IR Number: *7*
Source*: Environment Canada*
Requests:

1) *Please provide information on the density (number of individuals or detections) of each species of shorebird and songbird detected in surveys broken down by habitat type. Please indicate the sample size of survey plots and point counts in each habitat type and each year, provide the number of active nests recorded for each species by habitat type.*
2) *Please provide the density estimates for songbirds and shorebirds from the two studies that were cited in Volume 6 – Section 4 and Appendix 6E- 1 (Weider and Hobaek 2000 and Morrison et al. 2001) for comparison with densities estimated from the baseline surveys.*
3) *Please provide an assessment of the potential impacts to songbirds and shorebirds from construction and operations along the proposed transportation corridors linking the mine site to the two ports.*

BAFFINLAND RESPONSE

EC 7-1

The data presented in this report were collected during 2006 – 2008 by Dr. Matt Evans formerly of Knight Piésold (initial company conducting the environmental work for the Mary River Project). The results presented are based on the current project team's re-analysis of Dr. Evans survey data. Based on this re-analyses, we determined that the bird baseline report submitted as a component of the DEIS should be disregarded, and the information provided below is a better estimate of bird presence and distribution based on available data. We do not expect that the bird list represents a complete list of species that occur in the Regional Study Area (e.g., White-rumped Sandpiper are known to occur in the area based on recent observations).

METHODS

Surveys

Songbird and shorebird data were collected for three years (2006 – 2008) during field surveys conducted from 29 May to 25 June. Data were collected using 174, 100 m radius point-count surveys and 26, 1 ha plot surveys. Surveys were conducted throughout the daylight hours (i.e., 24 hours a day). Survey locations were chosen within the proposed mine site area, along the railway/roadway, and in other areas of the RSA to survey for birds in a variety of habitats (Figure 1). Point counts were not replicated within or among years.

At each survey location one observer (M. Evans) counted and recorded all birds present through visual and auditory cues (e.g., singing, calling). Birds were classified based on age (adult, juvenile, young of the year), sex grouping (alone, paired, in a group) and behaviour.

Point Counts — Point Count surveys consisted of circle plots with a radius of 100 m (Area = 3.14 ha). The location of the survey plot was recorded using a GPS unit. A total of 174 5-minute point-count surveys were conducted (2006 =50, 2007 = 93, and 2008 = 31). Survey efforts in 2008 were intentionally reduced due to perceived low songbird and shorebird densities from previous years, logistical constraints, and the fact that songbirds and shorebirds were not being identified as species of concern during Baffinland's community meetings and there was little interaction of species of conservation concern with terrestrial project activities.

Plots — Transect plots were 1 ha in size (100 m X 100 m) instead of the 12 ha recommended by the Canadian Wildlife Service (2006). A total of 26 transect plots were surveyed in 2006. Transect plots were not conducted in 2007 and 2008 due to the length of time taken to complete each plots (45 to 90 minutes) and the low density of birds encountered in 2006. A compromise was to increase sample size and coverage of point counts in 2007.

Incidental Sightings — Transect plots contained very few shorebird species; therefore, incidental sightings of songbird and shorebird species present within the RSA were also recorded outside of the designated plot surveys. Species presence was recorded during other wildlife survey work (e.g., while conducting habitat work, walking around wetlands counting waterfowl, during aerial surveys for waterfowl or aerial coastal surveys in Steensby and Milne).

Density Estimates

Overall density of songbirds and shorebirds was calculated for six of the species observed within the RSA survey areas (Common Ringed Plover was removed from density calculations due to only one sighting during 2006 – 2008). Distribution of species among different habitat types identified in the RSA was also calculated. To facilitate an assessment of the predicted effects of the Project on bird abundance and diversity we identified the amount of new disturbance that the Project will cause (i.e., PDA), and the local density of birds by habitat (plant community) types identified through ecological land classification (ELC) mapping (Knight Piésold 2010, DEIS Appendix 6D).

Bird point and plot coordinates were plotted in a GIS with the habitat (ELC) layer to determine the habitat class that was sampled. The bird plots and points fell with eight different habitat types: wet sedge – graminoids and bryoids, tussock graminoid tundra, moist to dry non-tussock graminoid/dwarf shrub tundra: 50-70% cover, prostrate dwarf shrub – dryas/sheath, sparsely vegetated till-coluvium, sparsely vegetated bedrock, bare soil with cryptogram crust – frost boils, and barren). Detailed descriptions of each of the eight habitat classes are provided in Knight Piésold 2010, DEIS Appendix 6D.

Densities of songbirds and shorebirds were calculated as the mean number of birds per plot type (100 m radius and 1 ha plots) by habitat type. These data were then extrapolated and combined to be presented as the mean number of birds per square kilometer. Density estimate calculations should be interpreted with caution as the survey methods were not initially designed to calculate density (e.g., various ELC units did not contain equal numbers of sample plots — summarized below in Results).

RESULTS

Terrestrial bird surveys and incidental observations recorded 29 species plus unconfirmed species of ptarmigan, phalarope and jaeger in the Mary River Project's Regional Study Area (RSA) from 2006 to 2008 (Table 1). The cumulative number of observed species present in the Mary River RSA is low compared with other bird studies conducted in Arctic regions. For example, on Bylot Island (southwestern portion of island) from 1979 to 1997, 65 species of birds were observed (LePage et al., 1998); in Devon Island, Northwest Territories, 43 species were identified (Pattie, 1990). Studies focusing on terrestrial breeding birds have recorded a greater diversity of breeding birds than reported in the current study (31 species, Bylot Island: LePage et al., 1998; 38 species, Northwestern Ungava Peninsula, QC: Andres, 2006). The low diversity of birds witnessed in the current study may be reflective of low plot

sample size, plot locations, time of year the surveys were conducted (e.g., too early in season to capture high diversity of birds), or overall level of effort (Mary River surveys were conducted by one individual from 2006 to 2008).

Seven species of songbirds and shorebirds were found within the various survey plots from 2006 to 2008. Species included American Golden Plover, Common Ringed Plover, Baird's Sandpiper, Horned Lark, American Pipit, Lapland Longspur, and Snow Bunting. A total of 485 individual birds were observed in the 200 point and plot surveys (Table 2). The most commonly sighted species, in order, were Lapland Longspur, Horned Lark, Baird's Sandpiper, Snow Bunting and American Pipit. American Golden Plovers and Common Ringed Plovers were observed infrequently.

Overall Bird Density — Based on data collected in the 200 survey points and plots, the overall average density of songbirds and shorebirds was 18 ± 75 birds/km^2 (mean ± S.D.; Table 3). Snow Bunting and Lapland Longspur occurred in the highest densities (28 ± 131 and 24 ± 72 birds/km^2, respectively), American Golden Plover and American Pipit in the lowest densities (4 ± 43 birds/km^{2}and 11 ± 35 birds/km^2, respectively).

Bird Density by Habitat Class — Bird density (birds/km^2) was calculated for each of the eight habitat classes identified during the 200 survey plots (Table 3). Tussock graminoid tundra contained the greatest density of birds/km^2 (36 ± 149), which was predominately Snow Bunting, Baird's Sandpiper and American Golden Plover (107 ± 291, 44 ± 155, and 40 ± 155, respectively). Sparsely vegetated till-coluvium and barren habitats contained the lowest density of birds (5 ± 15 and 10 ± 43, respectively). Common Ringed Plover were observed on only one occasion (2006) in moist to dry non-tussock graminoid/dwarf shrub tundra: 50–70% cover.

Incidental Sightings — The only additional songbird and shorebird species sighted outside of the 200 sample plots was an unidentified phalarope species (2008).

Songbird and Shorebird Nests — No songbird or shorebird nests were found in the Mary River Project RSA during the 2006 to 2008 surveys.

Table 1. Bird species observed within the Mary River Project terrestrial Regional Study Area, 2006 – 2008.

Common Name	Scientific Name	2006	2007	2008
Snow Goose	*Chen caerulescens*	x	x	x
Brant	*Branta bernicla*	x	-	-
Canada Goose	*Branta canadensis*	x	x	x
Tundra Swan	*Cygnus columbianus*	-	-	x
King Eider	*Somateria spectabilis*	x	x	x
Common Eider	*Somateria mollissima*	x	x	x
Long-tailed Duck	*Clangula hyemalis*	x	x	x
Red-breasted Merganser	*Mergus serrator*	x	x	x
Unspecified Ptarmigan	*Lagopus spp.*	-	-	x
Red-throated Loon	*Gavia stellata*	x	x	x
Pacific Loon	*Gavia pacifica*	-	x	x
Common Loon	*Gavia immer*	x	x	x
Yellow-billed Loon	*Gavia adamsii*	x	x	x
Northern Fulmar	*Fulmarus glacialis*	x	-	-
Rough-legged Hawk	*Buteo lagopus*	x	x	x
Gyrfalcon	*Falco rusticolus*	x	x	x
Peregrine Falcon	*Falco peregrinus*	x	x	x
Sandhill Crane	*Grus canadensis*	x	x	x
American Golden-Plover	*Pluvialis dominica*	x	x	x
Common Ringed Plover	*Charadrius hiaticula*	x	-	-
Baird's Sandpiper	*Calidris bairdii*	x	x	x
Unspecified Phalarope	*Phalaropus spp.*	-	-	x
Glaucous Gull	*Larus hyperboreus*	-	x	x
Arctic Tern	*Sterna paradisaea*	-	x	x
Unspecified Jaeger	*Stercorarius spp.*	-	-	x
Snowy Owl	*Bubo scandiacus*	x	x	x
Short-eared Owl	*Asio flammeus*	-	-	x
Common Raven	*Corvus corax*	x	x	x
Horned Lark	*Eremophila alpestris*	x	x	x
American Pipit	*Anthus rubescens*	x	x	x
Lapland Longspur	*Calcarius lapponicus*	x	x	x
Snow Bunting	*Plectrophenax nivalis*	x	x	x

'x' = present; '-' = absent

Table 2. Total number of birds observed during 100 m radius and 1 ha plot surveys (n = 200 plots).

Total number of birds observed, 2006–2008 Surveys							
American Golden Plover	**Common Ringed Plover**	**Baird's Sandpiper**	**Horned Lark**	**American Pipit**	**Lapland Longspur**	**Snow Bunting**	**TOTAL**
11	1	90	111	56	129	87	485

Table 3. Density estimates (birds/km^2 ± S.D.) for songbirds and shorebirds located in Baffin Island, NU. Densities are presented for eight habitat classes identified within the region.

Habitat Type	**No. of sample plots**	**Estimated density of birds per km^2 ± S.D.**						
		American Golden Plover	**Baird's Sandpiper**	**Horned Lark**	**American Pipit**	**Lapland Longspur**	**Snow Bunting**	**TOTAL**
Wet Sedge - Graminoids and Bryoids	17	4 ± 15	21 ± 51	4 ± 15	7 ± 24	34 ± 73	4 ± 15	12 ± 40
Tussock Graminoid Tundra	15	40 ± 155	44 ± 155	2 ± 8	8 ± 19	13 ± 23	107 ± 291	36 ± 149
Moist to Dry Non-Tussock Graminoid/Dwarf Shrub Tundra: 50-70% Cover	39	0	24 ± 42	21 ± 49	13 ± 40	33 ± 78	14 ± 30	18 ± 47
Prostrate Dwarf Shrub - Dryas/Sheath, Usually on Bedrock	29	1 ± 6	4 ± 14	38 ± 100	16 ± 38	21 ± 58	12 ± 40	15 ± 54
Sparsely Vegetated Till-Coluvium	16	0	4 ± 11	6 ± 17	4 ± 16	4 ± 16	10 ± 19	5 ± 15
Sparsely Vegetated Bedrock	27	4 ± 19	11 ± 40	20 ± 78	6 ± 22	9 ± 33	24 ± 79	12 ± 51
Bare Soil with Cryptogram Crust - Frost Boils	37	1 ± 5	41 ± 78	29 ± 73	20 ± 55	42 ± 112	53 ± 225	31 ± 114
Barren	20	0	10 ± 31	21 ± 62	0	18 ± 71	11 ± 31	10 ± 43
Combined Total	**200**	**4 ± 43**	**21 ± 62**	**21 ± 65**	**11 ± 35**	**24 ± 72**	**28 ± 131**	**18 ± 75**

EC 7-2

Density estimates for songbirds and shorebirds are not provided in the publication cited in Volume 6 – Section 4 and Appendix 6E- 1 (Weider and Hobaek 2000 and Morrison et al. 2001). As noted above, the terrestrial bird baseline provided in the DEIS should generally be disregarded. Comparative densities and citations are provided below.

COMPARATIVE BIRD DENSITIES

The four most abundant songbirds and shorebirds found in the RSA were Snow Bunting, Lapland Longspur, Horned Lark and Baird's Sandpiper. This is similar to what was observed on the east-central coast of Ellesmere Island where the most abundant bird species observed during breeding bird surveys (conducted in 1980–1982, 2003 and 2008) were Snow Bunting, Lapland Longspur and Baird's Sandpiper (Trefry et al., 2010). Breeding bird surveys conducted on Bylot Island between 1979 and 1997 reported similar species present in higher numbers including Lapland Longspur, American Golden Plover, and Baird's Sandpiper (LePage et al., 1998).

Although the general trend for species presence appears to be similar between studies, the overall songbird and shorebird densities for the current study appear to be lower than reported in other regions of the Canadian Arctic (Table 4).

Table 4. Density estimate comparisons for shorebirds and passerines at various locations in the Canadian Arctic.

Site	Density estimates birds/km^2			Source
	Shorebirds	Passerines	Total	
south Creswell Bay, Somerset Island, NU	12.5	-	-	Latour et al. 2005
Ekati Diamond Mine, NWT*	-	-	240.8	Smith et al. 2005
Prince Charles Island and Air Force Island, Foxe Basin, NU	148.2 (1996 plots); 81.5 (1997 plot)	-	-	Johnston and Pepper 2009
Baffin Island, NU	12.5	21	18.1	current study

* density reported for mine site only

American Golden Plover, Baird's Sandpiper and Horned Lark densities for Baffin Island are higher in this report than witnessed in other areas of the Arctic; however, similar densities are reported for American Pipit and Lapland Longspur (Table 5). Snow Bunting density is higher than reported for birds surveyed on Somerset Island, NU (Latour et al., 2005) and the northwestern Ungava Peninsula, QC (Andres, 2006); however, density is similar to what is reported by Freedman and Svoboda (1982) for Ellesmere Island, NU.

Table 5. Density estimates (birds/km^2) for songbirds and shorebirds at various locations in the Canadian Arctic region.

Species	Site	Location	Years	Survey months	Plot Sizes	Individuals/km^2	Pairs/km^2	Sources
American Golden Plover	Prince Charles Island and Air Force Island, Foxe Basin, NU*	67˚N	1996	late-June to mid-July	400 m^2 (n = 34)	1.2	0.2	Johnston and Pepper 2009
			1997		400 m^2 (n = 51)	2.1	1.7	
	Ekati Diamond Mine, NWT**	64˚N	1996 - 2003	early to mid-June	25 ha (n = 140)	2 (control) 2 (mine)		Smith et al. 2005
	south Creswell Bay, Somerset Island, NU	72˚N	1997	mid-June to mid-July	400 m^2 (n = 30)	0.6		Latour et al. 2005
	northwestern Ungava Peninsula, QC	60˚N	2002	early to mid-June	10 ha (n =100)	0.1		Andres 2006
	Baffin Island, NU	70˚N - 79˚N	2006 - 2008	late May to mid-June	100 m radius (n = 174); 1 ha (n = 26)	4		current study
Baird's Sandpiper	Alexandra Fjord, Ellesmere Island, NU	79˚N	1980	late June to late July	12 km^2		1	Freedman and Svoboda 1982
			1981				0.8	
	Prince Charles Island and Air Force Island, Foxe Basin, NU*	67˚N	1996	late-June to mid-July	400 m^2 (n = 34)	2.6	0.5	Johnston and Pepper 2009
			1997		400 m^2 (n = 51)	0	0	
	Ekati Diamond Mine, NWT**	64˚N	1996 - 2003	early to mid-June	25 ha (n = 140)	0.8 (control) 0.4 (mine)		Smith et al. 2005
	south Creswell Bay, Somerset Island, NU	72˚N	1997	mid-June to mid-July	400 m^2 (n = 30)	0.2		Latour et al. 2005
	Baffin Island, NU	70˚N - 79˚N	2006 - 2008	late May to mid-June	100 m radius (n = 174); 1 ha (n = 26)	21		current study

Species	Site	Location	Years	Survey months	Plot Sizes	Individuals/km^2	Pairs/km^2	Sources
Horned Lark	Ekati Diamond Mine, NWT**	64˚N	1996 - 2003	early to mid-June	25 ha (n = 140)	6.4 (control) 11.2 (mine)		Smith et al. 2005
	south Creswell Bay, Somerset Island, NU	72˚N	1997	mid-June to mid-July	400 m^2 (n = 30)	1.7		Latour et al. 2005
	northwestern Ungava Peninsula, QC	60˚N	2002	early to mid-June	10 ha (n =100)	4.9		Andres 2006
	Baffin Island, NU	70˚N - 79˚N	2006 - 2008	late May to mid-June	100 m radius (n = 174); 1 ha (n = 26)	21		current study
American Pipit	Ekati Diamond Mine, NWT**	64˚N	1996 - 2003	early to mid-June	25 ha (n = 140)	1.6 (control) 2 (mine)		Smith et al. 2005
	northwestern Ungava Peninsula, QC	60˚N	2002	early to mid-June	10 ha (n =100)	11.1		Andres 2006
	Baffin Island, NU	70˚N - 79˚N	2006 - 2008	late May to mid-June	100 m radius (n = 174); 1 ha (n = 26)	11		current study
Lapland Longspur	Alexandra Fjord, Ellesmere Island, NU	79˚N	1980 1981	late June to late July	12 km^2		0.5 0.4	Freedman and Svoboda 1982
	Ekati Diamond Mine, NWT**	64˚N	1996 - 2003	early to mid-June	25 ha (n = 140)	82.8 (control) 105.6 (mine)		Smith et al. 2005
	south Creswell Bay, Somerset Island, NU	72˚N	1997	mid-June to mid-July	400 m^2 (n = 30)	10.5		Latour et al. 2005
	northwestern Ungava Peninsula, QC	60˚N	2002	early to mid-June	10 ha (n =100)	30.7		Andres 2006
	Baffin Island, NU	70˚N - 79˚N	2006 – 2008	late May to mid-June	100 m radius (n = 174); 1 ha (n = 26)	24		current study

Species	Site	Location	Years	Survey months	Plot Sizes	Individuals/km^2	Pairs/km^2	Sources
Snow Bunting	Alexandra Fjord, Ellesmere Island, NU	79˚N	1980 1981	late June to late July	12 km^2		9.8 10.6	Freedman and Svoboda 1982
	south Creswell Bay, Somerset Island, NU	72˚N	1997	mid-June to mid-July	400 m^2 (n = 30)	0.2		Latour et al. 2005
	northwestern Ungava Peninsula, QC	60˚N	2002	early to mid-June	10 ha (n =100)	0.7		Andres 2006
	Baffin Island, NU	70˚N - 79˚N	2006 - 2008	late May to mid-June	100 m radius (n = 174); 1 ha (n = 26)	28		current study

[*] Only shorebird species were reported.
[**] Birds/km^2 were calculated from data presented (birds/0.25 km^2) for active mine and control sites.

Comparative Densities by Habitat — Bird density by habitat class for the current study was compared with other bird surveys conducted in Canadian Arctic environments (Table 6). Density is variable between habitat classes and species for all studies. This information is presented for very general comparisons — definition of habitats varied between all studies (Appendix Tables A1–A4).

Table 6. Density estimates (birds/km^2) for songbirds and shorebirds by habitat class for surveys conducted in Arctic environments.

Habitat Type[§]	Area	Estimated density of birds per km^2					Source
		American Golden Plover	Baird's Sandpiper	Horned Lark	Lapland Longspur	Snow Bunting	
Wet vegetated areas							
Wet sedge meadow	Northern Banks Island, NWT	0.6	5.1	0.3	41.4	-	Henry and Mico 2002
Wet sedge - graminoids and bryoids	Baffin Island, NU	4	21	4	34	4	current study
Sedge marsh	north Creswell Bay, Somerset Island, NU*	0	0	0	9.7	-	Latour et al. 2005
Wet graminoid/moss lowlands	Prince Charles Island and Air Force Island, NU**	2.1	0	-	13.9	0	Johnston and Pepper 2009
Sedge wetland	north Creswell Bay, Somerset Island, NU*	0	0.5	0	13	-	Latour et al. 2005
Moderately wet vegetated areas							
Tussock graminoid tundra	Baffin Island, NU	40	44	2	13	107	current study
Graminoid tundra	Northern Banks Island, NWT	11.1	6.7	1.6	477.7	-	Henry and Mico 2002
Moist to dry non-tussock graminoid/dwarf shrub tundra: 50-70% cover	Baffin Island, NU	0	24	21	33	14	current study
Graminoid-dwarf shrub tundra	Northern Banks Island, NWT	10.2	1.9	5.4	57.3	-	Henry and Mico 2002
Prostrate dwarf shrub - dryas/sheath, usually on bedrock	Baffin Island, NU	1	4	38	21	12	current study

Habitat Type[§]	Area	Estimated density of birds per km^2					Source
		American Golden Plover	Baird's Sandpiper	Horned Lark	Lapland Longspur	Snow Bunting	
Dwarf shrub tundra	Northern Banks Island, NWT	0	5.4	3.8	38.2	-	Henry and Mico 2002
Mixed dwarf shrub tundra	north Creswell Bay, Somerset Island, NU*	0.9	0	1.7	16.6	-	Latour et al. 2005
Hummocky tundra	Northern Banks Island, NWT	1.3	5.7	5.4	70.1	-	Henry and Mico 2002
Drier, sparsely vegetated areas							
Sparsely vegetated till-coluvium	Baffin Island, NU	0	4	6	4	10	current study
Sparsley vegetated ground	Northern Banks Island, NWT	0.3	2.5	3.2	20.7	-	Henry and Mico 2002
Sparsely vegetated bedrock	Baffin Island, NU	4	11	20	9	24	current study
Sparse herbaceous tundra	north Creswell Bay, Somerset Island, NU*	2.1	0	0.7	5.6	-	Latour et al. 2005
Dry vegetated tundra	Prince Charles Island and Air Force Island, NU**	4.6	0	-	12	4.5	Johnston and Pepper 2009
Dwarf shrub-lichen barrens	Northern Banks Island, NWT	1.6	3.8	5.4	28.3	-	Henry and Mico 2002
Unvegetated areas							
Bare Soil with Cryptogram Crust - Frost Boils	Baffin Island, NU	1	41	29	42	53	current study
Barren	Baffin Island, NU	0	10	21	18	11	current study
Unvegetated/barren tundra	Prince Charles Island and Air Force Island, NU**	3	0	-	2	2.8	Johnston and Pepper 2009

[§] for detailed descriptions of habitat types for each study see Appendix 1
*only data from 1997 plots are reported for Latour et al. 2005
** only data from 1997 plots are reported for Johnston and Pepper 2009
'-' no data were reported

DISCUSSION

Results from the current study show similar types of songbird and shorebird species present compared with other breeding bird surveys conducted in Arctic regions of Canada; however, densities and overall number of species present is lower than reported in other studies. Density estimate calculations should be interpreted with caution as the survey methods were not initially designed to calculate density (e.g., various habitat units did not contain equal numbers of sample plots). The density estimates presented are comparable, to a certain degree, to what is observed in other Arctic breeding bird surveys. The standard deviations presented for density are large, most likely due to the low sample size for plots and/or sampling error.

Sample plots conducted by M. Evans appear to be random, with no systematic selection (Figure 1). The raw data presented contained an uneven number of sample plots per habitat class. In addition, some sample plots overlapped (i.e., were less than 200 m apart) and were not included in analyses, further decreasing plot numbers.

Songbird activity, particularly territorial vocalizations, are greatest in the hour immediately before and the first four hours after local sunrise. Most breeding bird point-count surveys are conducted within four hours of local sunrise. In late May and June in Nunavut there is almost 24 hours of daylight. Data in this report were collected by M. Evans throughout all hours of the day. To ensure bird vocalizations are captured and the data are representative (and comparable) to other Arctic breeding bird surveys, surveys conducted between 4am and 9am would have been preferential. It is not possible from the available data to select plots that were surveyed during only that time period.

Weather patterns will affect density estimates. If one year has a particularly late snow melt, birds may not arrive and breed until later in the year. For some studies, variation between years has proved significant (e.g., Latour et al., 2005; Johnston and Pepper, 2009). It is not possible to determine inter-year variability from the available data for the Mary River project.

EC 7-3

Baseline Conditions

Seven species of songbirds and shorebirds were found within RSA between 2006 and 2008. These included American Golden Plover, Common Ringed Plover, Baird's Sandpiper, Horned Lark, American Pipit, Lapland Longspur, and Snow Bunting. The most abundant songbirds and shorebirds found in the RSA were Snow Bunting, Lapland Longspur, Horned Lark and Baird's Sandpiper.

Results from the current study show similar types of songbird and shorebird species present compared with other breeding bird surveys conducted in Arctic regions of Canada; however, densities and overall number of species present may be lower in the Mary River Project Area.

Potential Effects

The Mary River Project has the potential to adversely affect breeding songbirds and shorebirds through changes to availability of habitat and health. The Project will both reduce the availability of habitat due to the Project footprint and reduce the use of habitat close to project infrastructure from disturbance effects. The Project will increase exposure to metals from dust generated during crushing and hauling of mined materials. The introduction of contaminants such as metals released from ore dust could reduce species' health. Effects can occur through direct contact with the contaminant or indirectly through the food chain.

Effects on songbirds and shorebirds could potentially be reduced by:

- decreasing the project footprint that will minimize habitat loss;
- minimizing activity along the access roads which will reduce the functional loss of habitat due to disturbance; and
- applying dust suppression along roads and at the mine site when required during summers. This will limit the deposition of dust on adjacent vegetation that could expose birds to elevated minerals and impact their health.

Habitat Loss

Loss of habitat during migration, breeding/nesting and brood-rearing may occur throughout the construction, operation and closure phases of the Mary River Project. The total predicted loss of habitat for the Project (data provided by Knight Piésold) is estimated at 109.7 km^2. Table 7 shows estimates of songbirds and shorebirds that could potentially be displaced in the RSA by the Project. These estimates are based on density calculations from baseline data collected by M. Evans (formerly of Knight Piésold). The baseline data show an overall low density of birds in the Mary River RSA. The best estimates of the potential number of birds displaced in the RSA are based on the maximum density estimates for each habitat class. Using this conservative approach, we estimate that overall 2,641,155 songbirds and shorebirds are present in the RSA during late May to early June. If 109.7 km^2 of habitat are removed in the RSA, approximately 9,434 songbirds and shorebirds will be potentially displaced by the Project. This number represents 0.36% of the total estimated population of songbirds and shorebirds present in the RSA. For each individual habitat class, the greatest percentage of birds affected is less than 1% of the total estimated population.

The magnitude of loss for all songbirds and shorebirds with the Mary River RSA is estimated at -109.7 ha. The duration of the effects is long-term, however once mine decommissioning commences the effects may be reversible over time. Based on the estimates provided above, there are anticipated to be no significant effects on songbirds and shorebirds in the Mary River RSA. We are moderately confident with this prediction.

Monitoring

No monitoring is necessary if there is found to be no significant adverse effect on habitat suitability or health for songbirds and shorebirds. Baseline data collection should have been more systematic, standardized and a greater number of points should have been sampled by habitat type. However, comparative densities from other arctic studies illustrate that the birds in the Mary River Project area are generally representative of higher arctic tundra habitats.

Table 7. Estimated effects of habitat loss due to mining activities on songbird and shorebird species within the Mary River RSA.

RSA Vegetation Cover Classes*	Baseline RSA		Affected RSA				
	Area (km²)	% of RSA	Predicted loss of habitat (km²)*	Highest density of birds observed (birds/km²)**	Predicted # of birds in RSA+	Maximum # of birds affected in RSA	% of birds in RSA affected
Wetlands	124.9	0.41%	0.2	-	-	-	
Wet Sedge - Graminoids and bryoids	1276.9	4.16%	6.2	47	60014.3	291.4	0.49%
Tussock graminoid tundra	1726.3	5.62%	7.2	170	293471	1224	0.42%
Moist to dry non-tussock graminoid/dwarf shrub tundra: 50-70% cover	2546.8	8.29%	16.2	59	150261.2	955.8	0.64%
Dry graminoid prostrate dwarf shrub tundra: 70-100% cover	71.8	0.23%	0.5	-	-	-	
Prostrate dwarf shrub - dryas/heath, usually on bedrock	4124.9	13.43%	21.3	63	259868.7	1341.9	0.52%
Sparsely vegetated bedrock	4295.6	13.99%	29.7	59	253440.4	1752.3	0.69%
Sparsely vegetated till-colluvium	2922.2	9.52%	9.2	18	52599.6	165.6	0.31%
Bare soil with crypotgram crust - frost boils	2783.4	9.06%	12.8	133	370192.2	1702.4	0.46%
Barrens	3673.4	2.25%	2.7	47	172649.8	126.9	0.07%
Water/Ice/Snow/ Unclassified	7165	23.33%	-	-	-	-	
TOTAL	30711.1	100%	109.7	86	2641154.6	9434.2	0.36%

* Vegetation class covers and predicted loss of habitat were classified and provided by Knight Piésold.
** Calculated from mean density of birds + maximum standard deviation.
+ Calculation = (highest density of birds observed) * (vegetation class area)

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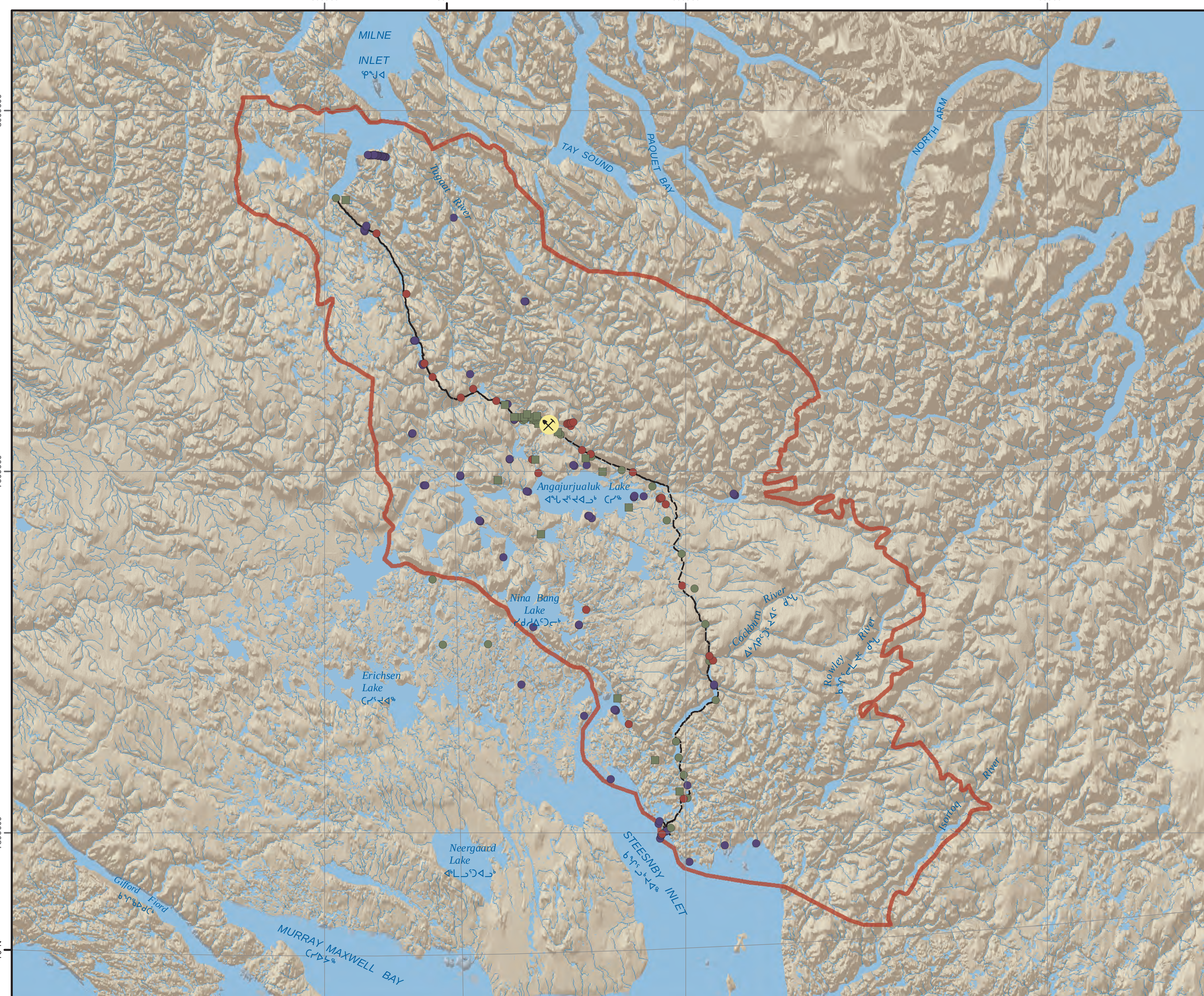

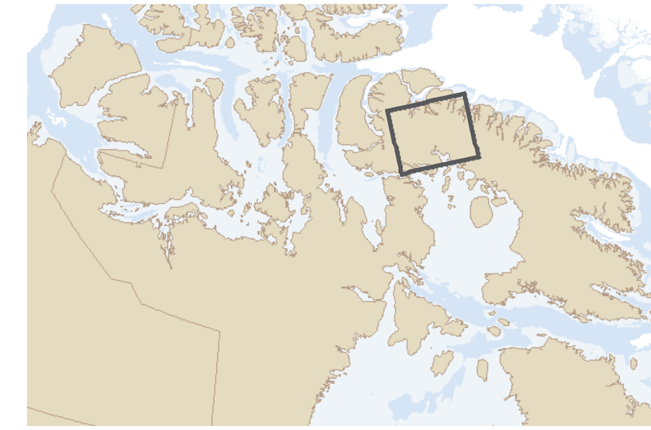

LEGEND ᑐᑭᑦᓯᕐᑦ

Mary River Project Study Specifics

.......Mary River Project ᓇᓂᔅᓂ ᐅᔪᕐᓯᐅᕐᑐᑦ

.......Proposed Rail Alignment ᓄᓇᓯᐅᑎᑯᑕᒃ ᐊᖁᑎᒋᓂᐊᕐᑕᖓ

.......Milne Inlet Tote Road ᕿᖑᐊᓂ ᐊᖅᑯᑎ ᐅᓯᑲᕐᑕᕐᕕᒃ

.......Mary River Project Regional Study Area

Bird Plots (Year and Plot Type)

- 2006 - 1 hectare plots
- 2006 - 100 metre radius point count
- 2007 - 100 metre radius point count
- 2008 - 100 metre radius point count

NOTES: ᖃᐅᔨᒪᔭᒃᓴᐃᑦ

Proposed Rail Alignment provided by Canarail September 2010.

Milne Inlet Tote Road: Knight Piesold (2007).

Projection: North American Datum 1983 UTM Zone 17N

Scale ᐊᖏᓂᖓ 0 10 20 30 40 50 Km ᑭᓚᒥᑕ

Baffinland Iron Mines Corporation

Location of bird survey points and plots in the Mary River Project's Regional Study Area from 2006 to 2008.

EDI Environmental Dynamics Inc.

Date: 8/11/2011

FIGURE 1

Path: J:\Yukon\Projects\2011\11_Y_0128_Baffinland_PostEIS\Mapping\Fig1_BirdSurveyPlots_11July2011.mxd

Table A1. Habitat Classification Descriptors for Current Study: Mary River, Baffin Island, NU

Wet sedge – graminoids and bryoids	This refers to Non-tussock sedge associations and Sedge-moss wet meadow, as well as mossy shorelines. The terrain is quite wet, often with a slow flow of water, and the dominant vegetation is arctic cotton (*Eriophorum angustifolium*) or *Carex* sedges.
Tussock graminoid tundra	This includes the Tussock sedge association, which occurs on wet soil, usually without standing water. Tussocks in the north Baffin area are of cottongrass (*Eriophorum vaginatum*). In drier areas, these are often being invaded by heaths (blueberry), mountain avens, willows (*Salix arctica*, *S. reticulata*, and *S. richardsonii*). Mosses and aquatic sedges (mostly *Carex aquatilis*) grow between the tussocks. There is relatively little of this on the project.
Moist to dry non-tussock graminoid/dwarf shrub tundra: 50 – 70% cover	This includes the Blueberry heath tundra, Cassiope heath tundra, and Mixed heath tundra, which often includes Labrador tea (*Ledum*). In these areas, there is little flow of water, although the water table may be seasonally high. Moisture varies considerably. Dominant shrubs include *Vaccinium uliginosum*, *Cassiope tetragona*, and in the south, *Ledum palustre decumbens* , often S*alix arctica* and sometimes *Empetrum nigrum*, south of the Mary River.
Prostrate dwarf shrub – dryas/heath, usually on bedrock	Includes the Avens – xeric sedge association on bedrock ledges in the slot canyon complexes, or on open bedrock ledges along escarpments, sometimes on simple outcrops. *Dryas integrifolia* is almost always accompanied by two sedges, *Carex rupestris* and *C. nardina* on bedrock.
Sparsely vegetated till-colluvium	2–10% vegetation cover on nonacidic and calcareous bedrock and ice-deposited materials. This group includes the Avens and Avens-xeric sedge barrens on glaciofluvial terraces and on the centres of megapolygons on the uplands. (The frost fissures of these polygons usually bear a heath tundra association, occasionally sedges or mixture of sedges and arctic or Richardson's willows.) Thin mat of vegetation with relatively few heaths.
Sparsely vegetated bedrock	Vegetation averages 2 – 10% vascular plant cover on acidic, igneous bedrock. This includes several Lichen- rock associations, including lichens on bedrock, on boulder fields and felsenmeer, and, sometimes on cliff ledges. Rock accounts for more than 60% of the substrate, and crustose lichens like map, sunburst, and rock tripe are common on acidic rocks. Lichen species vary with the chemical makeup of the rock. Rooted plants become established in lichen mats or in crevices in the rock and often include *Saxifraga tricuspidata*, *Potentilla nivea*, fragrant shield ferns, grasses like *Hierochloe alpina*, and *Poa* sp.
Bare soil with cryptogam crust/frost boils	Includes the Forb barrens, scattered mats and clumps of vegetation on calcareous soils to the west of the Philip's Creek valley near Milne Inlet. Usually shows considerable cryoturbation or soil movement, and 2-10% vegetation cover with grasses and xeric sedges plus non-vascular plants like lichens.
Barren	<2% vegetation cover on nonacidic and calcareous parent material. On the uplands, this includes the Purple saxifrage barrens, scattered tufts of vegetation, sheet flow of water across the land, active soil movement. Also includes Avens – xeric sedge associations and Luzula associations on the uplands. Purple saxifrage, *Saxifraga caespitosa*, poppies, woodrushes, and mountain avens are common here.

Table A2. Habitat Classification Descriptors from Henry and Mico (2002): Aulavik National Park, Banks Island, NWT

Wet sedge meadows	Occurs on level, hydric lowlands. Usually covered by shallow (<10 cm) water and a nearly continuous cover of sedges, especially *Carex aquatilis* var. stans and other hydrophobic species.
Graminoid tundra	Occupies mesic to hygric sites in lowlands and on gentle slopes, with continuous cover of graminoids species and sometimes dwarf shrubs (Salix species). Plant growth is most luxuriant on gentle slopes downslope from snowbeds.
Graminoid/dwarf shrub tundra	This type is intermediate between graminoid tundra and dwarf shrub tundra in terms of moisture and vegetation. Vegetation cover, characteristically between 75-100%, is a mosaic with graminoids and mosses dominate in moist depressions and herbs and dwarf shrubs dominate on the drier hummocks.
Dwarf shrub tundra	Occurs on moist, well-drained, middle and upper slopes as well as solifluction loves and terraces. Vegetation cover, characteristically 50–75%, is dominated by dwarf shrubs especially *Salix arctica* and *Cassiope tetragona*. Small non-sorted polygons as well as cryoturbated surfaces are often present.
Hummocky tundra	This type is non-sorted earth hummocks covering small to extensive area. Narrow furrows and cracks separating the hummocks supports mosses, lichens, herbs, and sometimes dwarf shrubs. The tops and sides of hummocks are dry and often free of vegetation.
Sparsely vegetated ground	Characterized by less than 10% vascular plant cover. This type occurs on cutbanks, mudflats, sand and gravel bars, uplands, windblown sites, sand dunes, frost-shattered bedrock, debris-mantled slopes and bare sandstone.
Dwarf shrub/lichen barrens	This variable type occurs at all elevations on windblown sites. Typically sites are rapidly drained, consisting of silty to stoney soils. Vegetation, characteristically 25–50% cover, is dominated by mat and cushion plants.

Table A3. Habitat classification description table for Latour et al. (2005): Creswell Bay, Somerset Island, NU.

Habitat type	Surface type	Dominant vegetation	% Vegetation cover	Moisture	% Standing water
Sedge marsh	Tussock tundra	Sedge (*Carex* spp)	100	100% saturated	10–35
Sedge wetland	Tussock/hummock tundra	Mainly sedge with some cotton grass (*Eriophorum* spp.)	100	60% saturated, 40% moist	< 10
Mixed dwarf shrub tundra	High/low centred polygons, finely patterned bare ground, scattered tussocks/hummocks	Willow (*Salix* spp) and dryas (*Dryas* spp) with scattered sedge and moss	60–80	10% saturated tundra, 50% moist, 40% dry	< 10
Evergreen/deciduous shrub tundra	High/low centred polygons, scattered tussocks/hummocks	Heath (*Cassiope* spp) and willow with scattered sedge	60–80	20% moist, 80% dry	< 5
Sparse herbaceous tundra	Bare ground/rock, scattered tussocks and saxifrage (*Saxifraga* spp)	Saxifrage, grasses and herbs (e.g., *Papaver* spp)	<10	10% moist, 90% dry	< 2

Table A4. Habitat classification description table for Johnston and Pepper (2009): Prince Charles Island and Air Force Island, NU.

Habitat type	Combined habitat class	% vegetation	Dominant vegetation type	Moisture	Other
Grassland	Wet graminoid/Moss lowlands	Most: > 80%	Grasses ≥ moss	Saturated to standing	
Sedge marsh	Wet graminoid/Moss lowlands	> 50%	Sedges ≥ moss	Saturated to standing	Can be hummocky
Wet graminoid marsh	Wet graminoid/Moss lowlands	Most: > 80%	Graminoids ≥ moss	Saturated to standing	
Saltmarsh	Wet graminoid/Moss lowlands	> 50%	*Puccinellia, Carex ursine, Stellaria humifusa*	Most saturated	
Wet moss marsh	Wet graminoid/Moss lowlands	> 80%	Mosses at least 25% > graminoids	Saturated to standing	
Dry graminoid tundra	Dry vegetated tundra	Most: > 80%	Graminoids ≥ moss	Moist	
Dry moss tundra	Dry vegetated tundra	> 50%	Mosses at least 25% > graminoids	Moist to dry	
Vegetated tundra	Dry vegetated tundra	≥ 50%	Dwarf shrub dominant, occasional graminoids or moss	Moist to dry	Often on ridge slopes
Unvegetated/rocky tundra	Unvegetated/Barren tundra	> 20%	Dwarf shrub, moss	Mixed	
Beach ridge top	Unvegetated/Barren tundra	< 20%	Dwarf shrub	Dry	
Barrens	Unvegetated/Barren tundra	< 20%	Dwarf shrub	Dry	
Mudflats	Unvegetated/Barren tundra	< 20%	Grasses, dwarf shrub	Mixed	