only partially absorbed (McEwan and Whitehead 1980) can cause lethal effects. Noted effects on Common Murres and Thick-billed Murres oiled off

Newfoundland's south coast include emaciation, renal tubular degeneration, necrosis of the duodenum and liver, anemia, and electrolytic imbalance (Khan and Ryan 1991). Glaucous-winged Gulls (*Larus glaucescens*) experienced similar effects after they ingested bunker fuel oil during preening (Hughes *et al.* 1990).

Another commonly observed effect is adrenal hypertrophy. This condition tends to make birds more vulnerable to adrenocortical exhaustion (*e.g.*, Mallards (Hartung and Hunt 1966; Holmes *et al.* 1979), Black Guillemots (Peakall *et al.* 1980), and Herring Gulls (Peakall *et al.* 1982)). The adrenal gland maintains water and electrolyte balance that is essential for the survival of birds living in the marine environment. Hartung and Hunt (1966) found that ingested oils can cause lipid pneumonia, gastrointestinal irritation, and fatty livers in several species of ducks. Aromatic hydrocarbons have been detected in the brains of Mallards (Lawler *et al.* 1978) and are probably associated with observed symptoms (*e.g.*, lack of coordination, ataxia, tremors and constricted pupils) of nervous disorders (Hartung and Hunt 1966). Polycyclic aromatic hydrocarbons (PAH) can also be detected in plasma samples of oiled Common Murres (Troisi and Borjesson 2005). The availability of an immunoassay for the determination of PAH concentrations in plasma samples of oiled birds potentially can serve in the exposure assessment during oil spill response and rehabilitation (Troisi and Borjesson 2005).

Other toxicological effects, however, do not appear to differ between oiled and unoiled birds (Kammerer *et al.* 2004; Pérez-López *et al.* 2006). Levels of zinc, copper, arsenic, chromium, lead and cadmium were all similar in the liver of three species (Common Murre, Atlantic Puffin and Razorbill Murre) affected by the *Prestige* oil spill of September 2002 on the northwest Spanish Galician coast; only mercury showed increased levels in the liver of oiled birds (Pérez-López *et al.* 2006). Vanadium hepatic and renal concentrations did not prove to be appropriate biomarkers for recent exposure to oil spills following analyses of samples from Common Murres, Black Scoters (*Melanitta nigra*), and Common Eiders exposed to the *Erika* wreck off coastal France (Kammerer *et al.* 2004).

Birds exposed to oil are also at risk of starvation (Hartung 1995). For example, oiled Common Eiders generally deplete all of their fat reserves and much of their muscle protein (Gorman and Milne 1970). In addition, energy demands are higher because the metabolic rate of oiled birds increases to compensate for the heat loss caused by the reduced insulating capacity of their plumage. This can expedite starvation (Hartung 1967; McEwan and Koelink 1973). For birds living under harsh environmental conditions (*e.g.*, winters in colder climates), even a seemingly insignificant amount of oiling can have fatal consequences (Levy 1980).

Oiled birds that are cleaned and released might not have high survival rates. Pooling across the three species with the most band recovery data between 1969 and 1994 (Western Grebe (*Aechmophorus occidentalis*), White-winged Scoter (*Melanitta fusca*) and Common Murre), the median days that cleaned birds survived were 4 to 11 days, or a mean of four days (Sharp 1996). Birds that survived longer were those that typically had a low degree of oiling and spent less time in captivity; initial or release weights did not seem to matter (Sharp 1996). Birds cleaned after 1990 using more modern methods do not have a higher survival rate than those cleaned before 1990 (Sharp 1996).

Birds are particularly vulnerable to oil spills during nesting, moulting, and the period of time before young marine birds gain the ability to fly. Because newly fledged murres and Northern Gannets are unable to fly for the first two to three weeks at sea, they are less likely to be able to avoid contact with oil during that time (Lock *et al.* 1994). Before and during moult, the risks of hypothermia and drowning are increased (Erasmus and Wessels 1985), because feather wear and loss reduce the ability to repel water by about 50 percent (Stephenson 1997).

It is clear that truly aquatic and marine species of birds are most vulnerable and most often affected by exposure to marine oil spills. Diving species such as Black Guillemot, murres, Atlantic Puffin, Dovekie, eiders, Long-tailed Duck, scoters, Red-breasted Merganser (*Mergus serrator*), and loons are considered to be the most susceptible to the immediate effects of surface slicks (Leighton *et al.* 1985; Chardine 1995; Wiese and Ryan 1999; Irons *et al.* 2000). Alcids, especially Common and Thick-billed Murres, often have the highest oiling rate of marine birds recovered from beaches along the south and east coasts of the Avalon Peninsula, Newfoundland (Wiese and Ryan 2003). Those were the only group of marine birds to show an annual increase over a 13-year period (2.7 percent) in the proportion of oiled to stranded birds (Wiese and Ryan 1999). There also appears to be a strong seasonal effect, as significantly higher proportions of alcids (along with other marine bird groups) are oiled in winter versus summer (Wiese and Ryan 1999).

Other species such as Northern Fulmar, shearwaters, storm-petrels, gulls, and terns are vulnerable to contact with oil because they feed over wide areas and make frequent contact with the water's surface. They are also vulnerable to the disturbance and habitat damage associated with oil spill cleanup (Lock *et al.* 1994).

Shorebirds may be more affected by oil spills than has been suggested by carcass counts. A total of 7,800 collected bird carcasses were identified after the *Nestucca* oil spill off Washington State in 1988, but only six shorebird carcasses were present out of 3574 oiled shorebirds observed by Larsen and Richardson (1990). The authors suggested that this reveals a historic difficulty in finding shorebird carcasses, which may be explained by the higher mobility of oiled shorebirds (Larsen and Richardson 1990).

The extent of bioaccumulation of the chemical components of oil in birds is limited because vertebrate species are capable of metabolizing them at rates that minimize bioaccumulation (Neff 1985, in Hartung 1995). Birds generally excrete much of the hydrocarbons within a short time period (McEwan and Whitehead 1980).

Some studies have suggested that oil pollution is unlikely to have major long-term effects on bird productivity or population dynamics (Clark 1984; Butler *et al.* 1988; Boersma *et al.* 1995; Erikson 1995; Stubblefield *et al.* 1995; White *et al.* 1995; Wiens 1995, 1996; Seiser *et al.* 2000) while others suggest the opposite (Piatt *et al.* 1990; Walton *et al.* 1997; Votier *et al.* 2005). Natural inter-annual variation in other factors that affect populations (*e.g.*, prey availability and weather) reduces the ability of scientists to assess the full effect of oil spills on bird populations (Eppley 1992; White *et al.* 1995; Votier *et al.* 2005).

Individual seabirds that come into contact with oil could suffer a variety of effects ranging from sublethal to lethal. If effects on individuals were extensive enough to cause large numbers of mortalities and/or severe sublethal effects on growth and reproduction, then effects could be measured at the level of populations. The duration of sublethal effects would likely vary by species, life stage, type and degree of exposure, and many other factors. The maximum duration of any effect at the individual level would be the life span of that individual. It is impossible to predict with any level of realistic precision how a range of sublethal effects might affect a particular population and thus, the conservative prediction was made that a large oil spill could significantly affect seabird populations. It also can be predicted that given the relatively large abundance and distribution of the seabird species in the Northwest Atlantic, no population would be extirpated and the affected colonies would likely rebound within several generations if environmental conditions were favourable. Bernanke and Kohler (2009) consider the effects of oil spills on seabird populations as "transient", with recovery times of 10 years, or possibly longer. Some sublethal effects reported in recent literature from two very large tanker spills include those briefly discussed below.

Large numbers of seabirds suffered mortality after the *Exxon Valdez* spill in Cook Inlet, Alaska and the Prestige spill in northwest Spain. Some reported sublethal effects of Prestige oil on birds included potential liver and kidney damage to Yellow-legged Gulls 17 months after the spill (Alonzo-Alvarez *et al.* 2007). Common Guillemots and razorbills (but not Atlantic Puffins) displayed brain acetylcholinesterase inhibition (Oropesa *et al.* 2007). Decreased breeding success at oiled colonies of European Shag (*Phalacrocorax aristotelis*) was reported by Velando *et al.* (2005).

Elevated hydrocarbon-inducible cytochrome P4501A in Harlequin Duck (Histrionicus histrionicus) livers up to 20 years after the *Exxon Valdez* spill was reported by Esler *et al.* (2010). It should be noted that this measurement is a biomarker for exposure and not necessarily a deleterious effect per se. Iverson and Esler (2010), based on modelling, suggested a recovery time of 24 years for Harlequin Duck after the spill.

In summary, it is possible that sublethal effects could persist for a number of years, depending upon generation times and the persistence of any spilled oil. Most seabirds are relatively long-lived. On the other hand, oil spilled on the Grand Banks, even if it made to the exposed coast, would likely not persist very long on Newfoundland's high energy rocky coastline.

Studies conducted following the *Exxon Valdez* oil spill in 1989 have tried to ascertain whether marine bird populations have recovered in the Prince William Sound area in Alaska. Esler *et al.* (2002) noted that as of 1998, the Harlequin Duck (*Histrionicus histrionicus*) population that winters in Prince William Sound has not yet recovered, based on initial high mortalities, the decrease in population size only in oiled areas during 1995 to 1997, and the fact that fewer female adults survived winters in oiled areas possibly because of continued oil exposure through at least 1998 (likely still from the *Exxon Valdez* spill). For other populations, it is not as clear whether they have or have not yet recovered. Irons *et al.* (2000) conducted a study of marine bird densities and found that as of 1998, five taxa (mostly those that dive for their food) were still negatively affected by the oil spill, including cormorants, goldeneyes (*Bucephala* spp.), mergansers, Pigeon Guillemot (*Cepphus columba*), and murres. Furthermore, as of July 2000, goldeneyes, mergansers (*Mergus* spp.), Pigeon Guillemot, and Black-legged Kittiwake had decreased significantly in oiled areas, and only one species, the Black Oystercatcher (*Haematopus bachmani*), had shown signs of recovery (Irons *et al.* 2001). Wiens *et al.* (2001) disagreed with the study design and interpretation of data by Irons *et al.* (2000), maintaining that most populations are no longer affected by the oil spill. However, Esler *et al.* (2002) pointed out that the studies that have found rapid recovery of bird populations are either based on presence / absence data (Wiens *et al.* 1996), which are not informative about the status of populations, on a short time period and inappropriate geographic scale for some species (Day *et al.* 1997), or on summer data (Murphy *et al.* 1997) when some populations mainly overwinter in Prince William Sound. All authors do agree; however, that bird populations responded differently to the *Exxon Valdez* oil spill. Some populations showed little signs of being affected, other populations recovered quickly, and some populations took as much as a decade to fully recover (*e.g.*, Pigeon Guillemot; Golet *et al.* 2002, in Esler *et al.* 2002). Populations of bird species with little genetic differentiation among breeding colonies are less likely to be affected severely by an oil spill because they have a greater potential for population recovery through dispersal (Riffaut *et al.* 2005).

Several small spills have occurred in or near the Study Area, and “small” oil releases (most likely from bilge pumping and de-ballasting by trans-Atlantic vessel traffic) occur frequently, killing thousands of marine birds (Brown *et al.* 1973; Brander-Smith *et al.* 1990; Chardine and Pelly 1994; Wiese and Ryan 2003). These discharges total more metric tons of oil on a world-wide basis than the total spillage from more well-known catastrophic spills, such as the *Exxon Valdez* and others (Brander-Smith *et al.* 1990, in Wiese and Ryan 2003). Between 1984 and 1999, the southeast coast of Newfoundland had the highest recorded rates in the world of oiled dead birds per kilometre of beach (0.77 versus 0.02 to 0.33 elsewhere; Wiese and Ryan 2003). Some researchers suggest that chronic oil pollution, acting in combination with other mortality factors, may affect seabirds at the population level (Piatt *et al.* 1990).

In February 1970, the *Irving Whale* spilled between 11,356 to 26,497 L (3,000 and 7,000 gallons) of Bunker C oil near St. Pierre and Miquelon, which subsequently spread along Newfoundland’s southeast coast. It was estimated that 7,000 birds, primarily Common Eiders, were killed (Brown *et al.* 1973). During the same month, the *Arrow* ran aground in Chedabucto Bay, Nova Scotia. Approximately 9,463,265 L (2,500,000 gallons) of Bunker C fuel oil were spilled, and at least 2,300 birds were killed in the bay itself (Brown *et al.* 1973). Primarily diving birds were affected, most notably Long-tailed Duck, Red-breasted Merganser, murres, Dovekie, and grebes (Brown *et al.* 1973). The spill spread offshore to Sable Island where mostly murres, Dovekie, and Northern Fulmar were killed. The lowest estimate of marine bird mortality from that part of the slick was 4,800 birds (Brown *et al.* 1973). In November 2004, a spill of crude oil occurred from the FPSO on the *Terra Nova* oil field. Based on the total area of the spill and on marine bird densities derived from marine bird surveys conducted in the spill area after the release, CWS has estimated that mortality to marine birds in the area may have been in the order of 10,000 (Wilhelm *et al.* 2007). This estimate depends on a number of assumptions, including: the marine bird surveys conducted seven and eight days following the incident were representative, the proportion of those birds flying during those surveys that made contact with the oil is known, and that the oil covered the entire surface area within the slick's perimeter. In fact, the high sea state during and after the spill resulted in areas of slick-free water within the slick (Wilhelm *et al.* 2007). Using a different method, a Memorial University scientist arrived at a mortality estimate for the Terra Nova spill that was of similar order of magnitude as the CWS estimate. He did this by inserting the *Terra Nova* spill volume into Burger's (1993) regression of mortality estimates on spill volumes, which was derived from historical spills occurring in a wide range of locations (Wilhelm *et al.* 2007).

On a broader geographical scale, estimates of the number of birds that die annually from spills range from 21,000 on the Atlantic coast of Canada, and 72,000 in all of Canada (Thomson *et al.* 1991), to 315,000 ±65,000 Common Murres, Thick-billed Murres and Dovekies annually in southeastern Newfoundland alone due to illegal oil discharges from ships (Wiese and Robertson 2004). Clark (1984) estimated that 150,000 to 450,000 birds die annually in the North Sea and North Atlantic from oil pollution from all sources.

Spill modelling at the site of the Hebron Platform shows that the majority of spills are predicted to travel eastward (ASA 2011b). Modelling was conducted for well blow-outs of crude oil, with oil released at either the seafloor or from the top of the drilling platform and durations of 30 to 120 days. Short duration (less than 24 hours) small volume batch transfer spills of crude oil and diesel fuel were also modelled. Additional extended duration spill simulations were completed for platform blow-out scenarios to track oil remaining on the sea surface 200 days beyond termination of the oil flow. Blow-out simulations >30 days duration are predicted to have a 0 to 3 percent probability of reaching segments of the Newfoundland shoreline (primarily the southern Avalon Peninsula). However, this probability increases to a maximum of 8 percent based on modelling of oil remaining 200 days beyond termination of a blowout. If oil reaches the shoreline during summer (1 percent probability), it is predicted that about 5 km of shoreline may be oiled (at >0.01 mm thickness). If oil reaches the shoreline during winter (1 to 8 percent probability), it is predicted that up to 785 km of shoreline may be oiled (at >0.01 mm thickness). These probabilities were based on modelling results in the absence of any spill intervention (ASA 2011b). Based on spill modelling, there is little chance that seabird colonies on the Avalon Peninsula will experience shoreline oiling during the breeding season. There is some chance that oil may reach the southern Avalon Peninsula, including Cape St. Mary's during winter. This could put Harlequin Ducks and other winter seabirds (*e.g.*, eiders) at risk to be exposed to weathered oil (three weeks to nine months old). Oil removal from the exposed and rocky shoreline of the Avalon Peninsula will be faster than removal from protected areas with softer substrate because of increased water penetration and flushing and wave erosion (ASA 2011b). Weathering processes will have reduced the amount of oil potentially reaching shorelines (ASA 2011b). Mitigation measures will likely reduce effects of potential hydrocarbon spills on marine birds in the Offshore Study Area.

Tracker buoy data collected during the 2004 Terra Nova spill indicated that it took five weeks for the buoy to reach 40.00.0W and approximately 48.00.00N in November / December (and basically confirmed the oil spill trajectory modelling results conducted to date for the Grand Banks oil developments). If an uncontrolled spill (*i.e.*, no spill countermeasures implemented) lasted more than 120 days, the modelling predicts that oil from a surface or sub-surface blowout at the Hebron Platform will extend beyond the model domain area and, therefore, could potentially (less than 10 percent probability) reach an international coastline with a thickness greater than 0.01 mm. However, any oil that did reach an international shoreline would be patchy, weathered oil.

Mitigation for accidental hydrocarbon spills will consist of following the protocols detailed in the spill response plan. The oil spill response plan is under development; however, Section 14.6 provides an outline of the proposed spill response plan for offshore operations. Depending on the nature and tiered response required, mitigations include the provision for spill response equipment and the rescue and rehabilitation of oiled marine birds. Marine bird rehabilitation will be facilitated through ExxonMobil's North American support network. These procedures will minimize the potential mortality from such accidental events.

The environmental effects of Project accidental events activities on Marine Birds are summarized in Table 9-13. The geographic extents provided in Table 9-13 were based on modelling results in the absence of any spill intervention (ASA 2011a, 2011b).

Table 9-13 Environmental Effects Assessment: Accidental Events

Project Activity	Potential Environmental Effect	Mitigation	Evaluation Criteria for Assessing Residual Adverse Environmental Effects[A]				
			Magnitude	Geographic Extent	Duration/ Frequency	Reversibility	Ecological / Socio-economic Context
Bund Wall Rupture	• Change in Habitat Quality • Change in Habitat Use	• Prevention through design standards and maintenance • Emergency Response Contingency Plan	1	1	1/1	R	2
Nearshore Spill	• Change in Habitat Quality • Change in Habitat Use • Potential Mortality	• Oil spill response plan • Training, preparation, equipment inventory, prevention, and emergency response drills	2	4	2/1	R/I [B]	2
Failure or Spill from OLS	• Change in Habitat Quality • Change in Habitat Use • Potential Mortality	• Oil spill response plan • Training, preparation, equipment inventory, prevention, and emergency response drills	3	5	2/1	R/I[B]	2
Subsea Blowout	• Change in Habitat Quality • Change in Habitat Use • Potential Mortality	• Oil spill response plan • Training, preparation, equipment inventory, prevention, and emergency response drills	3	5	3/1	R/I[B]	2
Crude Oil Surface Spill	• Change in Habitat Quality • Change in Habitat Use • Potential Mortality	• Oil spill response plan • Training, preparation, equipment inventory, prevention, and emergency response drills	3	5	2/1	R/I[B]	2
Other Spills (fuel, chemicals, drilling muds or waste materials on the drilling unit, GBS, Hebron Platform)	• Change in Habitat Quality • Change in Habitat Use • Potential Mortality	• Oil spill response plan • Training, preparation, equipment inventory, prevention, and emergency response drills	3	1	2/1	R/I[B]	2
Marine Vessel Incident (*i.e.*, fuel spills)	• Change in Habitat Quality • Change in Habitat Use • Potential Mortality	• Oil spill response plan • Training, preparation, equipment inventory, prevention, and emergency response drills	3	5	2/1	R/I[B]	2

Project Activity	Potential Environmental Effect	Mitigation	Evaluation Criteria for Assessing Residual Adverse Environmental Effects[A]				
			Magnitude	Geographic Extent	Duration/ Frequency	Reversibility	Ecological / Socio-economic Context
Collisions (involving Hebron Platform, vessel, and/or iceberg)	• Change in Habitat Quality • Change in Habitat Use • Potential Mortality	• Oil spill response plan • Training, preparation, equipment inventory, prevention, and emergency response drills	2	3	2/1	R/I [B]	2

KEY

Magnitude:
N = Negligible: There may be some environmental effect but it is not considered to be measurable
1 = Low: <10 percent of the population or habitat in the Study Area will be affected
2 = Medium: 11 to 25 percent of the population or habitat in the Study Area will be affected
3 = High: >25 percent of the population or habitat in the Study Area will be affected

Geographic Extent:
1 = <1 km^2
2 = 1-10 km^2
3 = 11-100 km^2
4 = 101-1,000 km^2
5 = 1,001-10,000 km^2
6 = >10,000 km^2

Duration:
1 = < 1 month
2 = 1-12 months.
3 = 13-36 months
4 = 37-72 months
5 = >72 months

Frequency:
1 = <11 events/year
2 = 11-50 events/year
3 = 51-100 events/year
4 = 101-200 events/year
5 = >200 events/year
6 = continuous

Reversibility:
R = Reversible
I = Irreversible

Ecological / Socio-economic Context:
1 = Area is relatively pristine or not adversely affected by human activity
2 = Evidence of adverse environmental effects

A Where there is more than one potential environmental effect, the evaluation criteria rating is assigned to the environmental effect with the greatest potential for harm
B Potential Mortality effects reversible at the population level and irreversible at the individual level

The potential environmental effects from some of the assessed accidental event scenarios could be high in magnitude, high in geographical extent and moderate in duration. However, a Project-related accidental event is considered unlikely.

9.5.5 Cumulative Environmental Effects

Marine oil and gas exploration, commercial fishery activity, marine transportation and existing production activity (*e.g.*, White Rose, Hibernia, and Terra Nova) all have the potential to interact with marine birds (see Table 9-9). Hunting of marine birds occurs in the Nearshore Study Area. It is unlikely that routine activities associated with other marine exploration, existing production areas, marine transportation, and commercial fisheries have substantive environmental effects on marine birds. The one exception would be an accidental hydrocarbon spill or blowout in the Offshore Study Area.

9.5.5.1 Nearshore

With the exception of marine bird hunting, cumulative environmental effects in the Nearshore Study Area are expected to be of a lower magnitude than those of the Offshore Study Area, as fewer activities have the potential to interact with the current Project (see Section 9.5.5.2 for cumulative environmental effects assessment of the Offshore Study Area).

Most hunting of marine birds in Newfoundland and Labrador waters occurs inshore. The harvested populations are primarily sea ducks (especially Common Eider) and murres (mostly Thick-billed Murre). Sea ducks occur primarily inshore, but Thick-billed Murre occurs both inshore and offshore (autumn to spring). The last harvest survey was run in 2001 and estimated that approximately 300,000 murres were harvested in Newfoundland and Labrador (Wiese *et al.* 2004). Since then, based on permit purchases, there has been a general decline in hunter participation (CWS, unpublished data). Wiese *et al.* (2004) modelled the effects of hunting and oil pollution on the population growth of Thick-billed Murres and found that hunting decreased the population growth at the same rate as chronic oil pollution, arising primarily from illegal discharges of oily water from ships. Hunting of sea ducks and murres may therefore have a cumulative environmental effect with effects of accidental hydrocarbon spills and produced water (Wiese *et al.* 2004).

9.5.5.2 Offshore

The effects of illumination on structures and vessels, air emissions, discharges, underwater sound, accidental hydrocarbon spills from exploration vessels, existing production drilling platforms and vessels, other exploratory drilling structures and platforms may have cumulative environmental effects with Project activities and Project accidental events.

Marine birds, particularly Leach's Storm-Petrels, may be attracted to the lights of offshore structures and vessels at night and during periods of poor visibility. As a result, Leach's Storm-Petrels may strand on offshore platforms, as discussed in Section 9.5.1.2. The stranding of birds at offshore platforms is largely mitigated by bird handling and release protocols so that any cumulative environmental effects, if they occur, would be low and not significant.

The Project will create additional emissions to the atmosphere, but air emissions from one drilling operation will be relatively small in scale and within the range of other offshore marine activities such as marine shipping. Emissions will very rapidly dissipate in the windy offshore environment and will not endanger the health of marine birds since any exposures will be of very low concentrations and durations. Any cumulative environmental effects are considered negligible.

Drill mud and other discharges are regulated by the *Offshore Waste Treatment Guidelines* (National Energy Board *et al.* 2010), and the quantities involved, geographic extents and magnitudes are small. There are few pathways for drill mud / cuttings discharges to affect marine birds, other than the potential exception of a sheen of synthetic-based mud (SBM) under flat calm conditions. As described for the effects of discharges on marine birds, any cumulative environmental effect is considered not significant.

The bycatch of marine birds in commercial fisheries has historically been a known source of at-sea mortality. However, bycatch of marine birds in commercial fisheries (*e.g.*, inshore gill netting) has declined sharply since 1992 (Piatt and Nettleship 1987; Benjamins *et al.* 2008). This has probably had a positive effect on marine bird populations, both those nesting in Newfoundland and those nesting in the Arctic. Consequently, the environmental effects of commercial fisheries probably no longer pose any significant cumulative environmental effects on marine birds.

As described in the assessment above, underwater sound has the potential to disturb marine birds that spend prolonged periods submerged near a loud sound source. Alcids are the only family of marine birds found in Newfoundland offshore waters that are known to dive underwater for extended periods and are, thus, more likely to be affected by underwater sound than other species. Avoidance or behavioural disturbance is the most likely effect of underwater sound produced by offshore operations associated with the Project or other nearby operations, but these effects are expected to be low in magnitude and only affect a small area. Thus, it is predicted that cumulative environmental effects of underwater sound on marine birds are not significant.

A major spill or blowout on the Grand Banks could affect marine birds, depending on the type, size, location, timing, species, and life stages involved. A major spill is statistically very unlikely to coincide among various operations on the Grand Banks. Nevertheless, cumulative environmental effects could occur from chronic discharges of oil bilges at sea by ships transiting the area or from other activities that could affect marine birds. A major oil spill could significantly affect marine birds on the Grand Banks and thus result in a significant cumulative environmental effect when considered in addition to other stressors on bird populations (*e.g.*, hunting, bycatch in commercial fishing, or oiling from bilge dumping). However, petroleum hydrocarbons from a deepwater blowout may be considerably reduced when it reaches the surface, and the wind and wave conditions typical of the Grand Banks will further aid in the dispersal of petroleum hydrocarbons. Spill countermeasures and marine bird rehabilitation would additionally reduce potential cumulative environmental effects.

9.5.6 Determination of Significance

The determination of significance is based on the definition provided in Section 9.2. It considers the magnitude, geographic extent, duration, frequency, reversibility and ecological context of each environmental effect with the Study Area, and their interactions, as presented in the preceding analysis. Significance is determined at the population level within the Study Area.

Adverse environmental effects of attraction to illumination on structures and vessels on Marine Birds during the construction / installation phase of the Project are predicted to be *low* in magnitude, geographic extent, duration and frequency when mitigation measures are practiced. Although significant at the individual level, these environmental effects are predicted to be reversible at the population level. These environmental effects are therefore predicted to be *not significant*.

Adverse environmental effects of attraction to illumination on structures and vessels on Marine Birds during the operation and maintenance phase are predicted to be *low* in magnitude, geographic extent, duration and frequency when mitigation measures are practiced. Adverse environmental effects of produced water on Marine Birds during the operation and maintenance phase are predicted to be *low* in magnitude, geographic extent, duration and frequency when mitigation measures are practiced. Although potentially significant at the individual level, these environmental effects are predicted to be reversible at the population level. Therefore, these environmental effects are predicted to be *not significant*.

Adverse environmental effects of attraction to illumination on structures and vessels on Marine Birds during the decommissioning and abandonment phase of the project are predicted to be *low* in magnitude, geographic extent, duration and frequency when mitigation measures are practiced. Although significant at the individual level, these environmental effects are predicted to be reversible at the population level. These environmental effects are therefore predicted to be *not significant*.

Adverse environmental effects of accidents, malfunctions and unplanned events (*i.e.*, hydrocarbon and other chemical spills due to collisions, failure of OLS manifolds or risers, subsea blowouts, batch spills or marine vessel incidents) are predicted to be *low* to *high* in magnitude, *low* to *high* in geographic extent, *low* to *moderate* in duration and *low* in frequency. Although significant at the individual level, these environmental effects are predicted to be reversible at the population level. Nevertheless, these environmental effects are predicted to be *significant*. Smaller scale spills and blowouts in calm conditions may be mitigated via oil spill response measures and marine bird rehabilitation; however, these mitigations are recognized to be limited. ExxonMobil's philosophy is focused on prevention using safety and risk management systems, management of change procedures, and global standards. There will be an emphasis on accident prevention at all phases of the Project.

The significance of potential residual environmental effects, including cumulative environmental effects, resulting from the interaction between Project-related activities and Marine Birds, after taking into account any proposed mitigation, is summarized in Table 9-14.

Because the adverse environmental effects of each Project phase are predicted to be *not significant,* the adverse environmental effects of the Project overall is predicted to be *not significant*.

Table 9-14 Residual Environmental Effects Summary: Marine Birds

Phase	Residual Adverse Environmental Effect Rating[A]	Level of Confidence	Probability of Occurrence (Likelihood)
Construction / Installation[B]	NS	3	N/A[D]
Operation and Maintenance	NS	3	N/A
Decommissioning and Abandonment[C]	NS	3	N/A
Accidents, Malfunctions and Unplanned Events	S	1	1
Cumulative Environmental Effects	NS	2	N/A

KEY

Residual Environmental Effects Rating:
S = Significant Adverse Environmental Effect
NS = Not Significant Adverse Environmental Effect

Level of Confidence in the Effect Rating:
1 = Low level of Confidence
2 = Medium Level of Confidence
3 = High level of Confidence

Probability of Occurrence of Significant Environmental Effect:
1 = Low Probability of Occurrence
2 = Medium Probability of Occurrence
3 = High Probability of Occurrence

A As determined in consideration of established residual environmental effects rating criteria.
B Includes all Bull Arm activities, engineering, construction, removal of the bund wall, tow-out and installation of the Hebron Platform at the offshore site.
C Includes decommissioning and abandonment of the GBS and offshore site.
D Effect is not predicted to be significant, therefore the probability of occurrence rating is not required under CEAA

9.5.7 Follow-up and Monitoring

The CEAA definition of "follow-up program" is "a program for (a) verifying the accuracy of the environmental assessment of a project, and (b) determining the effectiveness of any measures taken to mitigate the adverse environmental effects of the project”. Follow-up programs serve as the primary means to determine and quantify change from routine operations on the receiving environment. Compliance monitoring on its own, does not satisfy the requirements for a follow-up program. Compliance monitoring is conducted to ensure that a project and its activities are meeting the relevant environmental standards, guidelines and regulations. Compliance monitoring will be conducted for the Project in accordance with regulatory requirements.

Environmental effects monitoring (EEM) programs, for the nearshore and offshore components of the Project, are at the very early stages of development. Chapter 15 of the CSR outlines a proposed process to develop the EEM program. Based on the environmental effects assessment for marine birds, a marine bird EEM component is not contemplated at this stage. The EEM will be developed in consultation with stakeholders, including the public, regulatory agencies and scientific community. The final EEM design may include marine bird monitoring; however, that will be determined as the EEM design process progresses.

In light of current knowledge of bird strikes associated with lighting on offshore platforms, EMCP commits to the development and implementation of a research monitoring program at the Hebron field location. This program will be designed to provide information regarding potential interactions between pelagic seabirds (significant concentrations hosted on the Grand Banks) and the Hebron platform. Information from the Hebron Platform site would provide additional data to allow assessment of risk and mortality regarding potential seabird attraction to offshore structures. The program design would be developed in consultation with Environment Canada's Canadian Wildlife Service and would be completed prior to platform start-up in 2017. It is anticipated that field testing would begin upon completion of platform start-up and commissioning activities offshore.

In the event of a spill, and depending on the nature and size of the spill, marine bird monitoring will be implemented. The details regarding monitoring requirements and protocols will be outlined in the oil spill response plan and will be determined in consultation with the C-NLOPB and Environment Canada.

Mobile offshore drilling unit drilling programs typically engage a weather observer on staff to undertake dedicated marine bird and marine mammal observations. This position is not currently envisaged for the Hebron Platform, as all weather observations will be automated.

EMCP supports initiatives such as the recent ESRF marine bird monitoring program and will investigate the development of a marine bird observation program from Hebron Project supply vessels, where space is available. Marine bird monitoring protocols will be based on those provided by CWS (Wilhelm *et al*. n.d.) as per Appendix 2 in the C-NLOPB *Geophysical, Geological, Environmental and Geotechnical Program Guidelines* (C-NLOPB 2010).