TECHNICAL SUPPORTING DOCUMENT

Mary River Project | Phase 2 Proposal | FEIS Addendum | August 2018

TSD 12

Migratory Birds Baseline and Impact Assessment





BIRDS AND BIRD HABITAT TECHNICAL SUPPORTING DOCUMENT SUMMARY

The Birds and Bird Habitat Technical Supporting Document provides an assessment of the Phase 2 Proposal's effects on birds and bird habitat and includes new information collected or published since submission of materials for the Approved Project. The Phase 2 Proposal builds on the extensive baseline studies and assessments carried out since 2011 for the larger Approved Project and is thus closely linked to the FEIS and previous addendums.

The diverse environments found in the Project region offer an abundant supply of suitable bird habitats. Most bird groups such as raptors, seabirds, shorebirds, songbirds, waterbirds, and waterfowl are represented by at least a few species found throughout the area, including several species listed by the Committee on the Status of Endangered Wildlife in Canada or the Species At Risk Act. Staging and breeding habitats for numerous bird species are found in the Project area. Migratory birds are present in the area from late May to early September and into October in the marine environment, and there are several habitat sites in the region that are considered valuable to seabirds. Sirmilik National Park and Bylot Island Bird Sanctuary are situated in the Project region, but outside the Project footprint.

It is unlikely that bird mortality from construction activities associated with the Phase 2 Proposal will affect Birds and Bird Habitat at the population level. Mitigation is in place to reduce the probability of direct physical interactions with nests, eggs, and birds during site preparation activities, such as requirements to conduct pre-clearing nest surveys, implement activity setback distance buffers specific to species groupings for active nests, and develop nest management plans, including specific guidelines and procedures for nests located within recommended distance buffers. Mitigation has also been implemented (e.g., traffic speed limits, minimum aircraft flying heights, and bird diverters) to reduce the potential for collisions.

There is generally suitable habitat for bird species in the area and displacement from areas of disturbance to nearby suitable habitats should not result in changes to regional bird populations. Given the strong regulatory compliance measures associated with accidental vessel releases, it is unlikely that contaminant exposure will affect Birds and Bird Habitat at the population level. Shipping activity along the proposed shipping lane is not expected to result in indirect habitat loss because the disturbance associated with shipping activities will be of short duration and temporary.

The Phase 2 Proposal is not expected to influence birds and bird habitat at the population level due to planned mitigation and the small footprint affected relative to available habitat in the region. Based on the present assessment and planned mitigation, Project activities proposed as part of the Phase 2 Proposal are not predicted to result in significant adverse residual effects on birds and bird habitat.

RÉSUMÉ DU DOCUMENT D'ASSISTANCE TECHNIQUE SUR L'HABITAT AVIAIRE ET L'AVIFAUNE

Le document d'assistance technique sur l'habitat aviaire et l'avifaune comporte une évaluation des effets de la proposition de la phase 2 sur l'habitat aviaire et l'avifaune et comprend de nouveaux renseignements recueillis ou publiés depuis la soumission des documents pour le projet approuvé. La proposition de la phase 2 est fondée sur les études préliminaires et les évaluations complètes réalisées depuis 2011 pour l'ensemble du projet approuvé et est donc étroitement à l'énoncé des incidences environnementales (EIE) et aux addendas précédents.

Les divers environnements trouvés dans la région du projet offrent un abondant approvisionnement d'habitats aviaires appropriés. La plupart des groupes aviaires, tels que rapaces, oiseaux marins, oiseaux de rivage, oiseaux chanteurs, oiseaux aquatiques et sauvagine, sont représentés par au moins quelques espèces présentes dans la région, y compris plusieurs espèces répertoriées par le Comité sur la situation des espèces en péril au Canada ou la Loi sur les espèces en péril. Des habitats de rassemblement et de reproduction de nombreuses espèces d'oiseaux se trouvent dans la zone du projet. Les oiseaux migrateurs sont présents dans la région de la fin mai au début de septembre, et jusqu'en octobre dans le milieu marin, et plusieurs sites d'habitat de la région sont considérés comme précieux pour les oiseaux de mer. Le parc national Sirmilik et le refuge d'oiseaux de l'île Bylot sont situés dans la région du projet, mais en dehors de l'empreinte du projet.

Il est peu probable que la mortalité des oiseaux causée par les activités de construction associées à la proposition de la phase 2 ait une incidence sur l'avifaune et l'habitat aviaire au niveau de la population. Des mesures d'atténuation sont en place pour réduire les probabilités d'interactions physiques directes avec les nids, les œufs et les oiseaux pendant les activités de préparation du site, telles que l'exécution de relevés de nidification avant déboisement, la mise en place de tampons de distance de retrait d'activité spécifiques aux groupements d'espèces pour des nids actifs et le développement de plans de gestion des nids, y compris de lignes directrices et de procédures spécifiques pour les nids situés au sein des zones tampons recommandées. Des mesures d'atténuation ont également été mises en œuvre (p. ex. limites de vitesse de circulation, hauteurs de vol minimales des aéronefs et chasse-oiseaux) afin de réduire le risque de collision.

Il y a un habitat généralement convenable disponible pour les espèces aviaires de la région et le déplacement des zones perturbées vers les habitats appropriés à proximité ne devrait pas entraîner de changements dans les populations aviaires de la région. Compte tenu des mesures rigoureuses de conformité réglementaire associées aux rejets accidentels de navires, il est peu probable que l'exposition aux contaminants ait une incidence sur l'avifaune et l'habitat aviaire au niveau de la population. Les activités d'expédition le long de la voie maritime proposée ne devraient pas entraîner de perte indirecte d'habitat, car les perturbations associées aux activités d'expédition seront de courte durée et temporaires.

La proposition de la phase 2 ne devrait pas avoir d'impact sur l'habitat aviaire et l'avifaune au niveau de la population en raison des mesures d'atténuation prévues et de la faible empreinte laissée par rapport à l'habitat disponible dans la région. Selon la présente évaluation et les mesures d'atténuation prévues, les activités du projet proposées dans le cadre de la proposition de la phase 2 ne devraient pas entraîner d'effets résiduels négatifs importants sur l'habitat aviaire et l'avifaune.

ᑎᕐᒥᐊᑦ ᓇᔪᒐᕐᒋᑕᓗ ᓄᓇᐅᑉ ᐱᓯᕆᒍᔪᑦ ᐃᑲᔪᐃᔾᔪᑎᑦ ᑎᑎᖅᑲᑦ ᐅᓂᒃᑳᓕᐊᑦ

ᑖᓐᓇ ᑎᕐᒥᐊᑦ ᓇᔪᒐᕐᒋᑕᓗ ᓄᓇᐅᑉ ᐱᓯᕆᒍᔪᑦ ᐃᑲᔪᐃᔾᔪᑎᑦ ᑎᑎᖅᑲᑦ ᐅᓂᒃᑳᓕᐊᕐᒋᑦ ᐱᑕᖃᖅᑎᑦᑎᕗᑦ ᕿᒥᕐᕈᐃᓂᕐᒥᒃ ᐱᓕᕆᐊᑉ ᒪᕈᒋᓕᖅᑕᖓ ᐅᒃᑑᑎᖓᓚᑕ ᐊᒃᑐᐃᓂᖃᕐᓂᕐᒋᓄᑦ ᑎᕐᒥᐊᓄᑦ ᓄᓇᓄᓪᓗ ᓇᔪᓃᕐᒋᓄᑦ ᑕᑉᐹᓂ ᐊᒻᒪᓗ ᐃᓚᖃᖅᑰᓂᓗ ᓄᑖᓂᒃ ᑐᑭᓯᐅᒪᔾᔪᑎᒃᓴᓂᒃ ᑲᑎᖅᓱᒐᑦ ᑎᑎᕋᐅᓯᐅᔪᓪᓘᓐᓃᑦ ᑕᐃᒃᑯᓇᓂᑦ ᑎᑎᕋᐅᓯᑦ ᓱᕈᓪᓕᖅᐹᑦ ᑐᓐᓂᕆᔭᐅᓚᐅᖅᑎᓪᓗᒋᑦ ᐊᕐᒋᖅᓯᒪᔭᒨᑦ ᐅᔭᕋᕐᓂᐊᕐᓂᕐᒧᑦ. ᐱᓕᕆᐊᑉ ᒪᕈᒋᓕᖅᑕᖓ ᐅᒃᑑᑎᖓ ᐃᓚᒋᐊᕆᔭᕐᑲᖅᑐᖅ ᖁᖓᒍᑦ ᐊᕐᒌᔪᑦ ᑐᙵᕕᑦ ᖃᐅᔨᓴᕝᕕᓃᑦ ᐊᕙᑖᓄᑦ ᑕᒪᓐᓇ ᕿᒥᕐᕈᐃᓂᖅ ᑕᐃᒃᑲᖓᑦ 2011−ᒥ ᑖᒃᓯᒨᖓ ᐃᓗᐃᑦᑑᔪᒧᑦ ᐊᕐᒋᖅᓯᒪᔭᒧᑦ ᐅᔭᕋᕐᓂᐊᕐᓂᕐᒧᑦ ᑕᐃᓖᓪᓗ ᓂᒃᓯᒃᓯᒪᓂᖅᑲᖅᐳᖅ ᑭᖑᓪᓕᖅᐸᓪᓛᑉ ᐅᓂᒃᑳᕐᒋᓄᑦ FEIS ᓯᕗᓂᐊᒍᓪᓗ ᐅᐃᒍᒋᐊᖅᑕᐅᓂᑰᔪᒃᑯᑦ.

ᐊᔾᔨᒌᙱᕈᑎᒌᔭᖅᑐᑦ ᓄᓇᕆᔭᕐᒋᑦ ᐊᕙᑖᒍᑦ ᐅᔭᕋᕐᓂᐊᕐᕕᐅᑉ ᓴᖅᑮᔭᖅᑲᖅᓯᒪᕗᑦ ᐊᕐᒋᔪᒥᒃ ᓇᔪᒐᒃᓴᐅᔪᓂᒃ ᓄᓇᓂᒃ ᑎᕐᒥᐊᑦ ᐊᑐᓰᓇᔭᕐᒋᓐᓂᒃ. ᑎᕐᒥᐊᑦ ᑲᑎᙵᐅᖅᑐᑦ ᓲᕐᓗ ᓂᕿᑐᖅᑏᑦ, ᑕᓇᐅᑉ ᑎᕐᒥᐊᕐᒋᑦ, ᓯᒡᔭᓇᐊᑦ, ᖁᐸᓄᐊᑦ, ᐃᒪᕐᒥᐅᑕᑦ, ᐃᒪᕐᒥᓪᓗ ᐊᑐᐃᓐᓇᓲᑦ ᑎᕐᒥᐊᑦ ᑭᒡᒐᖅᑐᖅᑕᐅᕗᑦ ᖃᔅᓯᒐᓚᕐᓄᑦ ᑎᕐᒥᐊᓄᑦ ᓄᓇᕐᒋᒍᑦ, ᐱᖃᓯᐅᑎᔪᑦ ᑎᕐᒥᐊᑦ ᑕᐃᔭᐅᓯᒪᔪᑦ ᑲᑎᒪᔾᔨᖃᑖᑦ ᐃᓕᖅᑯᓯᕐᒋᓄᑦ ᓄᖑᓕᒫᓕᖅᑐᓄᑦ ᓂᖏᑎᑦ ᑲᓇᑕᒥ ᐊᒻᒪᓘᓐᓃᑦ ᓂᔾᔨᑏᑦ ᐅᓗᕆᐊᓇᖅᑐᒦᑦᑐᓄᑦ ᐱᖁᔭᖓᓂ. ᖃᔅᓯᓚᑦ ᐊᖅᑰᓵᑦ ᐃᓅᕙᐅᓰᓪᓗ ᓄᓇᕐᒋᑦ ᐅᓄᖅᑐᐊᓗᕐᓄᑦ ᑎᕐᒥᐊᓄᑦ ᐱᑕᖃᖅᐳᑦ ᐅᔭᕋᕐᓂᐊᕝᕙᕐᒥ. ᑎᑭᑦᑕᖅᑐᑦ ᑎᕐᒥᐊᑦ ᑎᑭᓲᖑᕗᑦ ᐃᓱᖅᐸᓯᐊᒍᑦ ᒪᐃ ᑎᑭᓪᓗᒍ ᓯᑎᐱᕆᐅᑉ ᐱᒋᐊᕐᓂᖓ ᐅᑐᐱᕆᒍᑦ ᑕᕆᐅᑉ ᐃᒪᕐᒋᓂ, ᐊᒻᒪᓗ ᖃᔾᔨᓚᐅᕗᑦ ᓇᔪᒐᐅᓰᑦ ᐊᕙᑖᓂ ᐊᓐᓂᕆᔭᐅᔪᑦ ᑕᕆᐅᑉ ᑎᕐᒥᐊᕐᒋᓄᑦ. ᓯᕐᒥᓕᒃ ᑲᓇᑕᐅᑉ ᒥᕐᖑᐃᖅᓯᕝᕙᖓ ᐊᒻᒪᓗ ᐊᑭᐊᖓ ᑎᕐᒥᐊᑦ ᒥᐊᓂᖅᓯᕙᖓ ᐃᓗᐊᓃᒃᑮᓪᓗᑎᒃ ᐅᔭᕋᕐᓂᕝᕙᐅᔩᑉ, ᑭᓯᐊᓂ ᓯᓚᑖᒍᑦ ᐅᔭᕋᕐᓂᐊᓪᓚᑦᑖᖅᑑᑉ ᓄᓇᕐᒋᑕ.

ᓂᕆᐅᕐᓇᓗᐊᕋᓂ ᑎᕐᒥᐊᑦ ᑐᕐᑯᓴᖅᑐᑦ ᓴᓇᔪᑦ ᐱᓕᕆᐊᕐᒋᑦ ᐊᒃᑐᐊᓇᔭᓕᖓᓖᕐᒋᑕ ᑖᒃᓯᒨᖓ ᐱᓕᕆᐊᑉ ᒪᕈᒋᓕᖅᑕᖓ ᐅᒃᑑᑎᖓᓚᑕ ᐊᒃᑐᐃᓇᔭᕐᒪᖓᓖᓪᓗᓐᓃᑦ ᑎᕐᒥᐊᓂᒃ ᓄᓇᓄᓪᓗ ᓇᔪᓃᕐᒋᓄᑦ ᐊᒥᓲᑦᑕᕐᓂᕆᔭᕐᒋᒍᑦ. ᓄᖅᑲᖓᔾᔪᑎᒃᓴᑦ ᐊᑐᕉᖅᑐᑦ ᐊᖅᐸᓯᖅᑯᓪᓗᒍ ᓴᖅᑭᑐᐃᓐᓇᓇᐊᓕᑦ ᓴᓇᔨᑦ ᐸᕝᕕᓵᖅᑲᕐᓗᑎᒃ ᐃᕙᔪᓂᒃ, ᒪᓐᓂᕐᒋᓂᒃ, ᑎᕐᒥᐊᓂᓪᓗ ᐸᖅᑳᓇᔭᖅᑲᖅᑎᒡᒋᑦ ᐱᓕᕆᓂᐊᒍᑦ, ᓲᕐᓗ ᐱᓕᕆᐊᕐᒋᑦ ᕿᓂᕐᓂᕐᒥᒃ ᓄᓇᓕᕆᓚᐅᕐᒋᓐᓂᐊᓂᒃ ᐃᕙᔪᖅᑲᐅᕐᒪᖓᓖᑦ ᖃᐅᔨᓴᕈᑎᕐᒋᑦ, ᐊᑐᕐᓗᒋᑦ ᐱᓕᕆᔪᑦ ᑭᒡᓕᖅᑲᐅᓯᕐᒋᑦ ᐅᖓᓯᖕᓂᓖᑦ ᓈᒻᒪᒋᔭᐅᔪᓂᒃ ᐊᑐᓂ ᑎᕐᒥᐊᑦ ᐸᒡᕕᒋᔭᕐᒋᓐᓄᑦ ᐃᕙᑎᓪᓗᒋᑦ, ᐊᒻᒪᓗ ᓴᓇᓗᑎᒃ ᐃᕙᔪᑦ ᑲᒪᒋᔭᐅᓂᕐᒋᓐᓄᑦ ᐸᖅᓇᐅᑎᓂᒃ, ᐃᓚᖅᑲᖅᓗᑎᒃ ᑐᕌᖓᔪᓂᒃ ᑐᑭᒧᐊᕈᑎᓂᒃ ᒪᓕᒃᑕᐅᔪᒃᓴᓂᓪᓗ ᐱᑭᐅᒃᑕᐅᔪᓄᑦ ᐃᓗᐊᒍᑦ ᐅᖓᓯᖕᓂᕆᔭᕆᐊᓕᕐᒋᑕ ᑎᕐᒥᐊᑦ. ᓄᖅᑲᖓᔾᔪᑎᒃᓴᑦ ᐊᑐᕈᖅᑐᑦ ᐊᑐᖅᐸᓪᓕᐊᔪᓪᓗ (ᓲᓪᓗ, ᐃᕐᒋᖅᑲᔪᑦ ᓱᒃᑲᓂᕐᒋᑦ, ᐳᒃᑭᓛᖅ ᖃᖓᑕᓲᒃ ᖃᖓᑕᕝᕕᕐᒋᑦ, ᑎᕐᒥᐊᓄᓪᓗ ᕿᒫᔭᐅᑎᕐᒋᑦ) ᐊᑐᖅᑕᐅᓗᑎᒃ ᑐᓗᖅᑐᖅᑲᖅᑯᓇᒍ ᑎᕐᒥᐊᒥᒃ.

ᑕᑯᔭᐃᓐᓇᕆᓪᓗᒋᑦ ᐱᑕᖃᓕᔪᒃᑐᖅ ᓈᒻᒪᒃᑐᓂᒃ ᓇᔪᒐᒃᓴᓂᒃ ᑎᕐᒥᐊᕐᒋᓐᓄᑦ ᐊᑐᓲᑦ ᓄᓇᖓᓂᒃ ᕿᒫᑎᑕᐅᓂᕐᒋᑕ ᓄᓇᓂᒃ ᐊᑐᖅᑕᐅᔪᓂᒃ ᖃᓂᕆᔭᓄᑦ ᓇᔪᒃᓴᕐᒋᓐᓄᑦ ᐊᓯᔾᔨᖅᓱᐊᕐᒋᑦᑐᖅ ᓇᑎᖅᓇᖅᔪᐊᑉ ᑎᕐᒥᐊᕐᒋᑕ ᐊᒥᓲᓂᖅᓲᕐᒋᓄᑦ. ᐱᖅᓱᒍ ᐅᓄᖅᑐᑦ ᐱᖁᔭᖅᑎᒍᑦ ᒪᓕᒋᐊᖅᑲᖅᑎᑦ ᐊᑐᓇᐊᖃᓲᖅᓱ ᐊᒃᑐᐊᔪᑦ ᐱᔮᖅᑯᑕᐅᕐᒋᑦᑐᒥᒃ ᐅᒥᐊᖅᔪᐊᑦ ᑯᕕᑎᑕᕐᒋᓄᑦ, ᓂᕆᐅᕐᒋᑦᑐᒍᑦ ᓯᕈᔪᒻᒧᑦ ᒪᑐᐃᕝᕕᐅᔪᓂᒃ ᐊᒃᑐᐃᓇᔭᕐᒪᖓᓖᑕᓗᐊᓐᓂᑦ ᑎᕐᒥᐊᓂᒃ ᓄᓇᓄᓪᓗ ᓇᔪᓃᕐᒋᓄᑦ ᐊᒥᓲᑕᓐᓂᕆᔭᕐᒋᒍᑦ. ᐅᓯᒃᑲᖅᑕᐃᓐᓂᑦ ᐱᓕᕆᓂᕗᑦ ᐊᑐᕈᒪᔭᑦ ᐅᒥᐊᔾᔪᐊᑦ ᐊᖅᑯᑎᔅᓴᒍᑦ ᓂᕆᐅᒋᔭᐅᕐᒋᑦᑕᖅ ᓴᖅᑮᖓᔭᓐᓂᖓᓂᒃ ᓇᔪᒐᐅᓲᑦ ᓱᕋᒍᑎᕐᒋᓐᓂᒃ ᐱᔾᔪᑎᒋᓪᓗᒍ ᐸᒡᕕᓵᖅᑲᓐᓂᖓ ᓇᐃᑦᑑᖓᔭᒻᒪᑦ ᐊᑯᓂᐅᕐᒋᓪᓗᓂᓗ.

ᐱᓕᕆᐊᑉ ᒪᕈᒋᓕᖅᑕᖓ ᐅᒃᑑᑎᖓ ᓂᕆᐅᒋᔭᐅᕐᒋᑦᑐᖅ ᐊᓯᔾᔨᓂᖅᑲᖅᓯᓂᐊᑕ ᐊᒃᑐᐃᓇᔭᕐᒪᖓᓖᑕᓗᐊᓐᓂᑦ ᑎᕐᒥᐊᓂᒃ ᓄᓇᓄᓪᓗ ᓇᔪᓃᕐᒋᓐᓄᑦ ᐊᒥᓲᑦᑕᕐᓂᕆᔭᕐᒋᒍᑦ ᐱᓪᓗᒍ ᐸᖅᓈᖑᓯᒪᔪᑦ ᓄᖅᑲᖓᑎᑦᑎᔾᔪᑏᑦ ᑕᒪᓐᓇ ᒥᑭᑦᑑᓂᖓᓄᑦ ᓄᓇᖓ ᐊᒃᑐᖅᑕᖅ ᐊᑐᖅᑕᐅᔪᓄᑦ ᓴᓂᕌᒍᑦ ᐊᑐᐃᓐᓇᐅᓲᒃ ᓄᓇᐃᑦ ᓇᔪᒐᕆᔭᒃᓴᑦ ᐊᕙᑖᒍᑦ. ᑐᙵᓪᓗᓂ ᐅᓪᓗᒥ ᕿᒥᕐᕈᐃᓂᐅᔪᒧᑦ ᐸᖅᓈᖑᔪᓄᓪᓗ ᓄᖅᑲᖓᑎᑦᑎᔾᔪᑎᖃᓄᑦ, ᐅᔭᕋᕐᓂᐊᖅᑐᑦ ᐱᓕᕆᓂᕐᒋᑦ ᐊᑐᖅᑕᐅᔪᓕᔪᑦ ᐃᓚᒋᔭᐅᔪᑦ ᑖᒃᓯᒪ ᐱᓕᕆᐊᑉ ᒪᕈᒋᓕᖅᑕᖓ ᐅᒃᑑᑎᖓᓗᑦ ᓇᓚᐅᑦᑖᕐᒋᒍᑦ ᓴᖅᑮᓇᔭᕐᒋᑦᑐᖅ ᐊᕐᒋᔪᒥᒃ ᐱᐅᙱᑦᑐᒥᒃ ᑎᕐᒥᐊᓄᑦ ᓄᓇᓄᓪᓗ ᓇᔪᓃᕐᒋᓄᑦ.

Baffinland Iron Mines Corporation
Mary River Project
Phase 2 Proposal —
Technical Supporting Document No. 12:
Migratory Birds Baseline
and Impact Assessment

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Down to Earth Biology

EDI
ENVIRONMENTAL DYNAMICS INC.

EXECUTIVE SUMMARY

The Mary River Project is an operating iron ore mine located in the Qikiqtani Region of Nunavut. Baffinland Iron Mines Corporation (Baffinland; the Proponent) is the owner and operator of the Project. As part of the regulatory approval process, Baffinland submitted a Final Environmental Impact Statement (FEIS) to the Nunavut Impact Review Board (NIRB), which presented in-depth analyses and evaluation of potential environmental and socioeconomic effects associated with the Project.

In 2012, the NIRB issued Project Certificate No 005 which provided approval for Baffinland to mine 18 million tonnes per annum (Mtpa) of iron ore, construct a railway to transport the ore south to a port at Steensby Inlet which operates year-round, and to ship the ore to market. The Project Certificate was subsequently amended to include the mining of an additional 4.2 Mtpa of ore, trucking this amount of ore by an existing road (the Tote Road) north to an existing port at Milne Inlet, and shipping the ore to market during the open water season. The total approved iron ore production was increased to 22.2 Mtpa (4.2 Mtpa transported by road to Milne Port, and 18 Mtpa transported by rail to Steensby Port). This is now considered the Approved Project. The 18 Mtpa Steensby rail project has not yet been constructed, however 4.2 Mtpa of iron ore is being transported north by road to Milne Port currently. Baffinland recently submitted a request for a second amendment to Project Certificate No.005 to allow for a short-term increase in production and transport of ore via road through Milne Port from the current 4.2 Mtpa to 6.0 Mtpa.

The Phase 2 Proposal (the third project certificate amendment request) involves increasing the quantity of ore shipped through Milne Port to 12 Mtpa, via the construction of a new railway running parallel to the existing Tote Road (called the Northern Railway). The total mine production will increase to 30 Mtpa with 12 Mtpa being transported via the North Railway to Milne Port and 18 Mtpa transported via the South Railway to Steensby Port. Construction on the North Railway is planned to begin in late 2019. Completion of construction of the North Railway is expected by 2020 with transportation of ore to Milne Port by trucks and railway ramping up as mine production increases to 12 Mtpa by 2020. Shipping from Milne Port will also increase to 12 Mtpa by 2020.

To assess potential Project effects from Phase 2 activities on birds, an understanding of baseline avian populations and distribution in the Project area is required. Initial baseline bird surveys were carried out from 2006 to 2008, and 2011. Additional bird surveys were completed as part of bird monitoring programs from 2012 to 2016. Combined, these data behave been used to inform mitigation measures for Project activities related to Phase 2 Proposal from the Mine Site north to Milne Port.

This report provides an update of baseline bird studies completed for the Mary River Project from 2006 to 2016 as well as an updated impact assessment on birds.

Bird studies included the following:

- Inuit Qaujimajatuqangit (Traditional Knowledge; 2006–2007)

  - This project gathered traditional knowledge on bird species, land use, and species important for harvest.
  - Elders indicated they still harvest birds and their eggs, primarily Snow Geese, Common and King Eiders, Arctic Terns and Long-tailed Ducks. Parts of the Project area are used seasonally by large densities of mainly migratory bird species.

- Marine Bird Aerial Transect Surveys (2006–2008)
  - These surveys documented seabird and waterfowl abundance and distribution in the marine areas along proposed shipping routes.
  - Thirty-five species of birds associated with marine habitats, including two species at risk, Ivory Gull and Ross's Gull, were observed in the study areas. Two other species at risk, Red-necked Phalarope (Steensby Inlet) and Harlequin Duck (Hudson Strait), were observed incidentally
  - Foxe Basin had the highest species diversity while Steensby Inlet had the second highest.
  - Milne Inlet and Eclipse Sound (northern shipping route) had lower species diversity than areas surveyed along the southern shipping route.

- Aerial Waterfowl and Cliff Nesting Raptor Reconnaissance Surveys (2006–2008, 2011)
  - These surveys identified waterfowl and raptor species using the area, their distribution, and some information on reproduction and migration.
  - The bulk of spring migration occurred between late May and early June and fall migration began in late August and continued through October. Thousands of geese migrate through the area. Peregrine Falcon and Rough-legged Hawk were the most commonly observed cliff-nesting raptors.

- Songbird and Shorebird Point Count and Transect Surveys (2006–2008, 2011)
  - These surveys documented songbird and shorebird diversity, distribution amongst identified habitat types, and estimated densities in the Project area.
  - Snow Bunting and Lapland Longspur occurred in the highest densities. In general, tussock graminoid tundra contained the greatest density of birds while sparsely vegetated till-colluvium and barren habitats contained the lowest density of birds.

- Shoreline Nesting Surveys (2012–2013)
  - These surveys identified potential areas in Milne and Steensby Inlets where nesting shorebirds and marine birds may be affected by shipping where wakes exceeding 0.5 m in height are expected. Approximately 135 km and 104 km of shorelines were surveyed in Milne and Steensby Inlets, respectively.

  - Surveys in Milne Inlet located four nesting sites representing a minimum of 23 nests and included a nesting colony of Glaucous Gulls on a cliff on the east side of Milne Inlet and a mixed colony of Glaucous and Thayer's Gulls on cliffs on the west side of Milne Inlet.
  - A total of 40 nests representing six species were found during the shoreline surveys in Steensby Inlet. No nesting colonies of gulls or other water birds were observed during the surveys.

- Raptor Nest Occupancy and Productivity Surveys (2011–2016)

  - These surveys confirmed cliff nest sites identified during earlier surveys, located additional nests, documented annual occupancy and productivity, and assessed the effect of distance from project footprint on reproductive parameters.
  - Since 2006, a total of 413 unique raptor sites have been documented in the TRSA.
  - Analysis to date has shown considerable variability in occupancy and reproductive success among species and is most likely representative of natural variability associated with variation in prey availability and weather. There has been no significant decline ($P>0.10$) in occupancy, productivity, nor nest success for Peregrine Falcon and Rough-legged Hawk from 2011 to 2016.
  - Analysis of the 2015 and 2016 Peregrine Falcon and Rough-legged Hawk occupancy and reproductive success data found no evidence that, to date, occupancy, nest success or productivity was affected by distance from disturbance.

- Habitat Suitability Modeling (2012–2016)

  - For the Final Environmental Impact Statement (FEIS), habitat suitability models based on ecological land classification and habitat suitability ratings were developed for Peregrine Falcon, Red-throated Loon, Snow Goose, and King and Common Eider.
  - For the assessment of potential effects of the Phase 2 Proposal, these habitat models have been updated or developed for bird species selected as Key Indicators and include Red-throated Loon, King and Common Eider, Peregrine Falcon, Red-necked Phalarope, and Red Knot.
  - Rather than habitat suitability modeling, density maps were created for two other Key Indicator species, Lapland Longspur and Thick-billed Murre. A map of Lapland Longspur habitat was created based on observed and estimated densities by habitat type. In the case of Thick-billed Murre, observations within the marine regional study area (RSA) were used to create maps showing areas where they are concentrated.

- PRISM Surveys (2012–2013)

  - These surveys established a baseline dataset of near site and far site bird plots within a variety of habitats types.

  - 15 species were identified during the surveys. Lapland Longspur made up the majority of bird observations (59.6%) and the five most abundant species (Lapland Longspur, Snow Bunting, Horned Lark, American Pipit, and Baird's Sandpiper) represented 93.6% of all bird observations. Shorebird diversity, abundance, and densities were very low.

- Bird Encounter Transects (2013)
  - These surveys were conducted on a trial basis to facilitate monitoring of Project effects on tundra breeding songbirds and shorebirds.
  - 18 species were identified during the surveys. The three most commonly detected species (Lapland Longspur, Horned Lark, and American Pipit) represented 75% of all observations. Shorebird diversity, abundance, and densities were very low.
  - A power analysis determined that there is no to very little power to detect a 10% decline in the number of birds closest to disturbance, even with a sample size of 250 transects.

- Roadside Waterfowl Surveys (2012–2014)
  - These surveys monitored waterfowl and waterbird populations in the Project area by means of an annual roadside survey along the Tote Road.
  - Across all years, nine different species of waterfowl and waterbirds were observed. Glaucous Gull was the most common species observed in 2012 and was one of the most commonly detected species in 2013 and 2014. The most common species observed in 2013 was Canada/Cackling Goose, and Snow Goose in 2014. Loons and Long-tailed Duck were commonly observed in all years.

- Red Knot Nest Surveys (2014)
  - These surveys aimed to locate Red Knot, a species at risk, in the Milne Port area.
  - Surveys were conducted to coincide with expected peak breeding displays when birds are easier to locate due to their distinctive call. No Red Knots were observed.

- Staging Waterfowl Surveys (2015)
  - These surveys looked at waterfowl and other marine bird densities and species composition at three open water areas in Milne Inlet during spring staging (the mouths of Robertson River, Tugaat River, and Phillips Creek).
  - At all three sites combined, the most abundant waterfowl and marine bird species were Snow Goose, Long-tailed Duck, Glaucous Gull, Red-throated Loon, Canada/Cackling Goose, and Yellow-billed Loon.

Bird distribution, abundance and breeding associated with the Project area on northern Baffin Island are well characterized. Baseline and post-construction surveys included studies on all major bird groups found in the Terrestrial Regional Study Area (TRSA) and the Marine Regional Study Area (MRSA). Sixty-four bird species have been confirmed within the Project RSAs from 2006–2016, with forty-nine species documented in the TRSA and thirty-five species recorded in the MRSA. Of the forty-nine species present within the TRSA, forty were confirmed to nest in the TRSA including three species at risk: Peregrine Falcon, Red-necked Phalarope, and Red Knot.

A fourth species at risk, Short-eared Owl, has been observed in the TRSA; however, no evidence of nesting has been found. The diversity of marine-associated species documented to date within the MRSA is greater along the southern route than the northern route — 35 species and 24 species documented respectively. Three species at risk have been recorded present in the MRSA: Ivory Gull has been observed along both the northern and southern routes, while Ross's Gull and Harlequin Duck have only been observed along the southern route.

Scoping activities contributed to the identification of migratory birds and their habitats as a VEC for the Mary River Project and the baseline and post-FEIS migratory bird studies provided information on local avian populations and their habitat use patterns in the Project area. Several Key Indicator species (KIs) were selected to guide the assessment of impacts on migratory birds and their habitats for the Phase 2 Proposal of the Project. These species were selected based on input from government biologists (territorial and federal), the IQ studies and workshops, legislative requirements, field observations, and the professional judgment of Project biologists. Fourteen Key Indicator species were selected for this assessment. Six species were selected based on the criteria listed above (Red-throated Loon, Snow Goose, Common Eider, King Eider, Thick-billed Murre, and Lapland Longspur) and additionally, all eight Species at Risk known to occur or that could potentially occur in the Project area were also selected.

There are several mechanisms or pathways through which the proposed Project could potentially affect migratory birds that use the Project area for part or all their annual cycle. All these potential effects could occur during any/all of the Project phases including the phases associated with the Phase 2 Proposal assessed in this report. Although there are a variety of pathways through which Project interactions could occur, potential Project effects were grouped into three main categories or issues: direct and indirect habitat loss, mortality, and health. These issues have the potential to affect bird KIs during all phases of the Project, potentially resulting in changes in behavior and/or in population abundance and distribution.

Assessment methods for these issues included determination of measurable parameters and specific thresholds, assessment of potential Project effects, identification of mitigation measures to limit any identified potential effects, determination of the residual effects (effects that remain after all mitigation attempts have been made to try to minimize Project effects), and an assessment of level of confidence that Project biologists have in the assessment based on available data.

The information collected for baseline characterization and post-production (Project monitoring) were sufficient to inform the environmental impact assessment on birds for the Project. Project-related activities could potentially alter bird behavior and cause displacement during all Project phases but will be confined to the Project footprint, a relatively small area in relation to the availability of suitable habitat in the TRSA, to a potential Zone of Influence (ZOI) adjacent to the Project Development Area (PDA), and to marine shipping routes. Densities of bird KIs are expected to decline within the PDA, and possibly within adjacent potential

ZOIs. However, these changes are expected to be a result of displacement out of the affected areas and not a result of mortalities to the birds or their offspring. Given the amount of available suitable habitat nearby, the overall effect of the Project to the KIs is expected to be minimal.

The residual effects of Project activities on bird KIs include habitat changes such as localized direct habitat loss and chronic disturbance; however, overall effects are not likely to have serious implications for the regional populations of any KI species. Species abundance and habitat use will almost certainly be altered within the port PDA, and to some extent within a potential ZOI around the port and some individuals may relocate to less-disturbed neighboring areas. Mitigation measures will need to be applied to minimize the effects of collisions with vehicles and infrastructure as well as exposure to contaminants because of the Project. The efficacy of proposed mitigations will be assessed through regular monitoring.

ACKNOWLEDGEMENTS

Baseline surveys for marine and terrestrial birds at the Mary River Project were commenced in 2006 by Dr. Matthew Evans. Dr. Evans completed three years of field surveys (2006–2008) within the Project area and prepared several unpublished reports summarizing this work including the initial baseline reports which were released by Knight Piésold and AMEC in 2010 as part of the Draft Environmental Impact Statement (DEIS). Traditional knowledge from Inuit Qaujimajatuqangit and current local knowledge on birds within the Mary River Project area was collected by Knight Piésold Ltd. in three local communities (Pond Inlet, Arctic Bay, and Igloolik). Alastair Franke (Adjunct Academic, Canadian Circumpolar Institute, University of Alberta) provided updates to the raptor nest database and Alexandre Anctil conducted the cliff nesting raptor verification survey in 2011.

Additional baseline bird work was conducted by EDI Environmental Dynamics Inc. Arctic Raptors Inc., and Baffinland staff from 2012 to 2016. Relevant staff who contributed to Project work can be referenced in the following reports:

- 2012 Annual Terrestrial Monitoring Report;
- 2013 Terrestrial Environment Annual Monitoring Report;
- 2014 Terrestrial Environment Annual Monitoring Report;
- 2015 Terrestrial Environment Annual Monitoring Report; and
- 2016 Terrestrial Environment Annual Monitoring Report.

AUTHORSHIP

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ACRONYMS AND ABBREVIATIONS

AGL ... Above Ground Level

ARInc ... Arctic Raptors Inc.

Baffinland ... Baffinland Iron Mines Corporation

CESCC ... Canadian Endangered Species Conservation Council

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

CWS ... Canadian Wildlife Service

ECCC ... Environment and Climate Change Canada

EDI ... Environmental Dynamics Inc.

EIS ... Environmental Impact Statement

ELC ... Ecological Land Classification

ERP ... Early Revenue Program

FEIS ... Final Environmental Impact Statement

IBA ... Important Bird Area

IQ ... Inuit Qaujimajatuqangit

KIs ... Key Indicator Species

KMHS ... Key Marine Habitat Sites

KTHS ... Key Terrestrial Habitat Sites

MRSA ... Marine Regional Study Area

Mtpa ... Million Tonnes Per Annum

NIRB ... Nunavut Impact Review Board

NLC ... Northern Land Cover

PC ... Project Certificate

PDA ... Project Development Area

PEFA ... Peregrine Falcon

PRISM ... Program for Regional and International Shorebird Monitoring

Project (the) ... Mary River Project

RLHA ... Rough-legged Hawk

RSA ... Regional Study Area

RSF ... Resource Selection Function

SARA ... Species at Risk Act

SAVS .... System for Assessing Vulnerability of Species

SMA .... Special Management Area

TEMMP .... Terrestrial Environmental Mitigation and Monitoring Plan

TEWG .... Terrestrial Environmental Working Group

TRSA .... Terrestrial Regional Study Area

TSP .... Total Suspended Particles

VEC .... Valued Ecosystem Component

1 INTRODUCTION

1.1 MARY RIVER PROJECT CURRENT OPERATIONS

The Mary River Project is an operating iron ore mine located in the Qikiqtani Region of Nunavut. Baffinland Iron Mines Corporation (Baffinland; the Proponent) is the owner and operator of the Project. As part of the regulatory approval process, Baffinland submitted a Final Environmental Impact Statement (FEIS) to the Nunavut Impact Review Board (NIRB), which presented in-depth analyses and evaluation of potential environmental and socioeconomic effects associated with the Project.

In 2012, the NIRB issued Project Certificate No 005 which provided approval for Baffinland to mine 18 million tonnes per annum (Mtpa) of iron ore, construct a railway to transport the ore south to a port at Steensby Inlet which operates year-round, and to ship the ore to market. The Project Certificate was subsequently amended to include the mining of an additional 4.2 Mtpa of ore, trucking this amount of ore by an existing road (the Tote Road) north to an existing port at Milne Inlet, and shipping the ore to market during the open water season. The total approved iron ore production was increased to 22.2 Mtpa (4.2 Mtpa transported by road to Milne Port, and 18 Mtpa transported by rail to Steensby Port). This is now considered the Approved Project. The 18 Mtpa Steensby rail project has not yet been constructed, however 4.2 Mtpa of iron ore is being transported north by road to Milne Port currently. Baffinland recently submitted a request for a second amendment to Project Certificate No.005 to allow for a short-term increase in production and transport of ore via road through Milne Port from the current 4.2 Mtpa to 6.0 Mtpa.

The Phase 2 Proposal (the third project certificate amendment request) involves increasing the quantity of ore shipped through Milne Port to 12 Mtpa, via the construction of a new railway running parallel to the existing Tote Road (called the Northern Railway). The total mine production will increase to 30 Mtpa with 12 Mtpa being transported via the North Railway to Milne Port and 18 Mtpa transported via the South Railway to Steensby Port. Construction on the North Railway is planned to begin in late 2019. Completion of construction of the North Railway is expected by 2020 with transportation of ore to Milne Port by trucks and railway ramping up as mine production increases to 12 Mtpa by 2020. Shipping from Milne Port will also increase to 12 Mtpa by 2020. Construction of the South Railway and Steensby Port will commence in 2021 with commissioning and a gradual increase in mine production to 30 Mtpa by 2024. Shipping of 18 Mtpa from Steensby Port will begin in 2025.

Phase 2 also involves the development of additional infrastructure at Milne Port, including a second ore dock. Shipping at Milne Port will continue to occur during the open water season and may extend into the shoulder periods when the landfast ice is not being used to support travel and harvesting by Inuit. Various upgrades and additional infrastructure will also be required at the Mine Site and along both the north and south transportation corridors to support the increase in production and construction of the two rail lines.

1.2 CHANGES FROM THE APPROVED PROJECT MATERIALS

The baseline information on birds and their habitats presented in this report is updated to include additional baseline and relevant monitoring data collected since 2012. This includes summaries of waterfowl, raptor, songbird, shorebird, and marine bird surveys that are presented in more detail in annual monitoring reports. New habitat suitability models were developed for Red-necked Phalarope and Red Knot while all other habitat suitability models and population density maps were updated with new data and variables.

The impact assessment portion of the document addresses the potential effects on birds and their habitats because of the increased footprint and shipping traffic of the Phase 2 Proposal.

Material in this document is provided for reviewers both familiar with the Mary River Project and written materials provided since 2012, and for those that are new to the review of the Project. There should be sufficient information in this document to form a suitable understanding of the characteristics of birds and bird habitat within the immediate Project area, the Regional Study Area, and the broader north Baffin Island region. There should be sufficient information provided on the potential impacts of the Phase 2 Proposal so that reviewers can determine the characteristics of the residual impacts following proposed mitigation and inform decisions on impact significance without having to review the entire Approved Project FEIS and Addendum documents.

1.3 REPORT OBJECTIVES

This Technical Supporting Document (TSD) provides a summary of baseline and Post-FEIS information gathered on bird populations, distribution, and habitats in the terrestrial and marine areas surrounding the Mary River Project. This TSD presents new baseline information collected or published since submission of materials for the Final Environmental Impact Statement (FEIS) and Early Revenue Phase (ERP) assessments (Baffinland Iron Mines Corporation 2012, 2013). A review of the issues and concerns raised in community meetings regarding impacts on birds is presented, along with an update of the impact assessment for migratory birds based on activities proposed for the Phase 2 Proposal.

2 BIRD AND BIRD HABITAT CHARACTERISTICS

2.1 NORTH BAFFIN ISLAND ECOLOGY OVERVIEW

The Project is in the eastern part of the Northern Arctic Ecozone which is the coldest and driest landscape in Canada. Daily temperatures average below -30°C in winter and only creep above freezing in July and August, while mean annual precipitation ranges from 10–20 cm. This precipitation is often in the form of snow which is present as ground cover for 10 months of the year (September to June). Cold temperatures, a short growing season, high winds, shallow soils, and limited precipitation result in sparse and dwarfed vegetation in this area. The Project falls mainly within the Melville Peninsula Plateau Ecoregion, an area of non-mountainous terrain characterized by major land components such as dry, rugged uplands, rolling plains, and lowland features with some standing water. Drier sites support sparse covering of purple saxifrage (*Saxifraga oppositifolia*), mountain avens (*Dryas integrifolia*), and willow (*Salix spp.*). Wet sites support continuous cover of graminoids, and predominantly include sedges (*Carex spp.*) and cottongrass (*Eriophorum spp.*). The Project is also located within or bordered by the Baffin Island Uplands and Borden Peninsula Plateau Ecoregions. The landscape is generally rugged and elevation ranges from sea level to 685 metres.

Marine habitats within the Project area are located mostly within the Arctic Archipelago Marine Ecozone, although the eastern-most sections along Hudson Strait overlap the Northwest Atlantic Marine Ecozone. The Arctic Archipelago Marine Ecozone is comprised of a patchwork of interconnecting bays, fjords, channels, straits, sounds and gulfs rather than vast, open seascapes. Water depths of 150 to 500 m are typical within this area with deeper waters occurring where this ecozone merges with the Northwest Atlantic Ecozone (Environment Canada 2011). During the winter, sea ice creates a solid sheet over the waters of the Ecozone except for localized areas where currents and upwellings create areas of open water called polynyas. The sea ice breaks up during the brief spring and summer seasons and most of the sea ice will have either melted or drifted away on southerly currents by September; however, some ice can persist throughout the year, particularly in the northwestern parts of the Ecozone (Environment Canada 2011). The coastline topography within this region varies considerably.

2.2 STUDY AREAS

2.2.1 TERRESTRIAL REGIONAL STUDY AREA

The Terrestrial Regional Study Area (TRSA) was identified for terrestrial environment studies associated with the Project. It was chosen to represent birds and their habitats at an ecologically relevant scale and to reflect regional habitat use and seasonal movement patterns on north Baffin Island. The TRSA also had to be a reasonable size so that surveys and information could be gathered in an economical fashion and provide information that is directly relevant to Project management and mitigation.

The TRSA is 21,054 km² and follows an approximately 50 to 80 km wide corridor roughly centered around the Project (Map 1). This corridor extends from Milne Inlet in the north to Steensby Inlet in the south, encompassing the Mine Site, Milne Port, Steensby Port, Tote Road, North Rail, and South Rail. The TRSA was developed based on ecological boundaries (Ecological Stratification Working Group 1995) and significant topographic and drainage features. It includes variable topography from higher elevation rugged terrain in the north near Milne Inlet to low elevation rolling tundra in the south near Steensby Inlet.

All terrestrial bird baseline studies and subsequent monitoring programs were completed within the boundaries of the TRSA. In some cases, field studies and habitat modelling did not extend to the full boundaries and analysis of survey or modelling results are presented within the survey or modelling extent. However, based on habitat distribution within the TRSA, unless otherwise stated, the results are generally assumed to be representative of the entire TRSA.

2.2.2 MARINE REGIONAL STUDY AREA

The Marine Regional Study Area (MRSA) includes all coastal and open water areas associated with Project shipping (Map 1), including a Southern Route (permitted but not yet operational) and a Northern Route (currently in use for Project shipping with amendments under the Phase 2 Proposal). The Southern Route MRSA includes Steensby Inlet, the central part of Foxe Basin and the northern and central parts of Hudson Strait. The Northern Route MRSA includes Navy Board Inlet, Eclipse Sound (and all inlets and sounds within them), as well as waters within a 30-km buffer southeast from the Borden Peninsula (Baffin Island), around Bylot Island, to Cape Coutts on Baffin Island. All waters within the MRSA are within the Nunavut Settlement Area boundary.

Map Area
Mary River Project
LEGEND
Mary River Project
Terrestrial Regional Study Area
Northern Route Marine Regional Study Area
Southern Route Marine Regional Study Area
NOTES
This document is not an official land survey and the spatial data presented is subject to change without notice.
Map Projection: Canada Albers Equal Area Conic.
Scale
Km
BYLOT ISLAND
Pond Inlet
Arctic Bay
Mary River Project Mine Site
Clyde River
BAFFIN BAY
BAFFIN ISLAND
Erichson Lake
GULF OF BOOTHIA
Igloolik
Hall Beach
PRINCE CHARLES ISLAND
Pangnirtung
FOXE BASIN
Iqaluit
Cape Dorset
Kimmirut
RESOLUTION ISLAND
SOUTHAMPTON ISLAND
SALISBURY ISLAND
NOTTINGHAM ISLAND
HUDSON STRAIT
QUEBEC
AKPATOK ISLAND
COATS ISLAND
Baffinland
Iron Mines Corporation
Marine and Terrestrial Regional Study Areas
EDI
Date: 6/18/2018
MAP 1

2.3 BIRD COMMUNITIES

Prior to the commencement of baseline surveys for the Mary River Project in 2006, no comprehensive avian surveys were conducted in the TRSA, nor had any comprehensive marine bird studies previously been conducted in Milne Inlet. However, the remainder of the MRSA has been relatively well studied.

The terrestrial and aquatic bird species found on north Baffin Island are generally reflective of those expected in the eastern Canadian Arctic. Most bird groups such as raptors, seabirds, shorebirds, songbirds, waterbirds, and waterfowl are represented by at least a few species found throughout the area. Field surveys and incidental observations documented 64 bird species within the TRSA and MRSA, of which 45 species were observed or reported breeding. This includes seven Species at Risk listed by the Committee on the Status of Endangered Wildlife in Canada (2016) or the Species At Risk Act (Environment and Climate Change Canada 2017a) consisting of Peregrine Falcon, Harlequin Duck, Red-necked Phalarope, Red Knot, Short-eared Owl, Ivory Gull, and Ross's Gull. The diverse environments found in the MRSA and TRSA offer an abundant supply of suitable bird habitats. Migratory birds are present in the Project Area from late May to early September in the TRSA and into October in the MRSA; however, a few species are known to overwinter in open water areas such as leads and polynyas in the region. Staging and breeding habitats for numerous bird species are found in the Project area including but not limited to Red-throated Loon, Canada and Cackling Goose, Common and King Eider, Peregrine Falcon, Rough-legged Hawk, Rock Ptarmigan, Baird's Sandpiper, Glaucous Gull, Thick-billed Murre, Lapland Longspur, and Snow Bunting. The TRSA also includes part of an important moulting area for Snow Geese prior to fall migration. Other than a small Glaucous Gull colony found in Milne Inlet, no seabird nesting colonies were recorded during project surveys within the TRSA.

Along the northern shipping route, Bylot Island and the adjacent regions of northern Baffin Island, including the Brodeur Peninsula, Eclipse Sound, Pond Inlet, Navy Board Inlet and Lancaster Sound, have perhaps the most well studied avifauna in the Canadian High Arctic and have been studied by many of Canada's foremost ornithologists (Tuck 1961, Nettleship and Gaston 1978, Renaud et al. 1979, 1981, Bradstreet 1982, McLaren 1982, Zoltai et al. 1983, Lepage et al. 1998, Gauthier et al. 2004, 2011, Mallory and Fontaine 2004, Latour et al. 2008). Long-term studies continue on Bylot Island, including areas along the shores of Eclipse Sound (Gauthier et al. 2004, 2011). From these studies it was concluded that Bylot Island and the surrounding marine environment, including Eclipse Sound, have among the greatest abundance and diversity of birds in the Canadian High Arctic (Lepage et al. 1998, Mallory and Fontaine 2004, Latour et al. 2008). Even 19th century explorers in search of the Northwest Passage commented on the abundance and diversity of birds in the region (Ross 1819, Parry et al. 1821, M'Clintock 1860). More than 74 species of birds (both marine and terrestrial species) were documented in the area including the world's largest greater Snow Goose colony (Batt 1998, Lepage et al. 1998). Several well documented seabird colonies are located within and adjacent to the Northern Route MRSA, notably on Bylot Island where large Thick-billed Murre and Black-legged Kittiwake colonies are found at Cape Hay and Cape Graham Moore and along the northeastern coast of Baffin Island where large colonies of Northern Fulmar are found at Buchan Gulf and Scott Inlet (Mallory and Fontaine 2004).

Ivory Gull nesting colonies are also found in this region on the Brodeur Peninsula (Gilchrist and Mallory 2005, Latour et al. 2008).

Along the southern shipping route, the nutrient-rich cold waters, numerous islands, and vast diversity of habitat types along Foxe Basin and Hudson Strait, also make them important regions for many species of seabirds, shorebirds, geese, ducks, eiders and loons (Ellis and Evans 1960, Reed et al. 1980, Gaston et al. 1986, Forbes et al. 1992, Béchet et al. 2000, Latour et al. 2008, Johnston and Pepper 2009). The Great Plain of the Koukdjuak on the southwestern shores of Baffin Island has the world's largest goose colony, with over two million birds, 75% of which are lesser Snow Geese and the remainder Canada Geese and Brant (Important Bird Areas Canada 2010). Foxe Basin is thought to be the main North American stronghold of the Sabine's Gull with some 10,000 nesting pairs (Important Bird Areas Canada 2010). Several hundred thousand Thick-billed Murre breed on the cliffs of Coats Island, Digges Islands, and Akpatok Island in Hudson Strait. Large numbers of Black Guillemots, Arctic Terns, Glaucous, Iceland and Herring Gulls also breed at these colonies. Several hundred thousand shorebirds and ducks also breed in or migrate through Foxe Basin. Johnston and Pepper (2009) recently recommended that Prince Charles Island and Air Force Island be protected under the *Canada Wildlife Act* (1973) regulations for National Wildlife Areas.

2.4 PROTECTED AREAS AND KEY HABITAT SITES

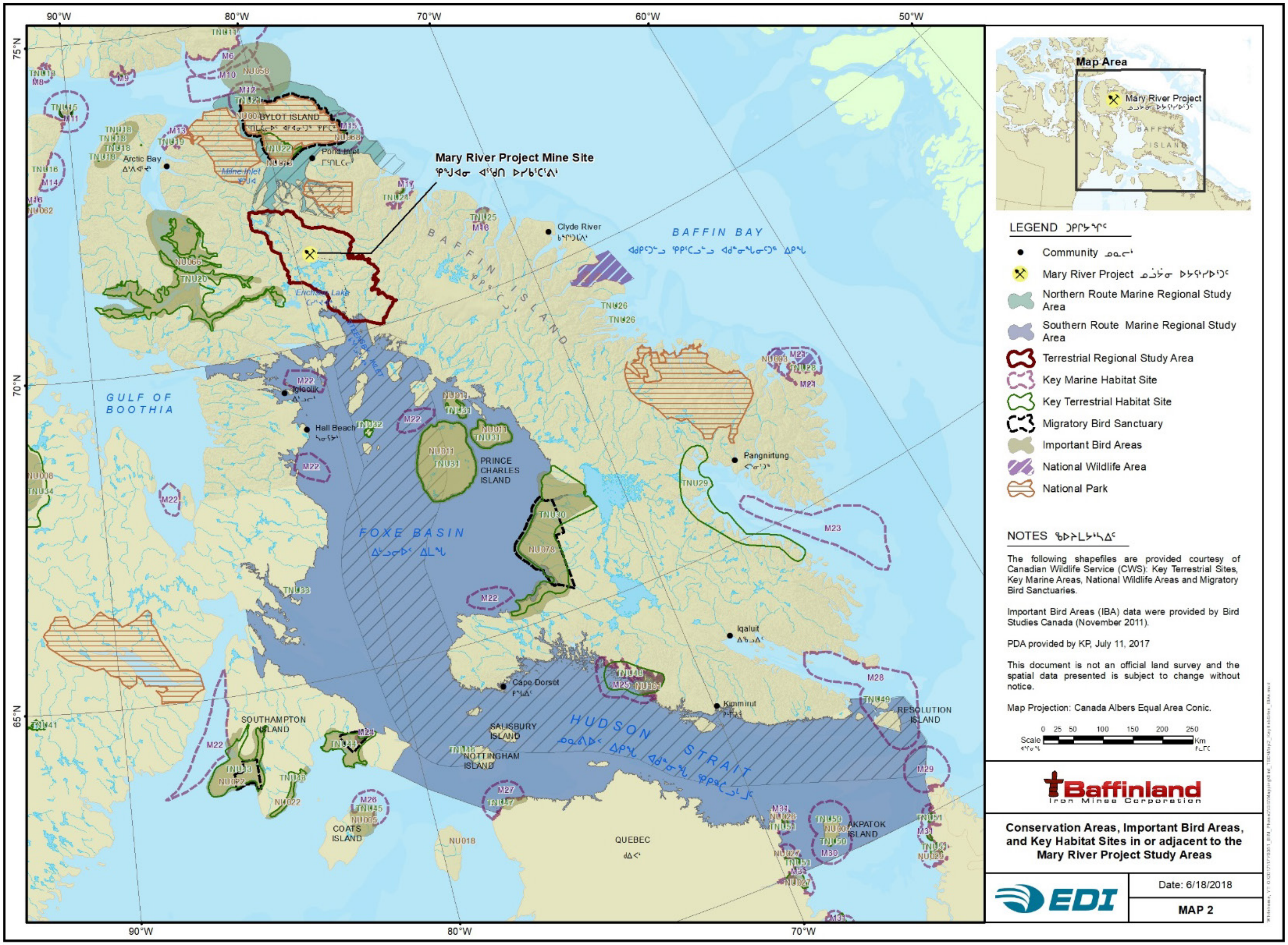
Sirmilik National Park and Bylot Island Bird Sanctuary are situated adjacent to the MRSA, outside the Project Footprint. The area contains more than 74 species of marine and terrestrial birds, and is considered sensitive to disturbance and marine pollution (Latour et al. 2008, Parks Canada 2009), and has special federal and international protection under the *Migratory Birds Sanctuary Regulations* (1997), the *Migratory Birds Convention Act* (1994), and *Canada's National Parks Act* (2000). Additionally, a National Marine Conservation Area (NMCA) has been proposed for Lancaster Sound. Lancaster Sound is an area of critical ecological importance with some of the largest seabird breeding colonies in Arctic Canada (Parks Canada 2010); a feasibility study for the proposed NMCA is expected to be completed in 2017 (Oceans North Canada 2017).

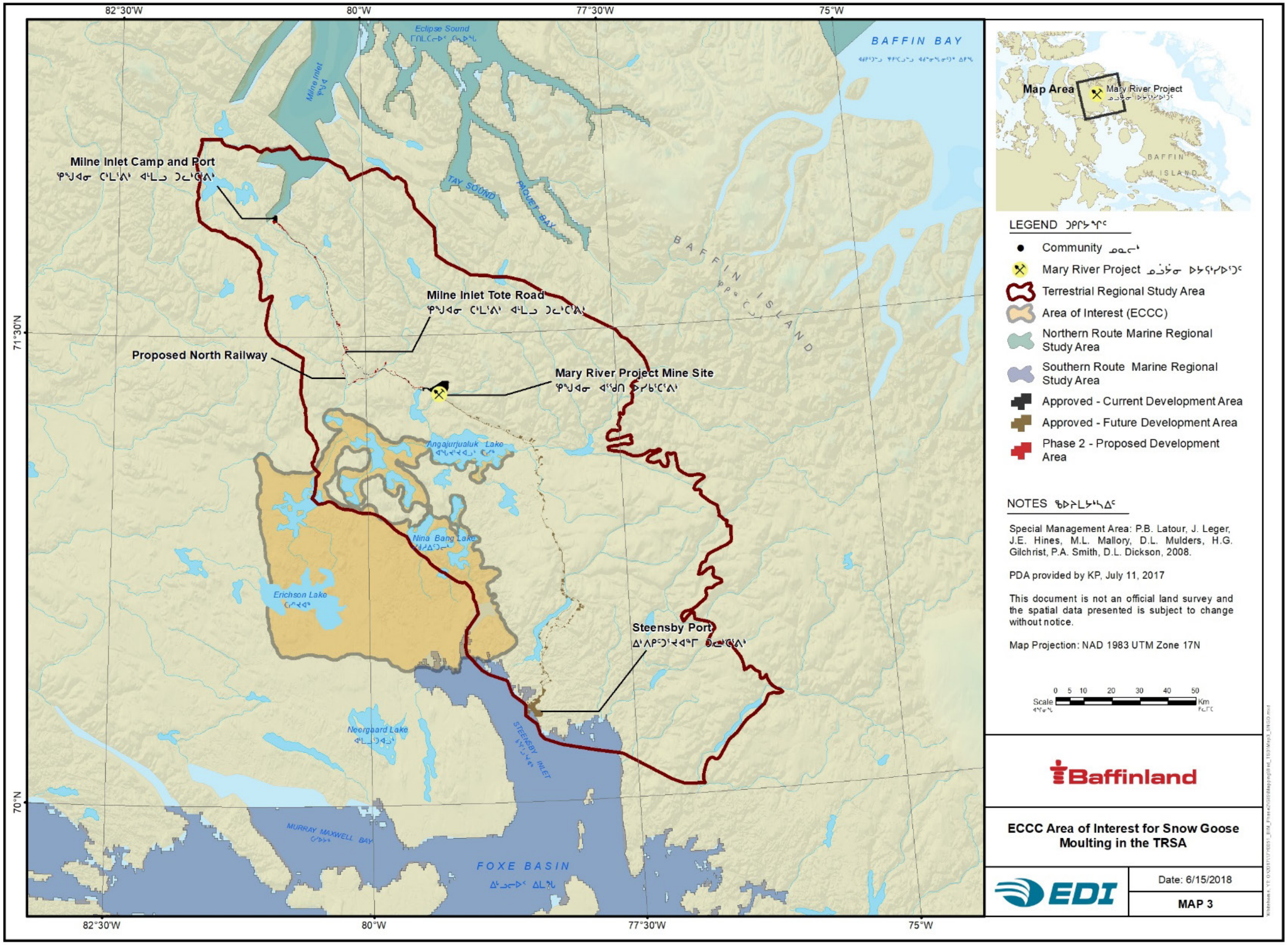
There are 32 Key Marine Habitat Sites (KMHS; (Mallory and Fontaine 2004) and 60 Key Terrestrial Habitat Sites (KTHS; (Latour et al. 2008) for migratory birds identified in Nunavut. In addition, there are 56 Important Bird Areas (IBAs) designated in Nunavut (Important Bird Areas Canada 2010). None of these occur within the TRSA; however, the MRSA overlaps or borders 15 KTHS, 10 KMHS, and 17 IBAs (Map 2).

There are no known polynyas or recurring shore leads in Milne or Steensby Inlet, nor in Eclipse Sound. The Lancaster Sound Polynya (Canadian IBA #NU058) is a large recurring polynya at the entrance of Lancaster Sound, north of Bylot Island, and is thought to support up to 3 million dovekies each year in May on their spring migration to Greenland (Johnson et al. 1976, Brown and Nettleship 1981, Renaud et al. 1982). There is another polynya at the entrance to Pond Inlet and in the spring and early summer there are also recurrent shore leads at the entrances to Pond Inlet and Navy Board Inlet.

Four reliable polynyas exist in Foxe Basin (two along Melville Peninsula, one north of Prince Charles Island, and one north of Foxe Peninsula) along with lengthy floe edges along both the east and west coasts of the Basin. Hudson Strait is also known to have recurring floe edges along its northern shoreline and a large polynya occurs regularly in nearby Frobisher Bay (Mallory and Fontaine 2004).

While there are no designated protected areas or key habitat sites in the TRSA, ECCC has identified an area of interest for moulting Snow Geese in the southern portion of the TRSA (Map 3; James Hodson, CWS, pers. comm.). Based on the results of an aerial survey in July 1993, the area was identified as moulting grounds for sub adults and failed breeders with more than 21,000 Snow Geese estimated present at the time of the survey (Reed et al. 1993).


Map Area
Mary River Project
Mary River Project Mine Site
BYLOT ISLAND
Pond Inlet
Arctic Bay
Milne Inlet
Clyde River
BAFFIN BAY
BAFFIN ISLAND
Eclipse Lake
GULF OF BOOTHIA
Igloolik
Hall Beach
PRINCE CHARLES ISLAND
FOXE BASIN
Pangnirtung
Iqaluit
Cape Dorset
Kimmirut
HUDSON STRAIT
RESOLUTION ISLAND
SOUTHAMPTON ISLAND
SALISBURY ISLAND
NOTTINGHAM ISLAND
COATS ISLAND
QUEBEC
AKPATOK ISLAND
90°W
80°W
70°W
60°W
50°W
75°N
70°N
65°N
LEGEND
Community
Mary River Project
Northern Route Marine Regional Study Area
Southern Route Marine Regional Study Area
Terrestrial Regional Study Area
Key Marine Habitat Site
Key Terrestrial Habitat Site
Migratory Bird Sanctuary
Important Bird Areas
National Wildlife Area
National Park
NOTES
The following shapefiles are provided courtesy of Canadian Wildlife Service (CWS): Key Terrestrial Sites, Key Marine Areas, National Wildlife Areas and Migratory Bird Sanctuaries.
Important Bird Areas (IBA) data were provided by Bird Studies Canada (November 2011).
PDA provided by KP, July 11, 2017
This document is not an official land survey and the spatial data presented is subject to change without notice.
Map Projection: Canada Albers Equal Area Conic.
Scale
0 25 50 100 150 200 250
Km
Baffinland
Iron Mines Corporation
Conservation Areas, Important Bird Areas, and Key Habitat Sites in or adjacent to the Mary River Project Study Areas
EDI
Date: 6/18/2018
MAP 2



Eclipse Sound
BAFFIN BAY
Milne Inlet
TAY SOUND
Milne Inlet Camp and Port
Milne Inlet Tote Road
Proposed North Railway
Mary River Project Mine Site
BAFFIN ISLAND
Angajurjualuk Lake
Nina Bang Lake
Erichson Lake
Steensby Port
Neergaard Lake
STEENSBY INLET
MURRAY MAXWELL BAY
FOXE BASIN
82°30'W
80°W
77°30'W
75°W
71°30'N
70°N
Map Area
Mary River Project
BAFFIN ISLAND
LEGEND
Community
Mary River Project
Terrestrial Regional Study Area
Area of Interest (ECCC)
Northern Route Marine Regional Study Area
Southern Route Marine Regional Study Area
Approved - Current Development Area
Approved - Future Development Area
Phase 2 - Proposed Development Area
NOTES
Special Management Area: P.B. Latour, J. Leger, J.E. Hines, M.L. Mallory, D.L. Mulders, H.G. Gilchrist, P.A. Smith, D.L. Dickson, 2008.
PDA provided by KP, July 11, 2017
This document is not an official land survey and the spatial data presented is subject to change without notice.
Map Projection: NAD 1983 UTM Zone 17N
Scale
0 5 10 20 30 40 50
Km
Baffinland
ECCC Area of Interest for Snow Goose Moulting in the TRSA
EDI
Date: 6/15/2018
MAP 3

2.5 PRE-DEVELOPMENT DATA

To characterize the pre-development conditions within the Mary River Project Area and identify important bird issues, a variety of scoping activities were completed. The information gathered from these various sources was combined to develop the bird baseline studies and the 2011 Mary River Project Bird Baseline Report (EDI Environmental Dynamics Inc. 2011).

Scoping activities included:

- A review of grey and peer-reviewed literature, Canadian Wildlife Service reports, and long-term monitoring reports from research on nearby Bylot Island;
- A review of Environmental Impact Statements from other northern projects;
- Discussions with federal and territorial wildlife agencies (e.g., Canadian Wildlife Service, Government of Nunavut); and
- Public consultation meetings and personal interviews were conducted in local communities to discuss Project plans and to scope potential issues of perceived Project effects.

The objective of the terrestrial and marine bird baseline studies was to provide up to date information on local avian populations and their habitat use patterns in the Project area. An understanding of bird species, habitat use, and distribution was required to assess the potential effects of the Project on birds. Prior to the commencement of baseline surveys for the Mary River Project in 2006, no comprehensive avian surveys were conducted in the TRSA, nor had any comprehensive marine bird studies previously been conducted in Milne Inlet. However, the remainder of both the Northern Route and Southern Route MRSA has been relatively well studied.

This section summarizes baseline bird studies performed in the Project area from 2006–2008 and 2011 prior to the submission of materials for review of the Approved Project, with a focus on work done within the MRSA (especially the Southern Route) and TRSA (Table 1). Section 2.6 provides details about continuing baseline studies and monitoring programs conducted since 2011.

Table 1. Baseline Bird Studies Conducted in the Terrestrial (TRSA) and Marine Regional Study Area (MRSA) from 2006–2008 and 2011

Survey/Study (Location)	Year	Survey Descriptions
Inuit Qaujimajatuqangit (Traditional Knowledge)	2006-2007	Traditional knowledge on bird species, land use, and species important for harvest was gathered at workshops, meetings, and personal interviews conducted in five local communities.
Aerial Waterfowl and Cliff Nesting Raptor Reconnaissance Surveys (TRSA)	2006–2008, 2011	These surveys identified waterfowl and raptor species using the area, their distribution, and some information on reproduction and migration.
Songbird and Shorebird Point Count and Transect Surveys (TRSA)	2006–2008, 2011	These surveys documented songbird and shorebird diversity, distribution amongst identified habitat types, and estimated densities in the Project area.
Marine Bird Aerial Transect Surveys (MRSA)	2006–2008	These surveys documented seabird and waterfowl abundance and distribution in the marine areas along proposed shipping routes.
Habitat Suitability Modeling (TRSA/MRSA)	2012	Habitat suitability models based on ecological land classification and habitat suitability ratings were developed for Key Indicator species: Peregrine Falcon, Red-throated Loon, Snow Goose, and King and Common Eider. Rather than habitat suitability modeling, density maps were created for Lapland Longspur based on observed and estimated densities by habitat type and for Thick-billed Murre by using observations within the MRSA (Northern and Southern Route) to show densities.

2.5.1 KEY REFERENCE DOCUMENTS

The following report was submitted to NIRB as part of the FEIS and contains baseline bird information for the Project:

- Wildlife Baseline Report, Appendix 6E, FEIS (EDI Environmental Dynamics Inc. 2011)

2.5.2 INUIT QAUJIMATJATUQANGIT

Traditional knowledge or Inuit Qaujimajatuqangit (IQ) studies were conducted by Knight Piésold Ltd. in part to learn more about birds in the Project area in addition to obtaining local knowledge of wildlife, land use, and areas of cultural value. IQ studies were initiated in Pond Inlet in 2006, expanded to Igloolik and Arctic Bay in early 2007, and to Hall Beach and Clyde River in 2008. Studies were introduced in those communities with the closest ecological and cultural ties to the Project first, and then expanded to the other potentially affected communities, modifying the study methodology based on the experiences in the initial communities.

Information collected from the IQ surveys indicated that the harvesting of birds and their eggs is still important to local communities, and that ducks and geese of all species are important to the Inuit for the harvest of eggs and for ceremonial and practical purposes. The species most commonly harvested include

Snow Geese, Common and King Eiders, Arctic Terns and Long-tailed Ducks. Many islands in Foxe Basin were identified by residents of Igloolik and Hall Beach as good nesting areas and are frequented by them for egg harvesting (e.g., Nirlirnartuuq, Siuraq, Naluqqajarvik, Manirtulik, Qaiqsu and Qikiqtani). Several large areas within the southwest portion of the TRSA were also identified as important to Snow Geese and waterfowl as nesting and foraging habitat and are believed to be an important stopover area during spring migration.

Bylot Island was identified as a very good area for nesting murres, Snow Geese, eiders, and other species. Murres, kittiwakes and other seabirds are known to nest in very large colonies on cliffs, while some nest on the ground along the coastlines. Geese, eiders, loons and ducks also nest on the ground along coastlines or inland along freshwater lakes.

The marine and TRSAs are used seasonally by birds; most bird species using the area are migratory and typically arrive between late-April and June. Fall migration occurs from early August to late October, with male birds and non-breeders leaving earlier than females with young. Some birds, such as the Black Guillemot, remain in the area year-round using open shore leads in the MRSA during the winter.

For further details on literature and observations made on the natural history of various local species, refer to the Bird Baseline Report, Appendix 6E, FEIS (EDI Environmental Dynamics Inc. 2011).

2.5.3 TERRESTRIAL BIRD FIELD STUDIES

The purpose of the terrestrial baseline surveys was to confirm the presence/absence and habitat use of birds within the TRSA during their spring migration, breeding season, and fall migration. The methods used for terrestrial field studies and the results of those studies are summarized in the sections below. For detailed methods and survey results, refer to the Bird Baseline Report, Appendix 6E, FEIS (EDI Environmental Dynamics Inc. 2011).

2.5.3.1 Terrestrial Survey Methods

Aerial and ground-based surveys for most bird species were conducted each year from 2006 to 2008 in late-May to early-June, mid- to late-June, mid- to late-July, and mid- to late-August. Songbirds and shorebirds were an exception to this and were only surveyed during the breeding season (mid- to late-June and July) when these birds were engaged in conspicuous courtship and territorial behaviours that made them easy to census using point-count surveys and transect plots.

Aerial reconnaissance surveys were conducted by helicopter on a regular basis within the TRSA, concentrating on the Project Footprint and adjacent areas. These surveys focused on locating waterfowl and raptor species using the area and collecting information relating to reproduction and migration. Wetlands, streams, rivers, and lakes within the RSA were surveyed for waterfowl during the spring migration, breeding season, and fall migration periods. Cliff-nesting habitat within the RSA was surveyed by helicopter each year to locate both active and inactive nests of Peregrine Falcons, Gyrfalcons, Rough-legged Hawks, and Common Ravens.

Beginning in 2010, Baffinland supported an independent raptor research team's study of raptors in Steensby Inlet. In 2011 the study was expanded to include verification of sites located from 2006–2008.

Ground surveys for songbirds and shorebirds were conducted from 2006 to 2008 between the end of May and the end of June, and were comprised of point-count surveys, plot surveys and incidental sightings. Point-count surveys were focused on songbirds and the transect plots were focused on shorebirds, but all species seen or heard were recorded during both survey types.

Species presence was also recorded during other wildlife survey work. Point counts were not replicated within or among years. In addition, density estimates were completed for songbirds and shorebirds within the TRSA and distribution of species among different habitat types identified was also calculated.

2.5.3.2 Terrestrial Survey Results

Bird baseline surveys in the TRSA recorded 29 species plus unconfirmed species of ptarmigan, phalarope and jaeger between 2006 and 2011, of which, 19 species were confirmed to breed in the RSA (Table 2). Two of the bird species detected, Peregrine Falcon and Short-eared Owl, are considered Species at Risk.

Table 2. Bird Species during Bird Baseline Surveys within the TRSA, 2006–2011.

Common Name	Latin Name	2006	2007	2008
Snow Goose	*Chen caerulescens*	B	B	B
Brant	*Branta bernicla*	S	-	-
Canada/Cackling Goose	*Branta sp.*	B	B	B
Tundra Swan	*Cygnus columbianus*	-	-	B
King Eider	*Somateria spectabilis*	B	B	B
Common Eider	*Somateria mollissima*	S	S	S
Long-tailed Duck	*Clangula hyemalis*	B	B	B
Red-breasted Merganser	*Mergus serrator*	B	B	B
Unspecified Ptarmigan	*Lagopus sp.*	-	-	S
Red-throated Loon	*Gavia stellata*	B	B	B
Pacific Loon	*Gavia pacifica*	B	B	B
Common Loon	*Gavia immer*	B	B	B
Yellow-billed Loon	*Gavia adamsii*	B	B	B
Northern Fulmar	*Fulmarus glacialis*	S	-	-
Rough-legged Hawk	*Buteo lagopus*	B	B	B
Gyrfalcon	*Falco rusticolus*	B	B	B
Peregrine Falcon	*Falco peregrinus tundris*	B	B	B
Sandhill Crane	*Grus canadensis*	B	B	B
American Golden-Plover	*Pluvialis dominica*	S	S	S
Common Ringed Plover	*Charadrius hiaticula*	S	-	-
Baird's Sandpiper	*Calidris bairdii*	S	S	S
Unspecified Phalarope	*Phalaropus sp.*	-	-	S

Table 2. Bird Species during Bird Baseline Surveys within the TRSA, 2006–2011.

Common Name	Latin Name	2006	2007	2008
Glaucous Gull	*Larus hyperboreus*	-	B	B
Arctic Tern	*Sterna paradisaea*	-	S	S
Unspecified Jaeger	*Stercorarius sp.*	-	-	B
Snowy Owl	*Bubo scandiacus*	S	S	B
Short-eared Owl	*Asio flammeus*	-	-	S
Common Raven	*Corvus corax*	S	S	B
Horned Lark	*Eremophila alpestris*	S	S	S
American Pipit	*Anthus rubescens*	S	S	S
Lapland Longspur	*Calcarius lapponicus*	S	S	S
Snow Bunting	*Plectrophenax nivalis*	S	S	S

Symbology: B = Confirmed Breeding; S = Confirmed Present; U = unconfirmed observation

Waterfowl and Related Species — The TRSA contains abundant wetlands, streams, rivers, and waterbodies of various sizes, ranging from small shallow ponds up to large deep lakes. These habitats are utilized by a variety of waterbirds including loons, ducks, and geese during both breeding, and spring and fall migration. Between 2006 and 2008, the bulk of spring migration occurred between late May and early June, while the fall migration occurred between late August and October (although this varied by species and year).

Thousands of geese, primarily Snow Geese with some Canada Geese and Brant, were observed migrating through the TRSA, believed to be traveling to and from nesting grounds on Bylot Island. During the 2006–2008 surveys, several thousand Snow Geese moved through the RSA in late-May to mid-June, some stopping to rest and forage on route to their breeding grounds further north. Between mid-July and late August, thousands of geese returned to the area to rest, forage, and to moult their feathers before continuing south. Most of the moulting observations made during baseline surveys were in the southwest section of the RSA, roughly corresponding to the Snow Goose area of interest identified by Environment Canada (Map 3). This area encloses several large lakes, including Angajurjualuk, Inuktorfik, Quartz, Nina Bang, and Erichson Lakes, as well as numerous small lakes and rivers.

In comparison to the thousands of geese observed during migration, a relatively small number of Snow Geese appear to nest within the bulk of the RSA (although a large colony of breeding Snow Geese was observed along the southern edge of the TRSA during the marine surveys, refer to Section 2.5.4.2). A total of 268 nests were located during terrestrial surveys; the observed Snow Goose nests were located throughout the TRSA, but were most concentrated in lowland areas, in well-vegetated habitats, often around small to mid-sized waterbodies and/or wetlands. Additionally, 42 Canada Goose nests and one Tundra Swan nest were located during the survey period.

King Eider, Common Eider, Long-tailed Duck and Red-breasted Merganser were all observed within the TRSA during baseline studies, with Long-tailed Duck being the most commonly observed species. Four Long-tailed Duck nests were documented during the study period, all in the interior of the RSA and adjacent to smaller water bodies such as ponds, small lakes, and rivers. Eiders were observed occasionally, although the majority of the eiders documented were King Eider. Four King Eider nests were located over the three-year study period (1 in 2007, and 3 in 2008), of which, three were located at Angajurjualuk Lake, and one approximately 8 km north of the western end of Steensby Inlet. Three Common Eider nests were reported in 2011 by other researchers, all located along the coastline on the north side of Steensby Inlet.

Breeding loons were common in the TRSA, with at least one pair present on most lakes, and a total of 63 nests identified throughout the RSA comprising four species: Red-throated Loon (41), Pacific Loon (10), Yellow-billed Loon (6), and Common Loon (6). Loon nests were scattered throughout the TRSA but were nearly always associated with lake or pond habitats, where the nests were typically found along or near the shoreline and on islands.

A minimum of 130 gull nests were located within the TRSA, along both Milne and Steensby Inlets coastlines and other interior waterbodies. Arctic Terns and jaeger species were observed infrequently during terrestrial surveys; no Arctic Terns nests were located and only two jaeger nests were located, both near Angajurjualuk Lake.

Sandhill Cranes were observed both migrating through and breeding in the TRSA, but were most common south of the Mine Site, particularly between the Mine Site and Angajurjualuk Lake and between Cockburn Lake and Steensby Inlet. Eleven (11) nests were located incidentally during the 2006–2008 survey period and all of these occurred south of the Mine Site.

Raptors — Five species of raptors were observed in the TRSA during field surveys, including cliff-nesting Peregrine Falcons, Rough-legged Hawks, and Gyrfalcons, and ground-nesting Snowy Owls and Short-eared Owls. Across all years, Peregrine Falcon and Rough-legged Hawk were the most commonly observed raptors.

Cliff-nesting raptor surveys documented a total of 43 occupied nesting territories in 2006, 26 in 2007, 113 in 2008, and 139 in 2011 (the number of active nest sites located between years primarily reflects the survey intensity, cumulative nest site knowledge, and increased familiarity with the study area during later years rather than changes in raptor populations across the survey period). Peregrine Falcon and Rough-legged Hawk occupied most of the active nest sites; however, the species balance was variable between years.

The number of occupied Rough-legged Hawk nest sites appeared to vary during the survey period. The number of productive Gyrfalcon nest sites was low throughout the baseline survey (although survey timing may have been too late for some Gyrfalcon — i.e., for nests that failed early in the nesting season).

A few Snowy Owl observations were made in the TRSA in 2006 and 2007; however, no nests were recorded. In contrast, Snowy Owls were observed in great abundance in 2008 with over 400 observations and 64 nests, likely owing to a high lemming population that year. The owl nests were primarily distributed south of the Mine Site and almost exclusively west of the railway. In 2011, on-site researchers found 19 Snowy Owl nests. Three Short-eared Owls were observed in 2007 and 2008, but no nests were found.

Common Raven were observed throughout all survey years, but active nests were only recorded in 2008 (7) and 2011 (2); however, most surveys were conducted too late in the breeding season to successfully locate active Common Raven nests.

Songbirds and Shorebirds — Due to the harsh climates of the eastern Arctic, the diversity of passerines and other terrestrial species that breed in this area is somewhat limited. Two hundred (200) point count and transect plot surveys yielded 485 individual bird observations, comprising seven species of songbirds and shorebirds. In order of abundance, the species observed consisted of: Lapland Longspur (129), Horned Lark (111), Baird's Sandpiper (90), Snow Bunting (87), American Pipit (56), American Golden-plover (11), and Common Ringed Plover (1). An unidentified phalarope species was also noted as an incidental sighting in 2008.

Overall density of songbirds and shorebirds was calculated for the species observed within the RSA during terrestrial surveys, except for Common Ringed Plover, using data collected in the point count and transect plot surveys. Snow Bunting and Lapland Longspur occurred in the highest densities (28 ± 131 and 24 ± 72 birds/km², respectively), while American Golden-plover and American Pipit occurred in the lowest densities (4 ± 43 birds/km² and 11 ± 35 birds/km², respectively). In general, tussock graminoid tundra contained the greatest density of birds, which were predominantly Snow Bunting, Baird's Sandpiper and American Golden-plover, while sparsely vegetated till-colluvium and barren habitats contained the lowest density of birds. However, these density estimates should be interpreted with caution as the survey methods were not initially designed to calculate density and the standard deviations presented are large.

2.5.3.3 Additional Observations

Since the work completed for the FEIS, additional bird observations made within the TRSA during the baseline data collection period have been received by the report authors. These observations were collected in July, August and September 2007 by biologists with LGL Limited as incidental observations while conducting vegetation surveys within the TRSA and while staying at/ferrying to and from the Mary River camp (now the Mine Site) during marine mammal surveys for the Project (Table 3). The observations include several species not previously reported during baseline studies within the TRSA; although due to the timing, some of the additional species observed may have been migrating through the MRSA and TRSA rather than local breeders. Of note, the incidental observations included several observations of species at risk including:

- Peregrine Falcon — observed nesting at a couple of cliff sites near the Mine Site on several occasions in 2007;
- Red Knot — on 3 August 2007, two adults and seven newly fledged young were documented near the sandbar of a river on the west end of Camp Lake (near the Mine Site);
- Red-necked Phalarope — on 28 July 2007, one adult male and two newly-fledged young were observed in a sedge-lined pond approximately 1 km south-southwest of the Mary River camp (now the Mine Site); and on 5 August 2007, three newly-fledged young were seen on a pond southwest of the airstrip;

- Short-eared Owl — Short-eared Owl were observed on three occasions in July/August 2007 and on three occasions in June 2008. No evidence of nesting was observed, and all observations were of a single individual located in the same general area within observation year and may represent repeat sightings of the same bird.

Table 3. Bird Species Documented as Incidental Observations during other Baseline Studies in the TRSA, 2007[1].

Common Name	Latin Name	2007	Common Name	Latin Name	2007
Snow Goose	*Chen caerulescens*	S	Purple Sandpiper	*Calidris maritima*	B
Brant	*Branta bernicla*	S	Red Knot	*Calidris canutus*	B
Canada/Cackling Goose	*Branta sp.*	S	Sanderling	*Calidris alba*	S
Tundra Swan	*Cygnus columbianus*	S	Pectoral Sandpiper	*Calidris melantos*	B
King Eider	*Somateria spectabilis*	S	White-rumped Sandpiper	*Calidris fuscicollis*	B
Common Eider	*Somateria mollissima*	S	Baird's Sandpiper	*Calidris bairdii*	B
Long-tailed Duck	*Clangula hyemalis*	B	Red Phalarope	*Phalaropus fulicaria*	B
Red-breasted Merganser	*Mergus serrator*	S	Red-necked Phalarope	*Phalaropus lobatus*	B
Rock Ptarmigan	*Lagopus mutus*	B	Glaucous Gull	*Larus hyperboreus*	S
Red-throated Loon	*Gavia stellata*	B	Arctic Tern	*Sterna paradisaea*	S
Pacific Loon	*Gavia pacifica*	B	Long-tailed Jaeger	*Stercorarius longicaudus*	S
Common Loon	*Gavia immer*	S	Pomarine Jaeger	*Stercorarius pomarinus*	S
Yellow-billed Loon	*Gavia adamsii*	B	Snowy Owl	*Bubo scandiacus*	S
Rough-legged Hawk	*Buteo lagopus*	B	Short-eared Owl	*Asio flammeus*	S
Gyrfalcon	*Falco rusticolus*	S	Common Raven	*Corvus corax*	S
Peregrine Falcon	*Falco peregrinus tundris*	B	Horned Lark	*Eremophila alpestris*	S
Sandhill Crane	*Grus canadensis*	B	Northern Wheatear	*Oenanthe oenanthe*	B
Black-bellied Plover	*Pluvialis squatarola*	B	American Pipit	*Anthus rubescens*	B
American Golden-Plover	*Pluvialis dominica*	B	Lapland Longspur	*Calcarius lapponicus*	B
Common Ringed Plover	*Charadrius hiaticula*	B	Snow Bunting	*Plectrophenax nivalis*	B
Ruddy Turnstone	*Arenaria interpres*	B	Hoary Redpoll	*Carduelis hornemanni*	S

Symbology: B = Confirmed Breeding; S = Confirmed Present; U = unconfirmed observation

[1] Source: (Renaud 2007)

2.5.4 MARINE BIRD FIELD STUDIES

The purpose of the marine baseline surveys was to confirm the presence/absence and habitat use of birds within the MRSA during the spring migration, breeding, and fall migration seasons. The methods and results of the marine field studies are summarized in the sections below. For detailed methodology and survey results, refer to the Bird Baseline Report, Appendix 6E, FEIS (EDI Environmental Dynamics Inc. 2011).

2.5.4.1 Marine Bird Survey Methods

Marine bird field studies consisted of systematic aerial transect surveys using both helicopter and fixed-wing aircraft (ground-based surveys of marine habitats along Steensby Inlet and Milne Inlet were completed as part of the terrestrial studies discussed above). The focus of the marine field studies was waterfowl, gulls, and other seabirds. Only two species of shorebirds were surveyed in the marine study (Red-necked Phalarope and Red Phalarope) as all other shorebird species were covered in the terrestrial bird studies.

Thirteen (13) helicopter surveys were conducted (4 in 2006, 4 in 2007, and 5 in 2008). In each survey, approximately 60 km of coastline was surveyed in Milne Inlet, 180 km in Eclipse Sound, and 130 km in Steensby Inlet, for a total coverage area of 24 km^2, 72 km^2, and 52 km^2, respectively (based on a transect width of 400 m).

Additional marine bird data were collected opportunistically by LGL Ltd. and North/South Consultants Inc. while conducting marine mammal surveys within the Project area (North/South Consultants Inc. 2010). A total of 63 fixed-wing surveys were conducted (1 in 2006, 19 in 2007, and 43 in 2008) around Steensby Inlet, Milne Inlet, Eclipse Sound, Foxe Basin, and Hudson Strait.

2.5.4.2 Marine Survey Results

The marine field surveys completed in the MRSA documented 35 species of marine-associated birds (Table 4), including two species at risk, Ivory Gull and Ross's Gull. Sixteen of the marine species detected were confirmed to breed within or immediately adjacent to the survey area. Also reported incidentally was Red-necked Phalarope in Steensby Inlet in 2007 and 2008, and a group of three Harlequin Ducks in Hudson Strait on April 28, 2008; both of which are listed as species at risk.

Table 4. Marine-associated Bird Species Observed in the RSA by Area (North – Milne Inlet / Eclipse Sound; South – Steensby Inlet / Foxe Basin / Hudson Strait), 2006-2008

Species	2006		2007		2008	
	North	South	North	South	North	South
Greater White-fronted Goose						S
Snow Goose (Lesser + Greater)	S	S	B	B	B	B
Ross's Goose						B
Canada Goose		S	S	B		B
Brant			S	S	S	B
Tundra Swan			B		B	B
King Eider	B	S	S	S		S
Common Eider			S	S	S	S
Black Scoter						S
Long-tailed Duck	S	S	S	S	S	B
Red-breasted Merganser		S		S	S	S
Red-throated Loon	S	S		B		B
Pacific Loon		B	S	S	S	B
Common Loon					S	B
Yellow-billed Loon			B	B	S	B
Northern Gannet			S			
Northern Fulmar	S		S		S	S
Red Phalarope						S
Ross's Gull						S
Herring Gull						B
Glaucous Gull			S	B	B	B
Iceland Gull			S		S	S
Thayer's Gull			S	S	S	S
Lesser Black-backed Gull						S
Great Black-backed Gull			S		S	S
Black-legged Kittiwake			S		S	S
Sabine's Gull					S	B
Ivory Gull			S		S	S
Arctic Tern			S	S	S	S
Pomarine Jaeger						S
Parasitic Jaeger			S		S	S
Long-tailed Jaeger			S			S
Dovekie			S		S	S
Thick-billed Murre			B		B	B
Black Guillemot			S		S	B

Symbology: B = Confirmed Breeding; S = Confirmed Present; U = unconfirmed observation

Marine surveys focussed on six main survey areas within the MRSA: Milne Inlet and Eclipse Sound along the northern shipping route, and Steensby Inlet, West Foxe Basin, East Foxe Basin, and Hudson Strait along the southern shipping route. Of these, Foxe Basin had the highest species diversity, while Steensby Inlet had the second highest despite being the second smallest of the six areas. Milne Inlet (the smallest survey area) and Eclipse Sound had the lowest species diversity. Similarly, Foxe Basin and Steensby Inlet had the highest marine bird densities, while Eclipse Sound and Hudson Strait contained the lowest bird densities during marine surveys. The overall density of marine birds (number of individuals per 100 km^2, for all species combined) in the MRSA was 43.7 birds per 100 km^2. Species diversity and average density for each of the survey areas was as follows:

- Milne Inlet: 20 species recorded; average density was 30.5 birds/100 km^2;
- Eclipse Sound: 20 species recorded, average density was 17.2 birds/100 km^2
- Steensby Inlet: 26 species recorded, average density was 47.3 birds/100 km^2
- Foxe Basin was only surveyed in 2007 and 2008, but had a total of 28 species recorded; average density was 73.9 birds/100 km^2:
    - West Foxe Basin: 27 species recorded; average density was 26.7 birds/100 km^2
    - East Foxe Basin: 22 species recorded; average density was 121.1 birds/100 km^2
- Hudson Strait was only surveyed in 2008 and 21 species were recorded; average density was 19.5 birds/100 km^2

Seasonal densities were highest in June and August due to large groups of Snow Geese migrating from Bylot Island just north of the RSA. Large groups of migrating Common and King Eiders and Long-tailed Ducks were also seen throughout the area in August. The five most abundant species (highest average densities across all surveys and all three years) were, in descending order: Snow Geese, eiders (Common and King Eiders combined as they were often difficult to distinguish during fixed-wing surveys), Brant, Arctic Terns and Long-tailed Ducks. Most of these species used the marine coastal waters of Steensby Inlet as staging grounds during their spring and fall migrations and dozens of eiders used these coastal waters to raise their young.

No large, conspicuous seabird nesting colonies were recorded in this study although several are known to exist along the edges of the MRSA, particularly on Bylot Island, in Foxe Basin, and along Hudson Strait (surveys were designed primarily for marine mammals; therefore, shoreline areas were not intensively surveyed). The surveys did record several seabird species including Dovekie, Thick-billed Murre, Black Guillemot, and Northern Fulmar. These species were observed throughout the MRSA but were most common along the northern shipping route (in Milne Inlet and Eclipse Sound) and along Hudson Strait. Thick-billed Murre were observed numerous times during marine surveys, particularly in Hudson Strait (over 2000 observations just in 2008), but also in Eclipse Sound and Navy Board Inlet in the north of the MRSA.

Numerous species of geese, swans, loons, mergansers, eiders and sea ducks were documented migrating through and breeding in the RSA. Snow Geese, Common and King Eiders, Brant, and Long-tailed Ducks were some of the most abundant species detected during the marine surveys. Additional species observed included Greater White-fronted Goose, Ross's Goose, Canada Goose, Tundra Swan, Black Scoter, Red-breasted Merganser, Red-throated Loon, Pacific Loon, Common Loon, and Yellow-billed Loon. Greater

White-fronted Goose and Black Scoter were both only observed once in Foxe Basin and Hudson Strait respectively, Ross's Geese were detected several times, but only in Foxe Basin and Steensby Inlet. The remaining species were found in generally low densities throughout the MRSA. The 2008 marine surveys located a Snow Goose nesting colony of more than 5000 individuals along the southwestern shore of Steensby Inlet, outside of the TRSA. The colony is located over approximately 26 kilometres of shoreline; it is unknown how far the colony extends inland.

2.6 PROJECT MONITORING DATA

Since the submission of the FEIS, additional bird studies have been conducted in the Project area. These studies are the result of Project Commitments made during the review process for the FEIS and the ERP, and Project Conditions under NIRB Project Certificate #005. Among other broader Project Commitments and Conditions, and Project Commitments and Conditions relating to the mitigation of Project effects, Project Commitments and Conditions specific to additional baseline data collection and/or monitoring for birds include:

- Project Commitment #75 — "*Baffinland is committed to monitoring relevant sections of the project area for nesting and migration activities, noting both areas and patterns, for falcons, eiders, Red Knots, sea birds, song birds and shore birds*" (commitment made July 19, 2012);
- Project Commitment #76 — "*Baffinland is committed to carrying out monitoring over the next few years to look at other types of birds not considered during other research for the Mary River Project*" (commitment made to the Hall Beach HTO, July 19, 2012);
- PC Condition # 74 — "*The Proponent shall continue to develop and update relevant monitoring and management plans for migratory birds under the Proponent's Environmental Management System, Terrestrial Environment Mitigation and Monitoring Plan prior to construction. The key indicators for follow up monitoring under this plan will include: peregrine falcon, gyrfalcon, common and king eider, red knot, seabird migration and wintering, and songbird and shorebird diversity.*"

Post-FEIS bird surveys were completed from 2012 to 2016 (Table 5). Project construction began in 2013; however, activity was limited until the first sealift arrived in Milne Port in August 2013, while mining did not commence until September 2014. Therefore, some of the post-FEIS studies are considered ongoing baseline (depending on the timing and location of the studies), while others are considered Project monitoring. Additionally, since 2012, Baffinland has supported research projects relating to raptors and marine birds within the Project region, with that work being conducted by Arctic Raptors Inc. and Environment and Climate Change Canada, respectively.

This section summarizes those bird studies conducted 2012–2016 that represent ongoing baseline data collection, and research programs completed within the RSAs. Information related to the monitoring of Project-related effects on birds is generally not included, except where the data collected contributes to a broader understanding of the bird species present and/or habitat use by those species within the RSAs. For more information on Project effects monitoring and the results of those studies refer to the relevant Annual

Monitoring Reports (EDI Environmental Dynamics Inc. (EDI) 2013, 2014, 2015, 2016). A complete list of bird species observed during pre- and post-FEIS surveys is presented in (Table 6).

Table 5. Bird Studies Conducted in the Terrestrial (TRSA) and Marine Regional Study Areas (MRSA) from 2012 to 2016 (includes both studies directly for the Mary River Project and research supported by Baffinland)

Survey/Study (Location)	Year	Baseline or Project Monitoring	Survey Description
Shoreline surveys (TRSA/MRSA)	2012–2013	Baseline	Shoreline surveys (nest searches) were conducted along Steensby (Southern Route) and Milne Inlet (Northern Route) to identify nesting shorebirds and waterfowl that could be at risk from Project activities, including wake from Project shipping. Surveys were completed prior to the commencement of Project shipping.
PRISM Surveys (TRSA)	2012–2013	Primarily Baseline	PRISM surveys were conducted to collect additional data on terrestrial nesting birds (particularly shorebirds and songbirds) within the TRSA, and to investigate the possibility of using the PRISM survey for monitoring Project effects. Surveys were conducted June/July 2012 and 2013 prior to most construction activity.
Bird Encounter Transects (TRSA)	2013	Primarily Baseline	Encounter transects were developed to investigate the potential for monitoring Project effects on shorebirds and songbirds. Surveys were conducted in June/July 2013, prior to most construction activity, and were intended as baseline with which to compare subsequent monitoring.
Raptor Nest Occupancy and Productivity Surveys (TRSA)	2012–2016	Baseline and Project Monitoring	Surveys to locate cliff-nesting raptor nests and document occupancy and reproductive success were conducted as a continuation of studies initiated during the pre-FEIS period. Survey results were analysed to assess the effect of distance from project footprint on reproductive parameters.
Roadside Waterfowl Surveys (TRSA)	2012–2014	Primarily Baseline	Roadside surveys for waterfowl populations along the Tote Road were conducted in July of each year. Surveys in 2012 and 2013 occurred prior to most construction activity; all surveys occurred prior to the start of mine operations.
Staging Surveys for Marine-Associated Birds (MRSA)	2015	Baseline and Project Monitoring	Surveys for staging waterfowl, waterbirds, and seabirds in Milne Inlet (Northern Route) were conducted in June 2015 prior to the beginning of the 2015 shipping season.
Red Knot Surveys (TRSA)	2014	Baseline and Project Monitoring	Surveys to locate Red Knot, a Species at Risk, were conducted in the Milne Port area in June and July 2014.
Pre-clearing Nest Surveys (TRSA)	2013–2016	Project Monitoring	Nest searches were conducted prior to clearing and construction activities. Active nests identified within the search area were assigned a no-disturbance buffer and protected until fledging occurred.
Raptor Nest Site Monitoring (TRSA)	2013	Project Monitoring	Site specific monitoring, including remote camera monitoring and behavioural monitoring, was conducted at an active Peregrine Falcon nest located near construction activities that could not be postponed until after the nesting season. One chick was successfully fledged from the nest and monitoring documented similar nesting activity between the monitored nest and a control (reference) nest site.

Table 5. Bird Studies Conducted in the Terrestrial (TRSA) and Marine Regional Study Areas (MRSA) from 2012 to 2016 (includes both studies directly for the Mary River Project and research supported by Baffinland)

Survey/Study (Location)	Year	Baseline or Project Monitoring	Survey Description
Communication Tower Surveys (TRSA)	2014–2015	Project Monitoring	Surveys were conducted around the base of communications towers along the Tote Road to investigate whether the towers were contributing to bird mortality. Several surveys were conducted, and no mortalities were observed.
Helicopter Flight Height Analysis (TRSA)	2015–2016	Project Monitoring	Helicopter flight tracks were collected and analysed in relation to height above ground and distance from areas identified as having significant importance to birds or other wildlife (e.g. the Snow Goose moulting area identified by Environment Canada).
Marine Habitat Use of Thick-billed Murre (MRSA)	2012–2016	Baseline and Project Monitoring	Studies were conducted by Environment and Climate Change Canada (supported in part by Baffinland) are ongoing at the Cape Graham Moore (Northern Route) and Digges Sound (Southern Route) seabird colonies to assess the population abundance and foraging distribution patterns of Thick-billed Murre. These studies also assessed how foraging behaviour and movements influence the physiology and energy budgets of Thick-billed Murre as well as monitored the levels and effects of contaminants.
East Bay Island Migratory Bird Research (MRSA)	2012–2016	Baseline	Studies conducted by Environment and Climate Change Canada (supported in part by Baffinland) are ongoing at East Bay Island (Southern Route) to assess the ecological importance of sea ice in determining habitat use by Common Eider and to identify key marine habitat sites.
Hudson Strait Common Eider and Polar Bear Surveys (MRSA)	2014–2016	Baseline	Common Eider and Polar Bear surveys were conducted by Environment and Climate Change Canada (supported in part by Baffinland) to quantify the distribution and abundance of Common Eider and Polar Bears in northern Hudson Strait (Southern Route) as well as the biological and physiological factors determining those patterns.
Inuit Qaujimajatuqangit (Traditional Knowledge	2015–2017	Baseline and Project Monitoring	Traditional knowledge on bird species, land use, and species important for harvest was gathered at multiple workshops and meetings held in Pond Inlet and Arctic Bay in 2015-2016.
Habitat Suitability Modeling	2017	Project Monitoring	Habitat suitability and population density models developed in 2012 were updated for the Phase 2 Proposal assessment with new data and variables and new models were developed for Red-necked Phalarope and Red Knot.

Table 6. Bird species observed within the Mary River Project TRSA and MRSA, 2006–2016

Species	Latin	TRSA[1]	MRSA: Northern Route[2]	MRSA: Southern Route[2]
Greater White-fronted Goose	*Anser albifrons*			S
Snow Goose	*Chen caerulescens*	B	B	B
Ross's Goose	*Chen rossii*			B
Brant	*Branta bernicla*	S	S	B
Cackling Goose	*Branta hutchinsii*	B		
Canada Goose	*Branta canadensis*	B		
Canada/Cackling Goose	*Branta spp.*	B		B
Tundra Swan	*Cygnus columbianus*	B	B	B
King Eider	*Somateria spectabilis*	B	B	S
Common Eider	*Somateria mollissima*	S	S	S
Harlequin Duck	*Histrionicus histrionicus*			S
Black Scoter	*Melanitta americana*			S
Long-tailed Duck	*Clangula hyemalis*	B	S	B
Red-breasted Merganser	*Mergus serrator*	B	S	S
Rock Ptarmigan	*Lagopus muta*	B		
Red-throated Loon	*Gavia stellata*	B	S	B
Pacific Loon	*Gavia pacifica*	B	S	B
Common Loon	*Gavia immer*	B	S	B
Yellow-billed Loon	*Gavia adamsii*	B	B	B
Northern Fulmar	*Fulmarus glacialis*	S	S	S
Rough-legged Hawk	*Buteo lagopus*	B	n/a	n/a
Gyrfalcon	*Falco rusticolus*	B	n/a	n/a
Peregrine Falcon	*Falco peregrinus tundris*	B	n/a	n/a
Sandhill Crane	*Grus canadensis*	B	n/a	n/a
Black-bellied Plover	*Pluvialis squatarola*	B	n/a	n/a
American Golden-Plover	*Pluvialis dominica*	B	n/a	n/a
Common Ringed Plover	*Charadrius hiaticula*	B	n/a	n/a
Semipalmated Plover	*Charadrius semipalmatus*	B	n/a	n/a
Ruddy Turnstone	*Arenaria interpres*	B	n/a	n/a
Red Knot	*Calidris canutus*	B	n/a	n/a
Sanderling	*Calidris alba*	B	n/a	n/a
White-rumped Sandpiper	*Calidris fuscicollis*	B	n/a	n/a
Baird's Sandpiper	*Calidris bairdii*	B	n/a	n/a
Pectoral Sandpiper	*Calidris melanotos*	B	n/a	n/a
Purple Sandpiper	*Calidris maritima*	B	n/a	n/a
Dunlin	*Calidris alpina*	S	n/a	n/a
Red-necked Phalarope	*Phalaropus lobatus*	B		
Red Phalarope	*Phalaropus fulicarius*	B		S
Black-legged Kittiwake	*Rissa tridactyla*		S	S

Table 6. Bird species observed within the Mary River Project TRSA and MRSA, 2006–2016

Species	Latin	TRSA[1]	MRSA: Northern Route[2]	MRSA: Southern Route[2]
Ivory Gull	*Pagophila eburnea*		S	S
Sabine's Gull	*Xema sabini*		S	B
Ross's Gull	*Rhodostethia rosea*			S
Herring Gull	*Larus argentatus*	B		B
Thayer's Gull	*Larus thayeri*	B	B	S
Iceland Gull	*Larus glaucoides*		S	S
Lesser Black-backed Gull	*Larus fuscus*			S
Great Black-backed Gull	*Larus marinus*		S	S
Glaucous Gull	*Larus hyperboreus*	B	B	B
Arctic Tern	*Sterna paradisaea*	S	S	S
Pomarine Jaeger	*Stercorarius pomarinus*	S[3]		S
Parasitic Jaeger	*Stercorarius parasiticus*		S	S
Long-tailed Jaeger	*Stercorarius longicaudus*	S[3]		S
Dovekie	*Alle alle*		S	S
Thick-billed Murre	*Uria lomvia*		B	B
Black Guillemot	*Cepphus grille*		S	B
Snowy Owl	*Bubo scandiacus*	B	n/a	n/a
Short-eared Owl	*Asio flammeus*	S	n/a	n/a
Common Raven	*Corvus corax*	B	n/a	n/a
Horned Lark	*Eremophila alpestris*	B	n/a	n/a
Northern Wheatear	*Oenanthe oenanthe*	B	n/a	n/a
American Pipit	*Anthus rubescens*	B	n/a	n/a
Lapland Longspur	*Calcarius lapponicus*	B	n/a	n/a
Snow Bunting	*Plectrophenax nivalis*	B	n/a	n/a
Common Redpoll	*Carduelis flammea*	S	n/a	n/a
Hoary Redpoll	*Carduelis hornemanni*	S	n/a	n/a

Symbology: B = Confirmed Breeding; S = Confirmed Present

[1] Includes species documented within the TRSA from 2006-2016 during pre and post-FEIS Project surveys as well as those reported as incidental observations by other Project biologists

[2] Includes species documented within the MRSAs from 2006-2016 during Project surveys. Does not include species documented during seabird research by other organizations. Species included were limited to marine-associated species; terrestrial species (e.g. raptors, songbirds, shorebirds) observed during marine surveys were not included in the species list for the MRSA.

[3] Unspecified jaeger species confirmed nesting in the TRSA in 2008

2.6.1 KEY REFERENCE DOCUMENTS

The following reports provide the results of bird studies and monitoring programs completed for the Project:

- 2012 Annual Terrestrial Monitoring Report (EDI 2013)
- 2013 Terrestrial Environment Annual Monitoring Report (EDI 2014)
- 2014 Terrestrial Environment Annual Monitoring Report (EDI 2015)
- 2015 Terrestrial Environment Annual Monitoring Report (EDI 2016)
- 2016 Terrestrial Environment Annual Monitoring Report (EDI 2017)

2.6.2 WATERFOWL (WITHIN THE TRSA)

Information on waterfowl (e.g. geese and ducks), loon and gull species within the TRSA was collected during roadside waterfowl surveys conducted along the Tote Road in 2012, 2013 and 2014. These surveys generally represent baseline conditions, although during the 2013 and 2014 surveys some construction-related traffic was present along the Tote Road.

2.6.2.1 Roadside Waterfowl Surveys

The roadside waterfowl surveys were initiated in 2012 as a trial program to look at the feasibility of developing an annual roadside survey to monitor waterfowl populations within the TRSA. Based on the success of the 2012 survey, the survey was expanded in 2013 to include all suitable waterfowl habitat viewable from the Tote Road.

The one-day waterfowl survey along the Tote Road provided valuable information on the waterfowl and other waterbird species present between the Mine Site and Milne Inlet by documenting the number of birds observed in lakes and wetlands adjacent to the road. The survey followed established methodology conducted in British Columbia and Yukon (e.g. Hawkings and Hughes 1999).

Surveys were to be conducted within the first two weeks of July, and ideally as close to 07 July as possible to ensure consistency between survey years and to ensure that breeding waterfowl had not yet left the region.

Methods

The preliminary 2012 survey was conducted on 9 July and looked at a total of 43 survey sites. The 2013 survey was carried out on 2 July and surveyed 64 sites (EDI Environmental Dynamics Inc. (EDI) 2015). The 2014 roadside waterfowl survey was completed on 15 July and surveyed 60 of the 64 sites surveyed in 2013 because four of the waterbodies previously surveyed no longer existed due to project construction and changes in the roadway.

The roadside waterfowl surveys were conducted in crews of two or three, including at least one qualified ornithologist. The surveyors drove the road between Milne Port and Mary River stopping at survey sites where waterfowl habitat (i.e. lakes, ponds, wetlands etc.) could be viewed from the road. At each site, the surveyors scanned waterbodies using binoculars for a few minutes to record all species present. The surveyor also recorded whether any individuals were incubating a nest or if young were present. GPS location and photos of each survey site were taken in 2013.

Results and Discussion

The 2012 roadside waterfowl survey observed a total of 67 birds, including 4 geese, 11 ducks, 17 loons and 35 gulls (Table 7). The 2013 survey found a total of 97 birds including 41 geese, 14 ducks, 19 loons and 23 gulls (Table 8). The 2014 roadside waterfowl survey recorded a total of 276 birds, including 230 geese, 7 ducks, 11 loons, and 28 gulls (Table 9).

Across all years, nine different species were observed including Snow Goose, Canada Goose, Cackling Goose, Long-tailed Duck, Red-breasted Merganser, Red-throated Loon, Common Loon, Yellow-billed Loon, and Glaucous Gull. Glaucous Gull was the most common species observed in 2012 and was one of the most commonly detected species in 2013 and 2014. The most common species observed in 2013 and 2014 were Canada/Cackling Goose and Snow Goose respectively. Of note, the surveys documented a nesting colony of Glaucous Gulls near km 26 — 9 nests and 22 adults were observed at the colony in 2012, 14 adults in 2013, and 11 suspected nests and 11 adults were observed in 2014. Additionally, nests of Canada/Cackling Goose, Red-throated Loon, Common Loon, and Yellow-billed Loon were observed during the surveys.

Due to differences in the number of survey sites, the 2012 survey results are not directly comparable to 2013 and 2014. However, comparison of the 2013 and 2014 roadside waterfowl survey results show a significantly higher number of birds in 2014 (97 birds in 2013 versus 276 birds in 2014). The main difference between the years was the number of Snow Geese observed — only 3 adult snow geese were observed in 2013 while a total of 221 snow geese including 58 juveniles were seen in 2014. This difference was likely a factor of survey timing (2 July 2013 as compared to 15 July 2014), although annual differences in species distribution may also have contributed. Other than the Snow Geese, the 2013 and 2014 survey results are relatively similar, although the 2013 survey found slightly higher numbers of Canada/Cackling Goose, Long-tailed Duck and Yellow-billed Loon.

Table 7. Waterfowl, loon and gull species observed at roadside waterfowl survey sites within the Project study area, 9 July 2012 (N=43 survey sites)

Species[1]	Observed Birds[2]					
	Males	Females	Unknown Sex	Pairs	Nests	Total Birds
Snow Goose			4			4
Long-tailed Duck	4	7				11
Red-throated Loon			1	4		9
Common Loon			2			2
Yellow-billed Loon			2	2		6
Glaucous Gull[3]			17		9	35
Total:	4	7	44	6	9	67

[1] Incidental bird species observed at survey sites include American Golden-plover (1), American Pipit (3), Baird's Sandpiper (5), Horned Lark (4), Lapland Longspur (10), Peregrine Falcon (3), Redpoll Species (9), Rough-legged Hawk (3), Snow Bunting (12), and Snowy Owl (7).

[2] Birds are only recorded once and are noted in the category denoting the highest level of breeding evidence – e.g. a pair of birds is recorded as 1 pair, and not included in the # of males and # of females. Those species for which sex cannot be determined (e.g. geese, loons) were assumed to be a pair when two adults were together on a waterbody.

[3] Glaucous gull colony on island at km 26.5 – 9 nests, 22 adults

Table 8. Waterfowl, loon and gull species observed at roadside waterfowl survey sites within the Project study area, 2 July, 2013 (N=63 survey sites)

Species[1]	Observed Birds[2]					
	Males	Females	Unknown Sex	Pairs	Nests	Total Birds
Snow Goose			3			3
Canada/ Cackling Goose			30	3	1	38
Long-tailed Duck	9	2	1			12
Red-breasted Merganser	1	1				2
Red-throated Loon			3	2	1	9
Common Loon					1	2
Yellow-billed Loon			4	2		8
Glaucous Gull[3]			23			23
Total:	10	3	64	8	3	97

[1] Incidental bird species observed at survey sites include American Pipit (2), Baird's Sandpiper (2), Lapland Longspur (6), Sandhill Crane (1), and Snow Bunting (2).

[2] Birds are only recorded once and are noted in the category denoting the highest level of breeding evidence — e.g. a pair of birds is recorded as 1 pair, and not included in the # of males and # of females. Those species for which sex cannot be determined (e.g. geese, loons) were assumed to be a pair when two adults were together on a waterbody.

[3] Glaucous gull colony on island at km 26.5 — 14 adults

Table 9. Waterfowl, loon and gull species observed at roadside waterfowl survey sites between the Mine Site and Milne Inlet, 15 July 2014 (N=60 survey sites)

Species[1]	Observed Birds[2]						
	Males	Females	Unknown Sex	Pairs	Nests	Juveniles	Total Birds
Snow Goose	-	-	3	80	-	58	221
Canada Goose	-	-	1	3	-	-	7
Cackling Goose	-	-	-	1	-	-	2
Long-tailed Duck	-	7	-	-	-	-	7
Red-throated Loon	-	-	3	2	-	-	7
Common Loon	-	-	-	1	-	-	2
Yellow-billed Loon	-	-	2	-	2	-	2
Glaucous Gull[3]	-	-	28	-	11	-	28
Total:	-	7	37	87	13	58	276

[1] Incidental bird species observed at survey sites include Snowy Owl (13 individuals), Snow Bunting (1 male and 1 unknown sex), Horned Lark (2 unknown sex and 1 juvenile), and Lapland Longspur (8 unknown sex, 1 pair, and 1 male).

[2] Birds are only recorded once and are noted in the category denoting the highest level of breeding evidence – e.g. a pair of birds is recorded as 1 pair, and not included in the # of males and # of females. Those species for which sex cannot be determined (e.g. geese, loons) were assumed to be a pair when two adults were together on a waterbody.

[3] Glaucous gull colony on island at km 26.5 — 11 nests, 11 adults each sitting on a suspected nest.

2.6.3 RAPTORS

Studies on cliff-nesting raptors within the TRSA were initiated during pre-FEIS data collection and continued in the post-FEIS period. As such, the data set includes both baseline conditions and information relating to Project effects monitoring. However, many of the nest sites surveyed are well-outside the area within which Project effects may be expected to occur. Raptor studies were focussed on occupancy and productivity surveys within the TRSA (refer to Section 2.6.3.1); however, additional studies looking at site-specific monitoring of nests in close proximity to Project construction were also conducted (the results of site-specific monitoring are not reported here but are available in the 2013 Annual Monitoring Report; (EDI 2014).

2.6.3.1 Raptor Occupancy and Productivity Surveys

Arctic Raptors Inc. (ARInc) personnel contributed to monitoring of raptors from 2011 through 2016 as part of the Baffinland terrestrial baseline surveys and terrestrial monitoring efforts led by EDI. ARInc. were initially tasked with conducting extensive surveys of cliff nesting raptors to substantiate and undertake quality control of monitoring data that had been collected by Knight Piésold from 2006 – 2008. In 2014, ARInc. was subsequently tasked to provide a monitoring design program that could differentiate natural variation from project-caused variation using appropriate demographic indicators for cliff nesting raptors.

From 2011 to 2014, the focus of field work was:

- Confirming sites identified during baseline surveys (2006–2008);
- Locating additional cliff nests within the TRSA; and
- Documenting annual occupancy of known nest sites by cliff-nesting raptors.

These surveys were extensive and necessary to establish regional-level baseline parameters of distribution and demography. In 2015, monitoring efforts shifted to focusing on measuring suitable demographic indicators at nest sites located within 10 km of active development in the northern section of the TRSA (i.e., the Mine Site, Tote Road, and Milne Port) to monitor and distinguish natural variability from project-related effects. For 2015 and 2016, the focus of the field work was:

- Locating additional cliff nests within 10 km of the active disturbance, focussing on locating a sufficient number of nests at various distances from the disturbance to facilitate analysis of Project effects; and
- Documenting annual occupancy and productivity of nest sites within 10 km of active disturbance.

Methods

Each year, a field crew dedicated to monitoring raptor species surveyed known nest sites and suitable nesting habitat by helicopter, boat, or on foot to determine the presence or absence of territorial pairs. In all years, surveys were conducted in June, with surveys extending in July and August in some years. The level of survey effort and the spatial extent of the surveys varied somewhat across the years depending on the focus of the fieldwork and available resources. In 2015 and 2016, the spatial extent of surveys was restricted areas to within 10 km of active development to facilitate monitoring of Project-related effects. Surveyed sites were visited at least once through the summer. An active nest located more than 100 metres away from an established location from previous years was a new breeding site.

Occupancy — Sites were considered occupied if one or more adults displayed territorial (e.g. vocalization and/or flight behavior associated with defense of breeding territory) or nest building behavior. The number of eggs and/or nestlings was recorded by binoculars from the helicopter at the time that each nesting territory was visited. Locations that exhibited limited nest building (e.g. few new nest materials) or old nests without presence of breeding aged adults were not considered occupied. In addition, sites that were missed in June, but discovered with eggs or nestlings later in the breeding season were also considered occupied. This approach has the potential to underestimate overall occupancy as breeding pairs that are missed in June and abandon early in the breeding season can be missed entirely.

Site occupancy is generally defined as the proportion of known breeding locations occupied by pairs per year. For this report, occupancy was calculated as follows:

$$\text{Occupancy} = N_{\text{Occ}} / N_{\text{Checked}}$$

where N_{Occ} is equal to the count of occupied sites and N_{Checked} is equal to the count of visited sites.

Reproductive Success — Clutch size and brood size were recorded at the time that each site was visited. Counts of eggs laid and eggs hatched were calculated as follows:

$$\text{Eggs laid per occupied site} = N_{Laid} / N_{TotalSitesOccupied}$$

$$\text{Eggs hatched per occupied site} = N_{Hatch} / N_{TotalSitesOccupied}$$

Productivity — In most years, nesting territories found occupied during the occupancy surveys were revisited in early August, when nestlings are expected to range between 15 and 25 days of age and are conspicuous. For nesting territories that were still active, the number of nestlings was recorded. Mean brood size of assumed fledging (or Productivity) was calculated as:

$$\text{Mean brood size of assumed fledging} = N_{Chicks} / N_{SitesOccupied}$$

where N_{Chicks} is equal to the total count of chicks observed in the productivity (i.e., summer) survey and $N_{SitesOccupied}$ is equal to the count of sites occupied in the productivity survey. This approach, however, does not address nest sites that were attempted but failed as they are often missed (not counted) during the survey due to limited time on site. August occupancy was used because many known sites are unoccupied in the spring occupancy survey but are occupied during the summer survey.

Nest Success — Precise determination of the number of young in a nest with certainty is difficult when counting young from a helicopter. Therefore, nest success can also be an informative index of breeding performance. Nest success was estimated from the proportion of occupied territories among monitored sites in which at least one nestling was counted. Nest success was calculated as:

$$\text{Nest Success} = N_{NestingTerritoriesChicks} / N_{NestingTerritoriessOccupied}$$

where, $N_{NestingTerritoriesChicks}$ is equal to the count of visited nesting territories where at least one nestling was present and $N_{NestingTerritoriesOccupied}$ is equal to the total count of occupied nesting territories.

Results and Discussion

Nesting Territories — Since 2006, a total of 413 unique raptor sites have been documented in the Project RSA extending from Milne Inlet in the north to Steensby Inlet in the south (Map 4). It is not possible to accurately identify alternate nest sites in an unmarked population such as the one surveyed within the TRSA; therefore, no attempt has been made to group nest sites into nesting territories. The 413 raptor nest sites identified are not believed to represent the total number of nesting sites within the TRSA but are concentrated in areas where surveys have focussed to date. Additional habitats outside of this area remain largely un-surveyed but are expected to contain similar densities of nest sites.

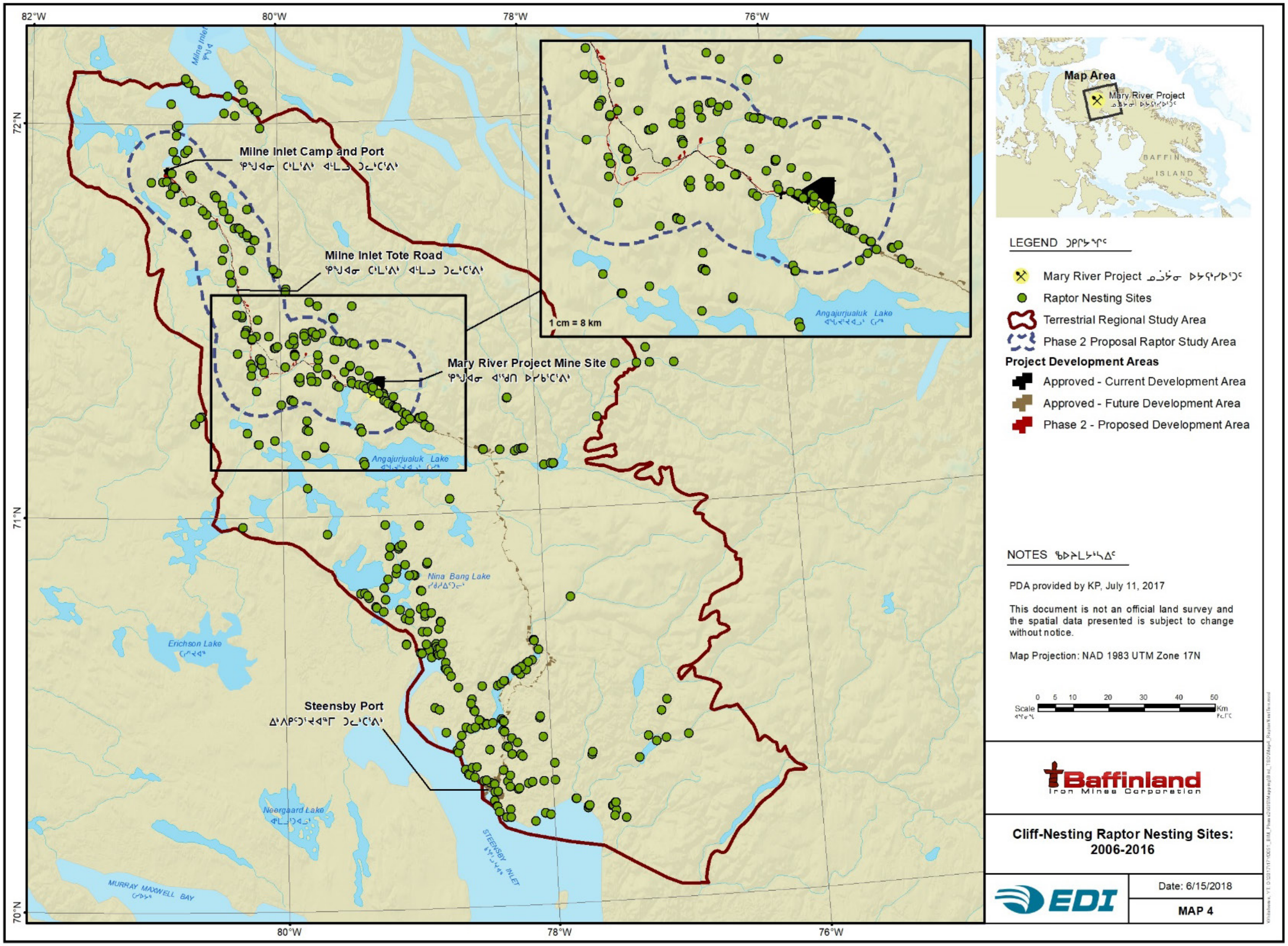
Occupancy — Across all years, Peregrine Falcon and Rough-legged Hawk were the most commonly observed species occupying cliff nest sites. Gyrfalcon were observed in all years but were less common. From 2011 to 2016, 17 of 413 nest sites (4%) were occupied at least once by gyrfalcons (the total number of sites occupied by Gyrfalcon ranged from one to seven in a given year). However, the breeding phenology of this resident species is much earlier than that of the Peregrine Falcon and Rough-legged Hawk; thus, the timing of the annual surveys was likely too late for Gyrfalcon, contributing to the low occupancy rates that were recorded (i.e. nests that were occupied at the start of the season, but failed early in the breeding season would be recorded as absent). Other species that were documented using cliff nest sites included Common Raven, Snowy Owl and Glaucous Gull.

Analysis of nest site occupancy from 2011 to 2016 showed considerable variability among species and years. There has been no significant decline (P>0.10) in occupancy for Peregrine Falcons or Rough-legged Hawks from 2011 to 2016; however, occupancy has been highly variable. A decrease in site occupancy was noted in 2013, almost entirely due to a striking decline in the count of sites occupied by Rough-legged Hawks (n=100 for 2012 and n=3 for 2013) despite having checked most of all known sites (93%). This was attributed to a drop in the availability of small mammal prey (primarily lemmings) due to the cyclical nature of these populations. Occupancy by Peregrine Falcons of all sites that were known to have been previously occupied by a Peregrine was also lowest in 2013 (Table 10). Peregrine Falcons prey primarily on other bird species, and as such are less susceptible to declines in small mammal populations; although in some areas, small mammal species can comprise a major portion of their diet.

Table 10. Occupancy and survey effort for raptors within the TRSA from 2011 to 2016.

Variable		Year					
		2011	2012	2013	2014	2015	2016
Effort	Total nesting territories known by 2016	413					
	# nesting territories checked (Effort)	216	306	287	374	158	143
	% known nesting territories checked	52%	74%	69%	91%	38%	35%
	# checked nesting territories occupied	159	178	87	166	105	69
	% checked nesting territories occupied	74%	58%	30%	44%	66%	48%
Peregrine Falcon	# nesting territories occupied	73	75	82	89	56	47
	Occupancy	0.70	0.51	0.48	0.65	0.67	0.59
Rough-legged Hawk	# nesting territories occupied	79	100	3[1]	72	49	18
	Occupancy	0.69	0.63	0.02	0.59	0.59	0.24

[1] 3 lone individuals were observed at 3 different nesting territories, but pairs failed to occupy any known nesting territory.


Milne Inlet Camp and Port
Milne Inlet Tote Road
Mary River Project Mine Site
Steensby Port
Nina Bang Lake
Erichson Lake
Neergaard Lake
Angajurjualuk Lake
Steensby Inlet
Murray Maxwell Bay
1 cm = 8 km
Map Area
Mary River Project
Baffin Island
LEGEND
Mary River Project
Raptor Nesting Sites
Terrestrial Regional Study Area
Phase 2 Proposal Raptor Study Area
Project Development Areas
Approved - Current Development Area
Approved - Future Development Area
Phase 2 - Proposed Development Area
NOTES
PDA provided by KP, July 11, 2017
This document is not an official land survey and the spatial data presented is subject to change without notice.
Map Projection: NAD 1983 UTM Zone 17N
Scale
0 5 10 20 30 40 50 Km
Baffinland Iron Mines Corporation
Cliff-Nesting Raptor Nesting Sites: 2006-2016
EDI
Date: 6/15/2018
MAP 4

Reproductive Success — Productivity and nest success for Peregrine Falcons and Rough-legged Hawks are reported in Table 11. Like occupancy, reproductive success has been highly variable among years for Peregrine Falcons and particularly for Rough-legged Hawks. Peregrine Falcon productivity has ranged from a low of 0.60 nestlings per occupied site in 2012 to a high of 2.89 nestlings per occupied site in 2011; while Rough-legged Hawk productivity ranged from 0.00 nestlings per occupied site in 2013 to a high of 3.73 in 2011. Nest success for Peregrine Falcon has ranged from a low of 0.29 in 2012 to a high of 0.98 in 2011; and for Rough-legged Hawks, the proportion of occupied sites that were successful ranged from 0.00 in 2013 to 1.00 in 2011 and 2016. The considerable variability evident to date in occupancy and reproductive success among species is most likely is representative of natural variability associated with variation in prey availability and weather. However, while the data has shown a high degree of variability, there has been no decline ($P > 0.10$) in productivity or nest success for Peregrine Falcons or Rough-legged Hawks from 2011 to 2016 (EDI Environmental Dynamics Inc. (EDI) 2017).

Table 11. Productivity (number of young per successful nesting territory) and Nest Success for raptors in the Mary River study area, 2011–2016

Measure	PEFA						RLHA					
	2011	2012	2013	2014	2015	2016	2011	2012	2013	2014	2015	2016
Total known nesting territories[1]	233						228					
# nesting territories occupied[2]	54	45	80	67	52	45	63	42	3	47	47	12
Count of nestlings (min)	156	27	82	103	102	110	235	73	0	105	116	32
# nesting territories with >0 nestlings[3]	53	13	70	45	36	39	63	31	0	41	39	12
Nest Success[4]	0.98	0.29	0.88	0.67	0.69	0.87	1.00	0.74	0.00	0.87	0.83	1.0
Productivity (no. of chicks/no. of occupied nesting territories)	2.89	0.60	1.03	1.54	1.96	2.44	3.73	1.74	0.00	2.23	2.47	2.67

Notes:

[1] Total number of nesting territories known to have been occupied since surveys began in 2006

[2, 3] Summer productivity survey only

[4] No. of nesting territories with >0 nestlings/# of nesting territories occupied

2.6.4 SONGBIRDS AND SHOREBIRDS

Information on tundra breeding birds (e.g. songbirds and shorebirds) within the TRSA was collected during PRISM surveys, encounter transects in 2012 and 2013, and Red Knot surveys in 2014. The 2012 and 2013 surveys generally represent baseline conditions, although some limited construction activities had been initiated prior to the 2013 surveys. The Red Knot surveys in 2014 occurred during Project construction but prior to the start of mining.

The PRISM surveys and encounter transect surveys had two primary objectives: 1) to enhance baseline data collection on tundra breeding birds within the TRSA; and 2) to investigate the potential for monitoring Project-related effects on songbird and shorebird species as required in the Project Certificate Conditions and Commitments. However, analysis of the survey results from the 2012 and 2013 PRISM plots and the 2013 bird encounter transects indicated that monitoring of Project effects on songbirds and shorebirds was unlikely to detect an effect of disturbance due to the low number of birds present. Subsequent discussions with the Baffinland Terrestrial Environment Working Group (TEWG) and CWS concluded that effects monitoring for tundra breeding birds could be discontinued but that Baffinland would:

- Contribute to regional monitoring efforts by conducting 20 PRISM plots every five years (next scheduled for 2018); and
- Conduct pre-clearing nest surveys prior to any clearing of vegetation or topsoil during the nesting season.

2.6.4.1 PRISM Surveys

PRISM surveys were conducted in June/July of 2012 and 2013. The objective of the surveys was to provide enhanced baseline data on tundra breeding birds within the TRSA and to determine whether PRISM surveys could be used to establish a baseline dataset of near site and far site plots with the intent of monitoring Project-related effects.

Methods

PRISM survey methods were based on the "Rapid Plot" PRISM (Program for Regional and International Shorebird Monitoring) method (Canadian Wildlife Service 2008). Plots were 12 ha (400 m x 300 m) and were surveyed transect-style with transects spaced every 25 m (Figure 1). All birds observed on the plot were documented on a plot map along with the boundaries of any habitat types. Habitat information for each plot was recorded on the habitat data sheet created by CWS for the PRISM program; GPS coordinates were collected at each plot corner, and several photos were taken for each plot. Bird observations were recorded as a pair (P), a male (M), a female (F), an individual of unknown sex (U), a probable nest (PN), or a nest (N). Birds were not recorded in the plot when a) they were associated with a nest or probable nest, or b) a flock of more than 5 birds of one species together in the plot (e.g. a feeding flock) — these were instead recorded as incidentals. Surveyors also recorded birds heard or seen outside the plot, and birds flying over the plot as incidental observations.

The 2012 PRISM surveys focused on the southern sections of the TRSA, and plots were split between near site (within and up to 5 km from the Project Development Area (PDA)), and far site (further than 5 km from the PDA). Effort was scaled back in 2013 as the earlier surveys concluded that bird densities in the RSA were likely too low to allow PRISM plot methods to be used successfully in ongoing effects monitoring for songbirds and shorebirds. Surveys in 2013 focused on the northern portion of the TRSA (from Mary River north to Milne Inlet) to augment baseline data.

Prior to the 2012 field surveys, CWS provided plot locations using their in-house random plot selection methods (Rausch and Kydd 2012). Due to logistical restrictions in the field, and the need for both near site and far site plots, additional plots were pre-selected by EDI using Circa-2000 northern land cover (NLC) of Canada data (Olthof et al. 2009). Plots with greater than 70% water or on relatively steep slopes or mixed habitat types based on available NLC data were excluded from selection. The pre-selected plots were all classified as good, medium or poor quality in relation to their suitability for shorebirds. Good plots (Photo 1.) were those containing greater than 50% of wetland habitat types; medium plots (Photo 2) were those habitats containing a mix of vegetated uplands, heaths, and drier grasslands; and poor plots (Photo 3) were those containing greater than 50% of sparsely vegetated uplands, barren areas, and bare gravel. In total, 93 plots were surveyed: 80 in 2012 and 13 in 2013 (Table 12; Map 5). Where possible, field surveys gave priority to randomly selected (CWS) plots; however, only seven (7) randomly selected plots were completed; the remaining 86 plots were non-randomly selected by EDI.

Following field data collection, PRISM data were entered into a copy of the CWS PRISM database and provided to CWS. PRISM data were then analysed to determine the number of birds detected, the observed density, and the corrected density by habitat type. The number of birds detected was calculated as follows:

$$\text{Birds Detected} = ((N_{\text{Nests}} + N_{\text{Probable Nests}} + N_{\text{Pairs}}) \times 2) + (N_{\text{Males}} + N_{\text{Females}} + N_{\text{Unknown}})$$

Where N_{Nests} is the number of nests observed, $N_{\text{Probable Nests}}$ is the number of probable nests, N_{Pairs} is the number of pairs observed, N_{Males} is the number of males observed, N_{Females} is the number of females observed, and N_{Unknown} is the number of individuals of unknown sex observed.

Observed density was assessed as the average, by habitat type, of the number of birds detected divided by the plot area. Observed density was calculated as follows:

$$\text{Observed Density} = \text{Average (Birds Detected/Plot Area)}$$

Corrected density is an estimate of the actual number of birds present calculated using a correction factor for the detection rate. Corrected density was calculated using the Canada-wide detection ratio of 1.27 to adjust results from rapid PRISM surveys (Bart and Smith 2012), but was only assessed for shorebird species since a detection ratio was not available for other species (e.g. passerine species).

$$\text{Corrected Density} = \text{Average (Birds Detected/Plot Area/1.27)}$$

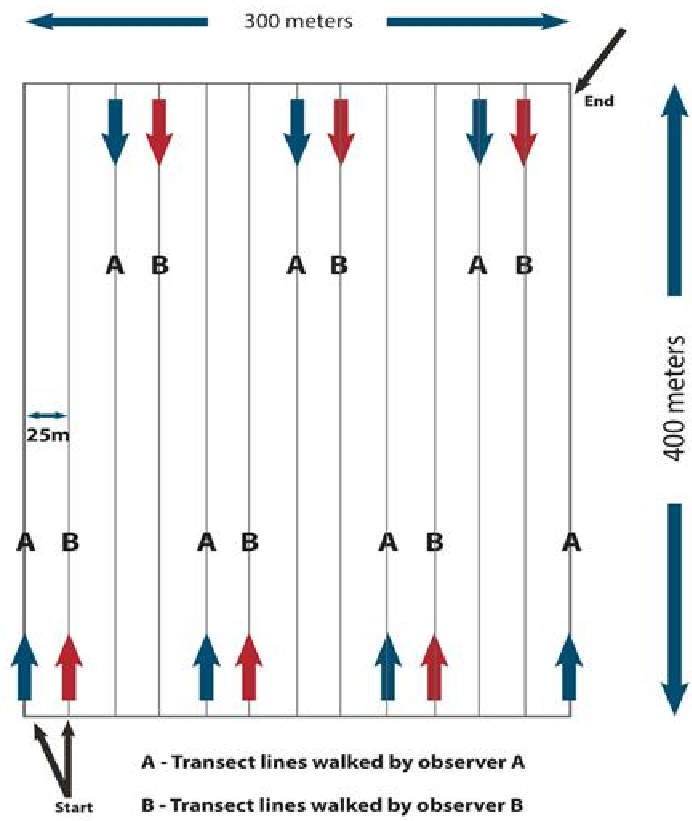


Figure 1. PRISM plot survey method (figure adapted from (Canadian Wildlife Service 2008).

Photo 1. Example of good quality habitat for shorebirds, wet sedge habitat with ponds (Plot MR-21B-AOI1, 2013)

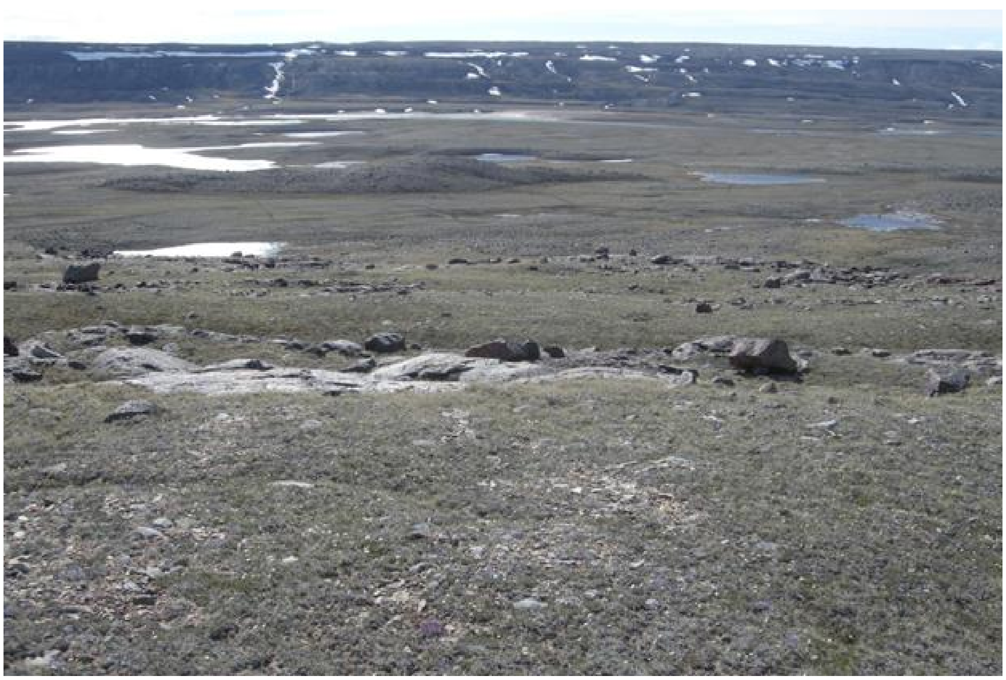


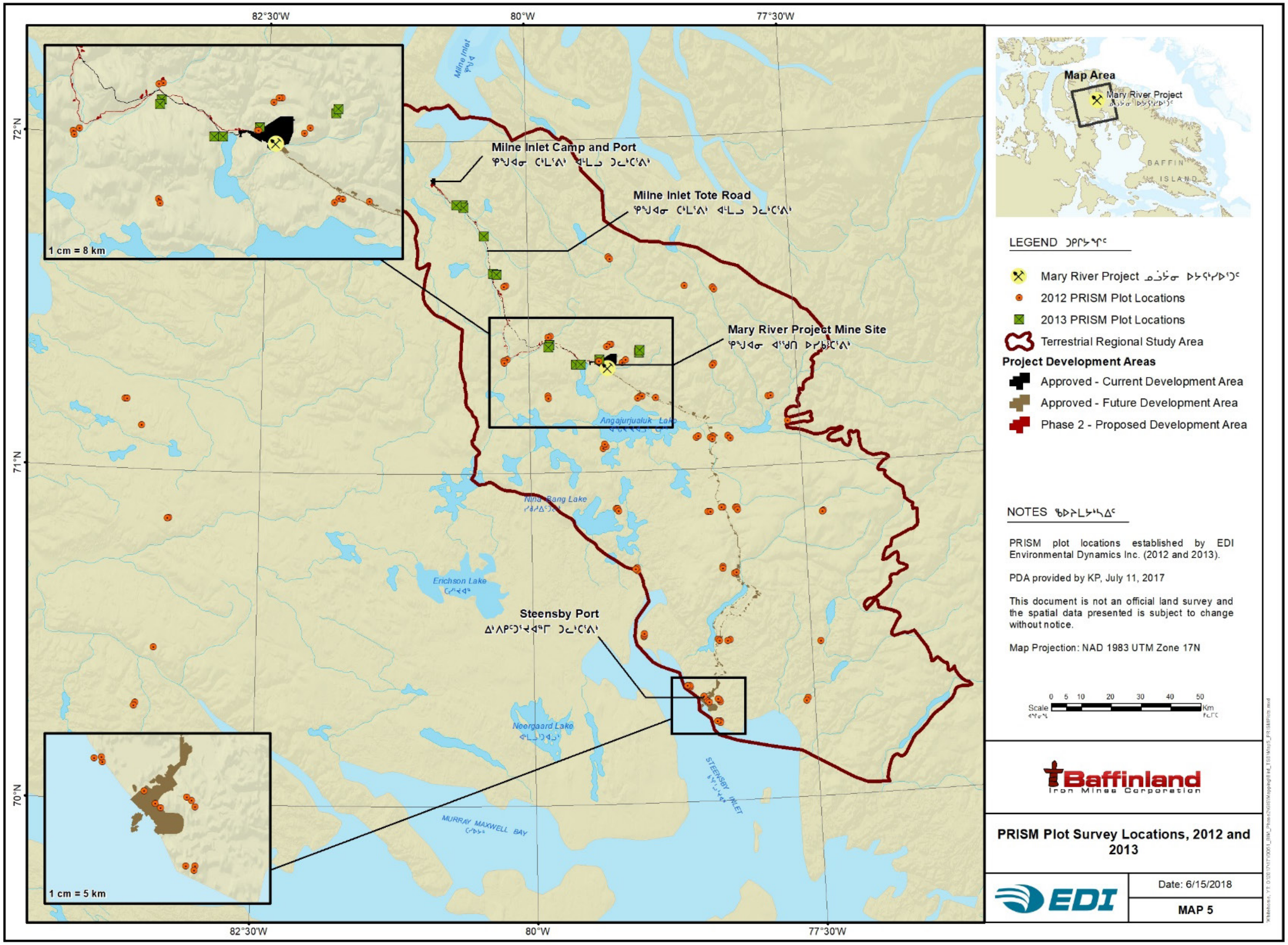
Photo 2. Example of medium quality habitat for shorebirds, dry graminoid – dwarf shrub tundra (Plot MR-8A-AOI1, 2013)

Photo 3. Example of poor quality shorebird habitat, sparsely vegetated till-colluvium with some prostrate dwarf shrub (Plot MR-12B-AOI1, 2013).

Table 12. Plant communities / habitat types used by EDI to select PRISM plots in the Mary River Project's Regional Study Area and number of plots sample in 2012 and 2013.

NLC Code	Northern Land Cover Vegetation Class[1]	Area (km^2)	% of Study Area	Stratum	No. plots sampled 2012	No. plots sampled 2013
11	Wetlands (Emergent sedge and non-tussock sedge associations)	258	1.2%	Good	0	0
2	Wet sedge - Graminoids and bryoids (Moss association, sedge moss wet meadow)	681	3.2%	Good	2	2
1	Tussock graminoid tundra (Tussock sedge association)	1,033	4.9%	Medium	5	0
3	Moist to dry non-tussock graminoid/dwarf shrub tundra: 50–70% cover (Shrub-sedge tundra)	1,699	8.1%	Medium	22	0
4, 7	Dry graminoid prostrate dwarf shrub tundra: 70–100% cover (Dry slope with forbs, dry cliff ledges)	3,292	16.7%	Medium	17	10
8	Prostrate dwarf shrub-Dryas/heath, usually on bedrock (Heath tundra grading to Dryas-xeric sedge association)	5,697	27.1%	Poor	14	0
9	Sparsely vegetated bedrock (Lichen-rock associations)	1,942	9.2%	Poor	17	1
10	Sparsely vegetated till-colluvium	2,227	10.6%	Poor	3	0
12	Bare soil with cryptogam crust - frost boils (Dry slope with forbs, calcerous substrate)	1,728	8.2%	Poor	0	0
0, 13–15	Barrens (Purple saxifrage barrens, avens and xeric sedge association, Luzula association)	2,493	11.8%	n/a	0	0
Total		**21,054**	**100%**		**80**	**13**

[1]Vegetation classes using circa-200 northern land cover of Canada data (Olthof et al. 2008)



Milne Inlet Camp and Port
Milne Inlet Tote Road
Mary River Project Mine Site
Steensby Port
Angajurjualuk Lake
Nina Bang Lake
Erichson Lake
Neergaard Lake
Murray Maxwell Bay
Steensby Inlet
Milne Inlet
1 cm = 8 km
1 cm = 5 km
82°30'W
80°W
77°30'W
72°N
71°N
70°N
Map Area
Mary River Project
BAFFIN ISLAND
LEGEND
Mary River Project
2012 PRISM Plot Locations
2013 PRISM Plot Locations
Terrestrial Regional Study Area
Project Development Areas
Approved - Current Development Area
Approved - Future Development Area
Phase 2 - Proposed Development Area
NOTES
PRISM plot locations established by EDI Environmental Dynamics Inc. (2012 and 2013).
PDA provided by KP, July 11, 2017
This document is not an official land survey and the spatial data presented is subject to change without notice.
Map Projection: NAD 1983 UTM Zone 17N
0 5 10 20 30 40 50
Scale
Km
Baffinland
Iron Mines Corporation
PRISM Plot Survey Locations, 2012 and 2013
EDI
Date: 6/15/2018
MAP 5

Results and Discussion

PRISM plots documented a total of 507 individual birds in 2012, representing 13 different species, and 90 individual birds in 2013, representing 7 species. Lapland Longspur was the most abundant species observed during the surveys, followed by Snow Bunting, Horned Lark, and Baird's Sandpiper. Together these species represent approximately 88% of all birds documented during PRISM surveys. A notable sighting during the 2012 surveys was one Dunlin, previously unrecorded on north Baffin Island. The combined 2012 and 2013 PRISM surveys documented total bird densities within the TRSA averaging 65.5 ± 15.0 birds/km² in good habitats, 71.6 ± 4.9 birds/km² in medium habitats, and 24.8 ± 4.1 birds/km² in poor habitats. Shorebird densities recorded during the 2012 and 2013 PRISM plots averaged 4.8 ± 2.5 birds/km², 5.4 ± 1.4 birds/km², and 3.8 ± 1.6 birds/km² in good, medium and poor habitats respectively (Table 13). Since the classification of PRISM plots into good, medium and poor-quality habitats is in relation to their suitability for shorebirds, shorebird densities would typically be expected to be highest in good habitats, lower in medium habitats and lowest in poor habitats. However, during the 2012 and 2013 PRISM surveys at Mary River, the most common shorebird observed was Baird's Sandpiper which generally selects drier habitats with low vegetation for nesting (habitats classed as medium) as opposed to the wetter habitats (classed as good) selected by many other shorebird species.

Comparison of the 2012 and 2013 PRISM data to the baseline data collected in the TRSA from 2006 to 2008 (Section 2.5.3.2), indicates that species composition was similar; however, estimated bird densities from the PRISM surveys were higher than those reported in the baseline studies (e.g., average density of 53.5 ± 4.0 birds/km² compared to 18 ± 3.4 birds/km²). These comparisons should be interpreted with caution as the baseline study methods used a combination of fixed-radius point counts rather than the standardized PRISM method. The methods used for the 2012 and 2013 surveys are considered more appropriate as a measure of bird densities in the RSA.

Based on the results of the 2012 and 2013 PRISM surveys, shorebird densities within the TRSA are low. In comparison to other PRISM survey data from the mid Arctic region of Nunavut, densities within the TRSA were considerably lower across all three habitat types than densities found in other surveys within the region (Table 14). It is important to note that many of these other surveys were conducted in areas known to have very high densities of shorebirds, some of which have been identified as KTHS (Latour et al. 2008) and IBAs (Important Bird Areas Canada 2010). However, closer investigation of the survey data indicates that the low densities found at Mary River are not unique:

PRISM surveys of the Kent Peninsula, Melbourne Island, and the adjacent mainland areas in 2001 and 2002 reported shorebird densities averaging between 10 to 54 birds/km² (Table 14):

- however, the report noted that Melbourne Island had significantly higher densities (33 shorebirds over 6 plots) than the remainder of the study area (55 shorebirds over 46 plots; (Bart and Smith 2012).

- On Somerset Island, PRISM surveys in 2001 focussed on a relatively small area in Creswell Bay; however, some plots were also conducted in the surrounding region. A total of 47 plots were conducted in this area documenting 28 indicated pairs of shorebirds. The authors concluded that they did not have a good basis for estimating density or population size within this area, but that shorebird populations in this region were low (Bart et al. 2012).

Based on the notations in the above cited reports, it is likely that other areas across the Canadian High Arctic have shorebird densities like those found in the Mary River RSA.

Additionally, examination of species-specific densities indicates that densities of the most common shorebirds present at Mary River are comparable to densities of those species across the Canadian Arctic. Geographically, the Western Baffin and Prince Charles Island/Air Force Island surveys are some of the nearest to the Mary River RSA. Both areas are well known to have high densities of migratory birds and surveys found significantly higher densities of shorebirds than at Mary River (densities of over 60 birds/km² in Western Baffin Island and over 110 birds/km² on Prince Charles and Air Force Island (Table 14)

However, the high shorebird densities found in both of these studies were driven by large numbers of Red Phalarope and White-rumped Sandpiper — these two species made up 88% and 96% of all shorebird detections in Prince Charles and Air Force Islands, and Western Baffin Island respectively (Johnston and Smith 2012). Red Phalarope and White-rumped Sandpiper on Prince Charles and Air Force Islands demonstrated a clear selection for marsh habitats (Johnston and Pepper 2009); these habitats are limited within the Mary River RSA, potentially explaining the limited number of Red Phalarope and White-rumped Sandpiper found there. Comparing densities of some of the more common species from Mary River (Lapland Longspur, Baird's Sandpiper and American Golden-plover) with the densities of these same species at Prince Charles and Air Force Islands and Western Baffin Island shows comparable densities of Baird's Sandpiper and American Golden-plover between the studies, and higher densities of Lapland Longspur at Mary River (Table 15). The low availability of high quality wetland habitats within the RSA appears to be the primary reason why the overall shorebird density is low compared to other survey areas.

Table 13. Birds Detected and Bird Densities from the combined 2012 and 2013 PRISM Survey Results in the Mary River TRSA.

Species[1]	Good (n=7)			Medium (n=51)			Poor (n=35)			All Combined (n=93)		
	No. obs.	Observed density bird / km² ± SE	Corrected density[2] bird / km² ± SE	No. obs.	Observed density bird / km² ± SE	Corrected density[2] bird / km² ± SE	No. obs.	Observed density bird / km² ± SE	Corrected density[2] bird / km² ± SE	No. obs.	Observed density bird / km² ± SE	Corrected density[2] bird / km² ± SE
Shorebirds												
AGPL	0	0	0	8	1.3 ± 0.7	1.0 ± 0.6	4	1.0 ± 0.8	0.8 ± 0.6	12	1.1 ± 0.5	0.9 ± 0.4
BASA	2	2.4 ± 2.4	1.9 ± 1.9	23	3.8 ± 0.9	3.0 ± 0.7	12	2.9 ± 1.1	2.3 ± 0.9	37	3.3 ± 0.7	2.6 ± 0.5
DUNL	1	1.2 ± 1.2	0.9 ± 0.9	0	0	0	0	0	0	1	0.1 ± 0.1	0.1 ± 0.1
PESA	1	1.2 ± 1.2	0.9 ± 0.9	1	0.2 ± 0.2	0.1 ± 0.1	0	0	0	2	0.2 ± 0.2	0.1 ± 0.1
REPH	0	0	0	1	0.2 ± 0.2	0.1 ± 0.1	0	0	0	1	0.1 ± 0.1	0.1 ± 0.1
All Shorebird	4	4.8 ± 2.5	3.8 ± 2.0	33	5.4 ± 1.4	4.3 ± 1.1	16	3.8 ± 1.6	3.0 ± 1.3	53	4.8 ± 1.0	3.7 ± 0.8
Other Bird Species												
CAGO*	1	1.2 ± 1.2	--	0	0	--	0	0	--	1	0.1 ± 0.1	--
LTDU	1	1.2 ± 1.2	--	14	2.3 ± 1.2	--	1	0.2 ± 0.2	--	16	1.4 ± 0.7	--
ROPT	0	0	--	1	0.2 ± 0.2	--	0	0	--	1	0.1 ± 0.1	--
SACR	0	0	--	2	0.3 ± 0.3	--	0	0	--	2	0.2 ± 0.2	--
HOLA	0	0	--	35	5.7 ± 1.4	--	2	0.5 ± 0.5	--	37	3.3 ± 0.8	--
AMPI	1	1.2 ± 1.2	--	21	3.4 ± 1.2	--	12	2.9 ± 1.1	--	34	3.1 ± 0.8	--
LALO	45	53.6 ± 14.0	--	286	46.7 ± 4.4	--	25	6.0 ± 2.4	--	356	31.9 ± 3.5	--
SNBU	3	3.6 ± 3.6	--	44	7.2 ± 1.8	--	48	11.4 ± 1.9	--	95	8.5 ±1.3	--
HORE	0	0	--	1	0.2 ± 0.2	--	0	0	--	1	0.1 ± 0.1	--
UNRE	0	0	--	1	0.2 ± 0.2	--	0	0	--	1	0.1 ± 0.1	--
Total	**55**	**65.5 ± 15.0**	**--**	**438**	**71.6 ± 4.9**	**--**	**104**	**24.8 ± 4.1**	**--**	**597**	**53.5 ± 4.0**	**--**

[1]Species Codes: AGPL – American Golden-plover, BASA – Baird's Sandpiper, DUNL – Dunlin, PESA – Pectoral Sandpiper, REPH – Red Phalarope, CAGO* - Canada/Cackling Goose, LTDU – Long-tailed Duck, ROPT – Rock Ptarmigan, SACR – Sandhill Crane, HOLA – Horned Lark, AMPI – American Pipit, LALO – Lapland Longspur, SNBU – Snow Bunting, HORE – Hoary Redpoll, UNRE – unidentified redpoll

[2]Corrected Density is an estimate of the actual number of birds present calculated using the Canada-wide detection ratio of 1.27 to adjust results from rapid PRISM surveys (Bart and Smith 2012).

Table 14. Comparison of the Mary River PRISM shorebird densities for 2012 and 2013 compared to other PRISM studies in the mid Arctic area of Nunavut[1]

Regional Studies	Mean Corrected Density (birds/km² [CV]) by Habitat Class		
	Good (wetlands)	Medium (moist areas)	Poor (uplands)
Mary River Study Area	3.75 (1.38)	4.25 (1.82)	3.00 (2.51)
Prince Charles Island / Air Force Island	133 (0.33)	168 (0.17)	110 (0.51)
West Baffin	64 (0.21)	66 (0.32)	0
Southampton Island	54 (0.27)	34 (0.39)	0
Coats Island	113 (0.23)	13 (0.17)	13 (0.17)
Queen Maud Gulf – west	18 (0.26)	15 (0.45)	20 (0.54)
Queen Maud Gulf – east	36 (0.50)	25 (0.44)	16 (0.26)
Kent Peninsula	54 (0.27)	10 (0.38)	14 (0.28)
Creswell Bay	60 (0.27)	54 (0.22)	42 (0.21)
Somerset Island	27 (0.17)	8 (0.32)	27 (0.99)

[1] Other than the Mary River data, densities are taken from (Bart and Smith 2012). Additional information on shorebirds within the mid Arctic region is available (i.e., Igloolik Island, Rasmussen Lowlands); however, direct comparisons cannot be made to the Mary River PRISM data due to differing survey methods or data presentation format.

Table 15. Comparison of American Golden-plover, Baird's Sandpiper, and Lapland Longspur densities from Mary River with other PRISM studies in the area (Western Baffin, Prince Charles, and Air Force Islands).

Habitat Class	Mean Observed Density (birds/km² ± SE)		
	Mary River 2012 and 2013	Prince Charles Island 1996[1]	Prince Charles and Air Force Islands 1997[1]
American Golden-plover			
Good	0	1.5 ± 1.3	2.1 ± 2.1
Medium	1.31 ± 0.71	0	4.6 ± 1.7
Poor	0.95 ± 0.75	1.9 ± 1.9	3.0 ± 2.1
Baird's Sandpiper			
Good	2.38 ± 2.38	3.8 ± 3.8	0
Medium	3.76 ± 0.88	0	0
Poor	2.86 ±1.13	0.9 ± 0.9	0
Lapland Longspur			
Good	53.57 ± 13.95	19.2 ± 5.6	13.9 ± 2.8
Medium	46.73 ± 4.38	19.5 ± 7.8	12.0 ± 2.9
Poor	5.95 ± 2.36	9.4 ± 6.2	2.0 ± 2.0

[1] Source: (Johnston and Pepper 2009)

2.6.4.2 Bird Encounter Transects

Analysis of the 2012 PRISM survey results indicated that bird densities within the TRSA were too low to allow PRISM plot methods to be used successfully for Project effects monitoring. Therefore, a trial program was initiated in 2013 to look at the use of encounter transects to facilitate monitoring of Project effects on tundra breeding birds and shorebirds. These data also contribute to an understanding of baseline characteristics of birds in the TRSA.

Methods

Encounter transects were distributed along the northern regions of the PDA, including the Tote Road, Mine Site, and Milne Inlet Port. Transects started at the road/PDA and ran perpendicular to the existing (e.g. Tote Road) or proposed (e.g. Mary River Mine Site) disturbance. Transects were randomly selected by GIS processes prior to field works and were 1.5 km long, spaced a minimum of 300 m apart. Transects were divided into 100 m segments and all birds seen or heard along a segment, within 100 m of either side of the transect line, were recorded. Transect segments were numbered one through fifteen with segment one always being the segment closest to disturbance. Bird observations within a segment were also classified into one of four distance bins in relation to the perpendicular distance from the transect centerline: 0 – 12.5 m, 12.5 – 50 m, 50 – 100 m, and >100 m. For any birds that were observed, the species, number of individuals, sex (if known), and behaviour were recorded. The dominant habitat types along transects were also documented. A total of 45 encounter transects were conducted between 27 June and 10 July 2013. Transect surveys were conducted by crews of two surveyors, and typically took 0.5–1 hour to complete.

Results and Discussion

The 2013 encounter transects documented a total of 424 birds from 18 different species. The three most commonly detected species, which represented 75% of the observations, were Lapland Longspur, Horned Lark, and American Pipit (Table 16). A power analysis was conducted to determine whether encounter transects would have the power to detect a change in the density of birds closest to the PDA. The power analysis determined that, due to the low density of birds found within the TRSA, there is very little power to detect a 10 % decline in the number of birds closest to disturbance, even with a very large sample size (e.g., 250 transects). A minimum of 145 transects would be required to detect a 25% decline in the number of birds closest to disturbance with >90% ability. Lower number of transects would detect percent declines unsuitable for Project effects assessment (e.g. 30 transects would detect a 50% decline with >90% ability). Further details are provided in the 2013 Annual Monitoring Report (EDI Environmental Dynamics Inc. (EDI) 2014).

Table 16. Bird species observed during 2013 encounter transects.

Species	# of Occurrences	Percent Total Occurrences	# Birds Observed	Percent Total Birds Observed
Snow Goose	2	0.6%	27	6.4%
Canada Goose	3	0.8%	7	1.7%
Long-tailed Duck	6	1.7%	10	2.4%
Rock Ptarmigan	1	0.3%	1	0.2%
Red-throated Loon	1	0.3%	1	0.2%
Pacific Loon	1	0.3%	1	0.2%
Yellow-billed Loon	1	0.3%	1	0.2%
Rough-legged Hawk	1	0.3%	1	0.2%
Peregrine Falcon	2	0.6%	3	0.7%
Sandhill Crane	4	1.1%	4	0.9%
Semipalmated Plover	2	0.6%	2	0.5%
Baird's Sandpiper	18	5.1%	20	4.7%
Glaucous Gull	4	1.1%	6	1.4%
Common Raven	3	0.8%	4	0.9%
Horned Lark	65	18.3%	72	17.0%
American Pipit	28	7.9%	31	7.3%
Lapland Longspur	196	55.1%	214	50.5%
Snow Bunting	18	5.1%	19	4.5%
Total	**356**	**100%**	**424**	**100%**

2.6.4.3 Red Knot

Red Knot surveys were conducted in 2014 to search for, and locate, any Red Knots in the area around Milne Port. Surveys were conducted on 15 June 2014 during peak breeding display time and during a follow up survey on 10 July 2014. Surveys were conducted along Phillips Creek, up and downstream of the potable water intake and along the shoreline near Milne Port where construction for the deep-water port was expected to occur. No Red Knots were observed in either the June or July survey.

2.6.5 MARINE BIRDS

Information on marine-associated birds within the MRSA was collected during shoreline nest surveys along Steensby and Milne Inlet (2012-2013) and spring staging surveys in Milne Inlet (2015). These surveys generally represent baseline conditions, although some activity was present at Milne Port in 2013 (port construction) and 2015. The 2012-2013 shoreline surveys were completed prior to the commencement of Project shipping, and the 2015 staging surveys were conducted before the 2015 shipping season began.

In addition to studies conducted specifically for the Project, Baffinland has supported additional research on marine bird populations along both the northern and south shipping routes associated with the Project. This work has been led by Environment and Climate Change Canada and has included studies on Thick-billed Murre, Common Eider, and other seabird species.

2.6.5.1 Shoreline Nesting Surveys

Shoreline surveys were conducted along the shoreline of Steensby Inlet in 2012 and Milne Inlet in 2013. The objective of these surveys was to identify nesting shorebirds and waterfowl that could be at risk from Project activities, specifically from the wake resulting from Project shipping; therefore, the surveys focussed on sections of the Project shoreline where wakes exceeding 0.5 m in height were expected to occur.

Shoreline Survey Methods

Ground-based shoreline surveys were conducted in Steensby Inlet from 27 June – 4 July 2012, comprising approximately 104 kilometres of shoreline surveys (220-person hours to complete; Table 17). Surveys were conducted north of the proposed Steensby Port area, at the port area itself, and south of the port to the mainland area adjacent to the islets at the mouth of Steensby Inlet (Map 6)(EDI Environmental Dynamics Inc. (EDI) 2013)(EDI Environmental Dynamics Inc. (EDI) 2013). From 8 July – 17 July 2013, surveys comprising approximately 135 kilometres of shoreline (80-person hours to complete) were conducted in Milne Inlet (Table 17). Surveys extended from the southernmost tip of Milne Inlet, continuing up the east and west coast as well as along a few islands within the Inlet, and consisted of both ground and aerial methods due to the significant amount of cliff shorelines in Milne Inlet (Map 7).

Table 17. Shoreline nesting surveys conducted at Steensby Inlet, 2012, and Milne Inlet, 2013.

Timing	Location in RSA	Survey Method	Total Shoreline Length	Survey Effort (person hours)
June 27, 28 & July 2-4, 2012	Steensby Inlet	Ground	104.1 km	219.9
July 8, 9 & 14, 2013	Milne Inlet	Aerial	69.8 km	2.81
July 8, 14 & 17, 2013	Milne Inlet	Ground	55.6 km	76.81

The shoreline types encountered during the surveys, their physical descriptions, and sensitivity to ship wakes are presented in Table 18. All shore types were surveyed with similar effort regardless of perceived shorebird and waterbird nesting potential. Nest site records were recorded in the Project's nest database, with records dating back to 2006, and each assigned a unique Nest Identification number.

Ground-based shoreline surveys consisted of crews of two to three individuals, including at least one experienced ornithologist. Surveyors walked slowly along the shoreline continually scanning for birds, bird activity, potential nest sites, and nest structures. Beginning at the high-water mark, crew members were usually spaced approximately 25 metres apart, but sometimes further when surveying more open habitats (Photo 4). Surveyors recorded shoreline habitat types along the survey and kept a running tally of all birds seen or heard within each shoreline type.

Aerial surveys (Milne Inlet only) consisted of a minimum of two observers (including at least one experienced ornithologist) along with the pilot flying along the shoreline (often cliffs), looking for any sign of nesting, including adult birds flushed from the cliffs, nest platforms, whitewash, etc.

When nests were located, crews would record coordinates and elevation with a hand-held GPS unit (Garmin GPSmap 62sc), photograph the site, and record nest details such as species, number of eggs or young, nesting material, estimated distance to shoreline and height above high tide mark (to compare to GPS elevation), and any other relevant information. If a bird was observed showing nesting-type behavior (e.g., distraction displays, aggressive behavior, flushed quickly), crew members would space themselves around the potential nest area and watch for the bird's return to identify the nest location.

Photo 4. Typical crew configuration on a shoreline survey of Steensby Inlet, Baffin Island, Nunavut, 27 June 2012.

Table 18. Description of Shore Types along Steensby and Milne Inlet (adapted from the FEIS Volume 8, Appendix 8D-2 and Appendix 8A-1).

Shore type	Physical description	% occurrence in Steensby	% occurrence in Milne	Sensitivity to ship wakes
Rock Cliff	Rock cliffs without beaches. Slopes range from steep (>30) to ramped. Heights generally moderate. Intertidal zone widths less than 10m. Most common on the east shore from proposed Steensby Inlet port site south to Cape Jensen; and in the Southern finger of Milne Inlet on both the west and eastern coast lines, Fair weather bay, Bruce Head, the islands just off Bruce Head, and in smaller sections on the eastern coastline.	5	18	Low sensitivity to ship wakes. Attached biota relatively rare and capable of surviving ice contact, fall storms. Minimal risk to nesting birds from ship wakes.
Rock Cliff with Beach	Rock cliff or ramp backshore with poorly sorted sand-cobble-boulder beaches in the intertidal. Boulder ridges in the intertidal are common. Intertidal widths usually less than 30m. Most common on the east shore of Steensby Inlet from head of Inlet south to Cape Jensen; and scattered all throughout Milne Inlet.	14	10	The armoring of most beaches with cobble-boulder makes this shore type relatively insensitive to wakes effects and shoreline erosion. Nesting birds are unlikely to be affected by ship wakes as they would locate above the tidal zones. This shoreline has low sensitivity to ship wakes.
Alluvial Fans	Areas of till and glacial outwash. Backshore slopes are moderate and usually include a tundra vegetation cover. Associated intertidal areas are usually moderate to narrow coarse sediment beaches of boulder, cobble, pebble and sand. Boulder ridging tends to be common.	20	44	Generally armored by cobble-boulder in the lower intertidal; may include pebble berms. Presence of boulder-cobble armoring in mid and lower intertidal reduces sensitivity to erosion; boulders especially cause wave breaking to reduce energy as wave crosses intertidal. Also, lower gradients nearshore help to disperse energy of wakes. Assumed Low sensitivity to wake effects because of armoring.
Eroding Cliffs	Areas of eroding, unconsolidated sediments that produce steep cliffs with sand and gravel beaches. Generally, the shoreline of the Inlet is progradational due to isostatic rebound but at a few locations eroding cliffs are noted. Intertidal zone widths vary but are comparatively narrow (<30m). These cliffs occur at isolated locations with limited extent.	2	-	May be sensitive to wave effects but this shore type is rare (2% of shoreline). Assumed to be Moderate sensitivity. This shoreline type was not found in the 2012 survey area.

Table 18. Description of Shore Types along Steensby and Milne Inlet (adapted from the FEIS Volume 8, Appendix 8D-2 and Appendix 8A-1).

Shore type	Physical description	% occurrence in Steensby	% occurrence in Milne	Sensitivity to ship wakes
Wide Flats	Low gradient shorelines with flat backshores and foreshores. Raised beach ridge deposits common in the backshore. Wide intertidal flats (unconsolidated) or rock platforms (sedimentary bedrock) occur; widths up to 1 km. Beaches typically consist of pebble-cobble and include supratidal storm berms and intertidal berms and beach faces. Common on islets in Steensby Inlet and the west shore of the inlet.	31	-	Low gradients of nearshore likely to dissipate energy of wakes as they propagate into shallow water. Ship wakes likely to reach shorelines as a surge rather than a breaking wave. Attached kelps observed offshore are assumed to be tolerant to wind and wave-generated currents so not likely affected by wakes. Assumed sensitivity to wake impacts is Low.
Beach Ridge Complex	Short open-water season in Milne Inlet leads to a coastal geomorphology that is storm dominated. This shoreline is created primarily during infrequent, yet episodic, high-energy storm events.	-	23	With higher proximity to ocean levels this shore type is relatively insensitive to wakes effects and shoreline erosion. Nesting birds unlikely to be affected by wakes as they would locate above the tidal zones. Low sensitivity to ship wakes.
Alluvial Delta Complex	The presence of sea ice causes numerous ice rideup features both within the intertidal zone as well as in the backshore and subtidal areas.	-	1	Low gradients near shore are likely to dissipate energy of wakes as they propagate into shallow water. Ship wakes likely to reach shorelines as a surge rather than a breaking wave. Assumed sensitivity to wake impacts is Low.
Delta Flats	Delta flats and channel complexes associated with larger streams (e.g., Rowley River). Wide intertidal flats comprised of sand are bifurcated by distributary channels. Salt marsh occurs locally. Intertidal zone widths may be up to 1 km. Delta flats are most common on the east shore of Steensby Inlet; and are uncommon in Milne Inlet but can be found on the eastern shore near Poirier Island.	2	4	Low gradients of near shore likely to dissipate energy of wakes as they propagate into shallow water. Ship wakes likely to reach shorelines as a surge rather than a breaking wave. However, sediments are usually fine so may be more sensitive resulting in moderate sensitivity. May be sensitive to wave effects but this shore type is rare (less than 1% of shoreline).
Lagoon Complexes	Low gradient shorelines primarily in the northern portion of Steensby Inlet. The "shoreline" is extremely complex. Coastal gradients are very low with "backshores" only a few centimeters above the intertidal zone. Coarse boulder-cobble veneers dominate the intertidal. Finer sediments may occur in the shallow subtidal, where ice-gouging commonly occurs. White subtidal mats interpreted as Beggiatoa (indicate anaerobic seabed conditions) occur locally. Brine pools noted in some isolated lagoon basins.	26	-	This shore type is not present in ship wake areas. Intertidal areas typically contain coarse, cobble-boulder substrates.

Results and Discussion

A total of 40 nests were found during the shoreline surveys in Steensby Inlet in 2012, representing six species — Canada Goose, Semi-palmated Plover, Herring Gull, American Pipit, Lapland Longspur and Snow Bunting (Table 19; Map 6). No nesting colonies of gulls or other water birds were observed during the surveys or on ferrying flights between transects. Other bird observations associated with the shoreline surveys included relatively low numbers of King and Common Eider, Pacific, Yellow-billed and Red-throated Loons, Baird's Sandpiper, American Golden-plover, Peregrine Falcon, Sandhill Crane, Horned Lark, Glaucous Gull, Long-tailed Duck, etc. (Table 20). None of the additional species observed displayed nesting behaviour within the shoreline study area. An indication that surveys may have been too early to observe nesting eiders was the daily observation of pairs of Common and King Eider, indicating that nesting had yet to begin in the areas surveyed.

The 2013 shoreline surveys in Milne Inlet located four nesting sites representing a minimum of 23 nests (Table 19; Map 7) — these included a nesting colony of Glaucous Gulls on a cliff on the east side of Milne Inlet, a mixed colony of Glaucous and Thayer's Gulls on cliffs on the west side of Milne Inlet, and a single Semi-palmated Plover nest. The remaining nesting site had two nests located within a couple meters of each other, which were not currently active, but appeared to be left over from the previous year. Both nests were composed of grasses and suspected to be eider. A couple of other birds observed during the survey gave some indication of nesting (Common Ringed Plover and Baird's Sandpiper) but despite intensive searching, surveyors were unable to locate a nest. In addition to the nest observations, a total of 1,016 birds of 23 different species were observed during shoreline surveys in Milne Inlet in 2013 (Table 20), with the most common species being Long-tailed Duck (n=254), King Eider (n=253) and Glaucous Gull (n=150). The majority of observations consisted of actively migrating or locally moving birds that did not display nesting or breeding-type behaviours and likely did not represent local nesters.

Large sections of the Milne Inlet shoreline were too steep to survey safely from the ground. Wake effects are not expected to have a large effect on nesting birds in these areas since any nesting is likely well above the potential extent of wake effects. These steep areas were surveyed by helicopter to identify any larger colonies of marine birds. However, comparison of the ground-based surveys from Steensby Inlet (2012) and Milne Inlet (2013) showed considerably more nests per kilometre of surveyed coastline along Steensby Inlet than Milne Inlet. This was likely due in part to differences in the shoreline structure of the two inlets (refer to Table 18) but may also have been influenced by survey timing (27 June – 4 July in 2012 as compared to 8 July to 17 July 2013). In both 2012 and 2013, there was excellent visibility in the surveyed habitats providing excellent sightability (i.e., low cover of vegetation) and there were a high number of observer hours in a relatively small area along the shoreline for ground surveys. Except for the more cryptic nests of species such as American Pipit, surveyors were confident that most if not all nests that were present in the shoreline survey areas during the surveys were located. Although it is possible that surveys may have been too early in both years to observe nesting by some species, particularly eiders (as suggested by the daily observation of pairs and rafts of Common and King Eider), the survey observations indicate that nesting densities are low.

Table 19. Bird nests located during shoreline surveys at Steensby Inlet (2012) and Milne Inlet (2013).

Survey	Species	Nest ID	Transect	Survey Type	Lat	Long	No. eggs	Notes
Steensby Inlet (2012)	Canada Goose	2012-033	T03	Ground	70.290	-78.512	5	On island on pond, higher elevation, well outside of any potential wave or wake effect.
	Semi-palmated Plover	2012-006	T04	Ground	70.209	-78.377	4	
		2012-010	T04	Ground	70.217	-78.384	-	
		2012-012	T04	Ground	70.220	-78.389	-	
		2012-014	T04	Ground	70.225	-78.401	-	
		2012-016	T05	Ground	70.237	-77.742	3	~ 2 m above seas level
		2012-017	T05	Ground	70.240	-77.830	4	
		2012-018	T05	Ground	70.240	-77.837	4	
		2012-021	T05	Ground	70.250	-77.935	4	
		2012-022	T05	Ground	70.251	-77.945	4	
		2012-023	T05	Ground	70.254	-77.921	4	
		2012-024	T05	Ground	70.262	-77.897	4	
		2012-025	T05	Ground	70.265	-77.890	4	
		2012-026	T05	Ground	70.266	-77.849	4	
		2012-029	T04	Ground	70.270	-78.427	4	
		2012-030	T03	Ground	70.280	-78.518	4	~15 m from ice edge, ~2 m above water
		2012-040	T02	Ground	70.299	-78.511	4	25 m to ice edge, ~ 2m up from edge of ice
	Herring Gull	2012-013	T04	Ground	70.225	-78.403	-	Island on small lake
	American Pipit	2012-002	T07	Ground	70.050	-77.666	-	4 young
		2012-003	T07	Ground	70.068	-77.663	2	
		2012-035	T02	Ground	70.292	-78.483	6	
		2012-042	T01	Ground	70.303	-78.519	6	~ 3 m above possible high-water mark
		2012-045	T01	Ground	70.331	-78.503	1	~ 3 m above high-water mark

Table 19. Bird nests located during shoreline surveys at Steensby Inlet (2012) and Milne Inlet (2013).

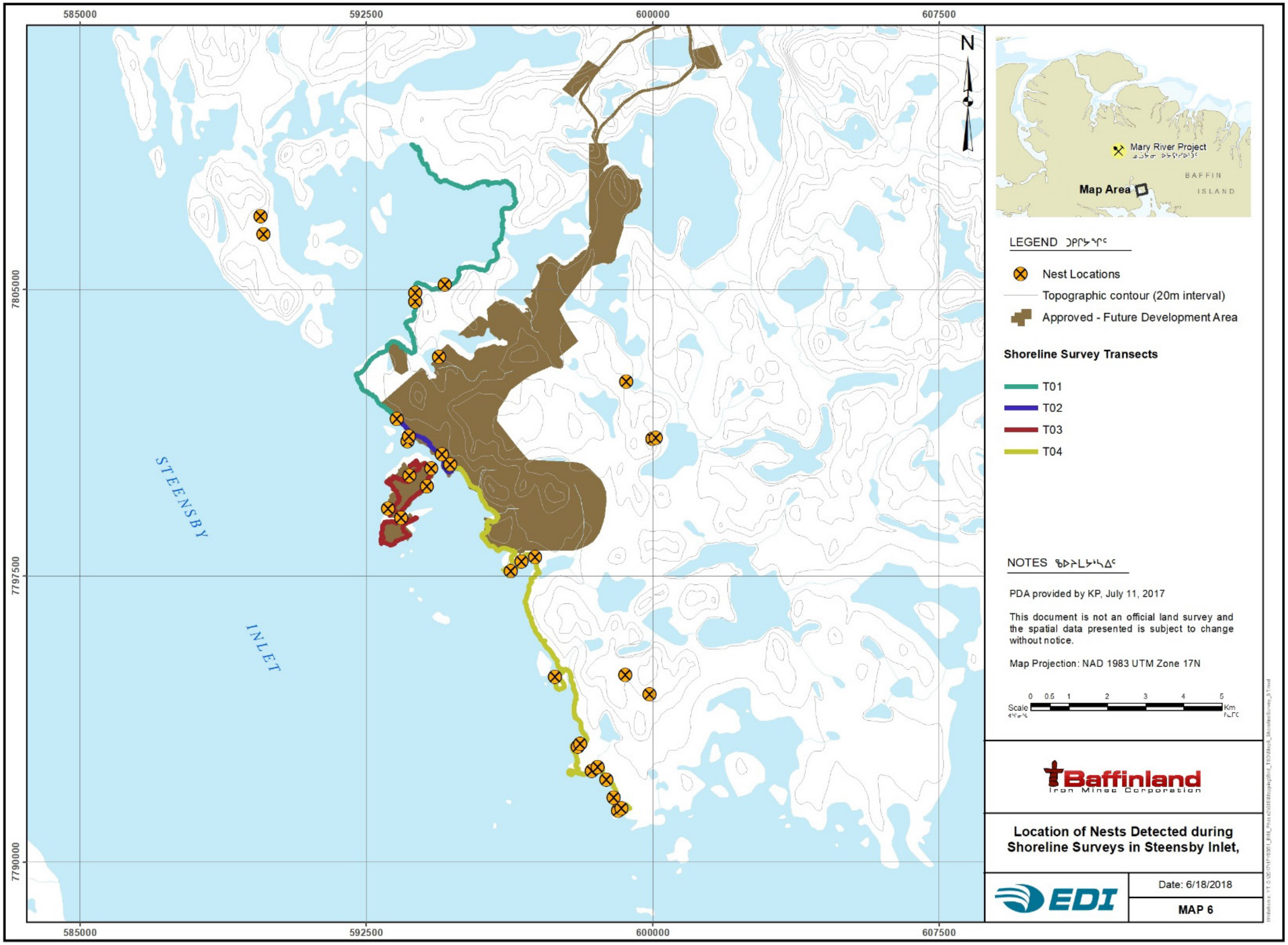
Survey	Species	Nest ID	Transect	Survey Type	Lat	Long	No. eggs	Notes
		2012-046	T01	Ground	70.333	-78.502	5	~ 4 m above water
Steensby Inlet (2012)	Lapland Longspur	2012-004	T05	Ground	70.165	-77.645	-	
		2012-036	T02	Ground	70.295	-78.488	6	
	Snow Bunting	2012-001	T07	Ground	69.971	-77.682	6	
		2012-005	T05	Ground	70.198	-77.674	4	At bottom edge of shoreline vegetation, ~2 m above high tide
		2012-007	T04	Ground	70.210	-78.374	-	Could not count eggs
		2012-008	T04	Ground	70.212	-78.379	5	Well above high tide
		2012-009	T05	Ground	70.213	-77.707	-	
		2012-011	T04	Ground	70.219	-78.394	6	
		2012-020	T04	Ground	70.241	-78.416	4	At high tide mark
		2012-027	T04	Ground	70.267	-78.444	-	
		2012-028	T04	Ground	70.269	-78.436	-	
		2012-031	T03	Ground	70.282	-78.527	-	
		2012-032	T03	Ground	70.287	-78.500	-	
		2012-034	T03	Ground	70.292	-78.496	-	Deep in rock crevice, just above high tide
		2012-039	T02	Ground	70.298	-78.512	-	Under boulder near shoreline, ~8 m from ice edge. Extremely concealed, could not count eggs. Chicks will probably fledge prior to break-up
		2012-047	T01	Ground	70.335	-78.481	>1	In wave zone, but will likely fledge before ice is gone
Milne Inlet (2013)	King\Common Eider	2013-018 2013-019	Milne01	Ground	71.904	-80.842	-	Two nests – not active (last year's). Suspect eider. 1 to 2 m above high water mark.
	Semi-palmated Plover	2013-017	Milne04	Ground	71.876	-80.931	4	Active nest at the mouth of Phillips Creek - 4 eggs. On flats, >25 m from water.

Table 19. Bird nests located during shoreline surveys at Steensby Inlet (2012) and Milne Inlet (2013).

Survey	Species	Nest ID	Transect	Survey Type	Lat	Long	No. eggs	Notes
	Glaucous Gull	2013-036	Milne09	Aerial	71.906	-80.839	-	Nesting colony on cliffs (east side of Milne Inlet). Minimum 10 birds and 5 nests
	Glaucous & Thayer's Gull	2013-037 2013-038	Milne02	Aerial	71.887	-80.934	-	Mixed colony on cliffs (western shoreline). Minimum 50 birds (~30% Thayer's) and 15 nests

Table 20. Summary of incidental bird observations during shoreline surveys in Steensby Inlet (2012) and Milne Inlet (2013).

Species	Steensby Inlet	Milne Inlet
Snow Goose	✓	✓
Ross's Goose	✓	
Canada/Cackling Goose	✓	✓
Tundra Swan	✓	
King Eider	✓	✓
Common Eider	✓	✓
Long-tailed Duck	✓	✓
Red-breasted Merganser	✓	✓
Rock Ptarmigan	✓	
Red-throated Loon	✓	✓
Pacific Loon	✓	✓
Common Loon	✓	✓
Yellow-billed Loon	✓	✓
Rough-legged Hawk	✓	✓
Peregrine Falcon	✓	
Sandhill Crane	✓	
American Golden-Plover		✓
Common Ringed Plover		✓
Semipalmated Plover	✓	✓
Baird's Sandpiper	✓	✓
Pectoral Sandpiper	✓	
Red Phalarope	✓	
Herring Gull	✓	
Thayer's Gull		✓
Glaucous Gull	✓	✓
Common Raven	✓	✓
Horned Lark		✓
American Pipit	✓	✓
Lapland Longspur	✓	✓
Snow Bunting	✓	✓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STEENSBY
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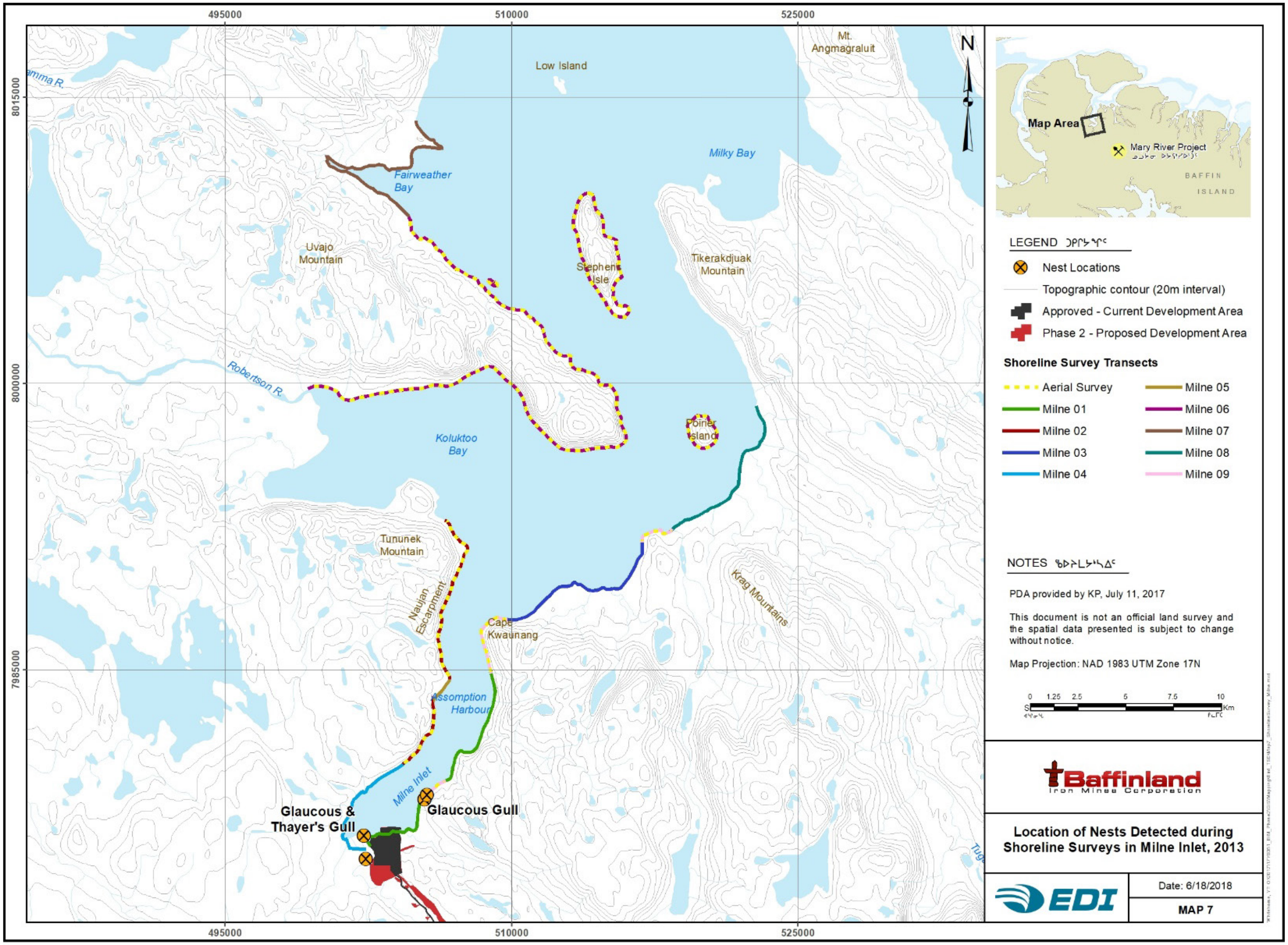
ISLAND
Map Area
LEGEND
Nest Locations
Topographic contour (20m interval)
Approved - Future Development Area
Shoreline Survey Transects
T01
T02
T03
T04
NOTES
PDA provided by KP, July 11, 2017
This document is not an official land survey and the spatial data presented is subject to change without notice.
Map Projection: NAD 1983 UTM Zone 17N
Scale
0 0.5 1 2 3 4 5
Km
Baffinland
Iron Mines Corporation
Location of Nests Detected during Shoreline Surveys in Steensby Inlet,
EDI
Date: 6/18/2018
MAP 6



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7985000
Low Island
Mt. Angmagraluit
Fairweather Bay
Milky Bay
Uvajo Mountain
Stephens Isle
Tikerakdjuak Mountain
Robertson R.
Koluktoo Bay
Poirier Island
Tununek Mountain
Naujan Escarpment
Krag Mountains
Cape Kwaunang
Assomption Harbour
Milne Inlet
Glaucous & Thayer's Gull
Glaucous Gull
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Map Area
Mary River Project
BAFFIN ISLAND
LEGEND
Nest Locations
Topographic contour (20m interval)
Approved - Current Development Area
Phase 2 - Proposed Development Area
Shoreline Survey Transects
Aerial Survey
Milne 01
Milne 02
Milne 03
Milne 04
Milne 05
Milne 06
Milne 07
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Milne 09
NOTES
PDA provided by KP, July 11, 2017
This document is not an official land survey and the spatial data presented is subject to change without notice.
Map Projection: NAD 1983 UTM Zone 17N
0 1.25 2.5 5 7.5 10 Km
Baffinland Iron Mines Corporation
Location of Nests Detected during Shoreline Surveys in Milne Inlet, 2013
EDI
Date: 6/18/2018
MAP 7

2.6.5.2 Milne Inlet Staging Surveys

Spring staging surveys were conducted in Milne Inlet in 2015. Waterfowl and other marine-associated birds use staging sites in areas of open water during spring migration to meet energetic needs. Due to river flow and snow melt, the river mouths are the first areas of open water. Understanding of early open water use by waterfowl and marine-associated birds in the Milne Inlet area was limited. Therefore, staging surveys were conducted to determine species composition, abundance and use of river mouths by staging waterfowl. The 2015 staging surveys were conducted prior to the 2015 shipping season while marine ice was still frozen and open water within Milne Inlet was limited to small areas around the river mouths.

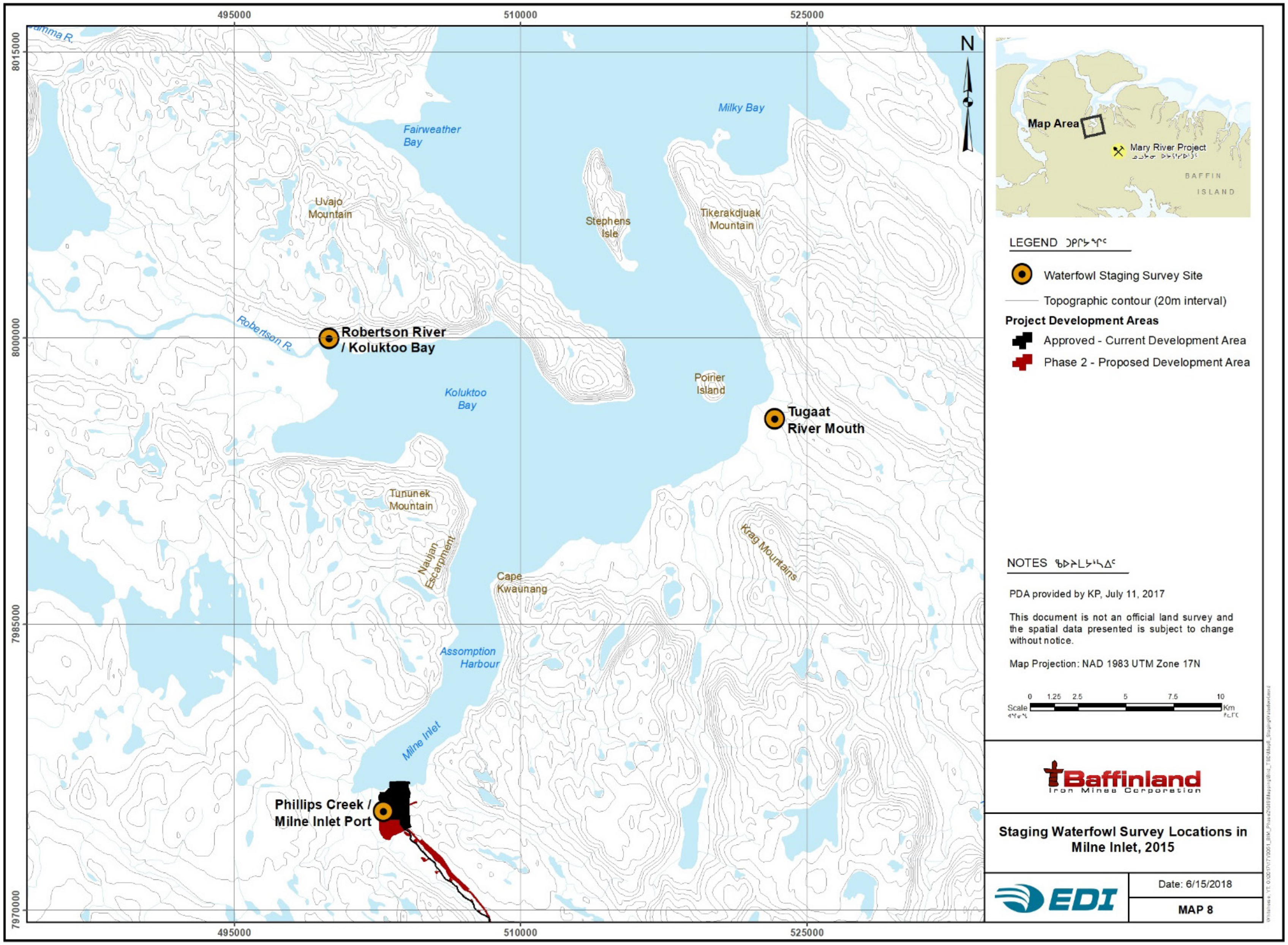
Methods

Three sites in Milne Inlet were selected for the spring staging surveys in Milne Inlet (Map 8): the mouth of Phillips Creek (near the Milne Inlet Port), the mouth of the Tugaat River, and the mouth of the Robertson River (in Koluktoo Bay).

Surveys were conducted for five days at each site from 10–15 June 2015 by an experienced birder, a field biologist, and a Baffinland environmental monitor. Surveys on 10 June consisted of reconnaissance and aerial counts of birds from a helicopter along the river. Ground-based survey locations at each site were selected to have clear views of the river mouth and estuary from a prominent location. Staging surveys involved three observers at each site using binoculars and a spotting scope to scan water and surrounding upland sites for birds and wildlife. At each staging survey location, the following information was recorded:

- Date
- Location
- Start and end time
- Species
- Number of individual
- Weather conditions
- Notes on ice conditions
- Photos

Additional incidental observations of wildlife were noted while in transit in the study area.



495000
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Fairweather Bay
Milky Bay
Uvajo Mountain
Stephens Isle
Tikerakdjuak Mountain
Robertson R.
Robertson River / Koluktoo Bay
Koluktoo Bay
Poirier Island
Tugaat River Mouth
Tununek Mountain
Naujan Escarpment
Krag Mountains
Cape Kwaunang
Assomption Harbour
Milne Inlet
Phillips Creek / Milne Inlet Port
N
Map Area
Mary River Project
BAFFIN ISLAND
LEGEND
Waterfowl Staging Survey Site
Topographic contour (20m interval)
Project Development Areas
Approved - Current Development Area
Phase 2 - Proposed Development Area
NOTES
PDA provided by KP, July 11, 2017
This document is not an official land survey and the spatial data presented is subject to change without notice.
Map Projection: NAD 1983 UTM Zone 17N
Scale
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Baffinland
Iron Mines Corporation
Staging Waterfowl Survey Locations in Milne Inlet, 2015
EDI
Date: 6/15/2018
MAP 8

Results and Discussion

Five staging waterfowl surveys were completed at each of the three survey sites between 10 and 15 June (Table 21), and a total of 359 individuals of 14 different bird species were observed (Table 22). Species diversity and abundance were greatest at the Phillips Creek site with 11 species and lowest at the Tugaat River mouth with 8 species.

Marine ice in the bays was completely frozen throughout the study period. Rivers upstream of the mouth had open sections with anchor ice and sunken ice where most waterbirds were observed. Throughout the study period, ice in rivers continued to melt developing more open water and increased flows. Upland shallow ponds near Milne Port were open and being used by Long-tailed Ducks. All larger lakes and ponds were frozen in the study area with few having 1–3 m of melted edge. The unfrozen margins of the larger lakes had Long-tailed Ducks and loons foraging under the ice. Tugaat River showed the least amount of open water with upstream portions opening during the study period and marine ice remaining frozen. Phillips Creek also showed a similar pattern with increases in open water and increased flows over the study period. Robertson River had the most open water with large shallow sections increasing in size over the study period. The estuary appeared shallow with large areas of open mudflats. Marine ice remained frozen throughout the study period.

Migration timing, species abundance, and species composition can change from year to year based on several factors including temperature and snow and ice cover on both the wintering and breeding range. Most waterfowl and waterbirds known to breed in the area based on previous studies were observed using open water areas at the study sites. A few common species known to breed in the area were not detected which may indicate they are later migrants (e.g., Common Eider).

Table 21. Staging waterfowl survey effort and number of species detected in Milne Inlet between 10–15 June 2015.

Survey Area	No. of Surveys (Three Observers)	Survey Effort (hh:mm)	No. of species observed	No. of individual birds observed
Phillips Creek/Milne Inlet Port	5	03:24	15	154
Robertson River/Koluktoo Bay	5	03:22	12	92
Tugaat River Mouth	5	03:40	11	165
Totals	**15**	**10:26**	**20**	**411**

Table 22. Bird species observed at each staging waterfowl site in Milne Inlet (N = 15), June 10-15, 2015.

Species[1]	Phillips Creek	Robertson River	Tugaat River	Total
Snow Goose	48	3	70	121
Canada/Cackling Goose	16	4	7	27
King Eider	6	-	-	6
Long-tailed Duck	24	27	6	57
Red-breasted Merganser	2	-	-	2
Red-throated Loon	10	12	15	37
Common Loon		1	-	1
Yellow-billed Loon	7	16	-	23
Sandhill Crane		-	5	5
American Golden-Plover	2	-	-	2
Semipalmated Plover	-	-	9	9
Plover sp.	-	-	7	7
Baird's Sandpiper	12	-	-	12
Thayer's Gull	2	8	-	10
Glaucous Gull	9	13	18	40
Total	**138**	**84**	**137**	**359**

[1] Incidental bird species observed at survey sites include Peregrine Falcon (1), Common Raven (1), Horned Lark (24), American Pipit (9), Lapland Longspur (13) and Snow Bunting (4).

2.6.5.3 Seabird Research

Environment and Climate Change Canada is conducting ongoing research in marine regions of Canada's Arctic looking at the potential risk from increased shipping activity on seabirds. Baffinland has supported research on seabird populations within or surrounding the MRSA including:

- Hudson Strait Common Eider and Polar Bear surveys;
- Peak seabird activity and overlap with shipping activity off Baffin Island and Hudson Strait (Mitacs Report);
- Marine habitat use by Thick-billed Murres at Digges Island and Cape Graham Moore, and;
- East Bay Island migratory bird research.

Much of this work is ongoing, and research results are being analyzed and written up by graduate students and post-doctoral fellows at Carleton University, Acadia University, McGill University, Université du Québec à Rimouski, and the University of Windsor. However, interim results are provided in annual field summary reports.

Hudson Strait Common Eider and Polar Bear Surveys — This project aims to address information gaps related to marine wildlife habitat assessments to support resource development projects in arctic marine environments. Project objectives are to quantify the distribution and abundance of marine birds in the Hudson Strait-Foxe Basin region on a yearly basis, as well as the physical and biological factors that determine those patterns (Environment and Climate Change Canada 2016a). This data will eventually be integrated into computer simulation models to assess and anticipate possible interactions between bird populations and proposed project activities, such as marine shipping. Surveys completed in 2016 included: eider population monitoring and response to Polar Bear activity, Polar Bear behaviour and genetics, and disease monitoring of costal eider colonies (Environment and Climate Change Canada 2016a).

Mitacs Report — This report was completed in 2017 and reviewed at-sea distribution of seabirds in relation to shipping lanes using historical seabird datasets spanning from 1965 to 1992 and 2007 to 2016. Marine areas of high density for Thick-billed Murres, Dovekies, Black-legged Kittiwakes, Northern Fulmars, and Black Guillemots were identified and overlaid with shipping activity data spanning from 2011 to 2015. Interaction of these layers identified regions where high shipping activity would pose the highest risk to these species (Wong 2017). The report identified the following regions where high shipping activity posed the highest risk: Navy Board Inlet, Eclipse Sound, Frobisher Bay, Hudson Strait and the coast of Labrador; three out of five of these areas are within the MRSA. These areas provide important foraging and post-breeding/migratory habitats and are frequented by ships servicing nearby communities (Wong 2017).

Thick-Billed Murre Habitat at Digges Island and Cape Graham Moore — The goal of this project is to determine the distribution and abundance patterns of Thick-billed Murres from these nesting colonies in order to identify key marine habitats to fill information gaps related to potential ecological impacts of increased shipping (Environment and Climate Change Canada 2016b). This research was expanded in 2014 in response to the northern shipping route of the Mary River Project, and now looks at shipping routes that fall within both the northern and southern portions of the MRSA (Janssen and Macdonald 2014).

Studies completed in 2016 at the Digges Island colony in Hudson Strait looked at Thick-billed Murre habitat use in different marine habitat areas relative to changes between breeding stages (incubating eggs vs. feeding chicks), as well as foraging behaviour influences on physiology and energy budgets (Environment and Climate Change Canada 2016b). At the Cape Graham Moore colony on Bylot Island, data were collected on foraging movement and physiology, which will be compared to previous Digges Island work to understand differences between colonies. The intent of these ongoing studies is to establish a baseline of marine habitat use by Thick-billed Murres for assessing potential impacts of increased shipping and identifying marine protected areas in the region (Environment and Climate Change Canada 2016b).

Eider Duck Ecology on East Bay Island — Research on eider duck ecology has been conducted on East Bay Island for the past 20 years in response to concerns regarding overharvesting of northern Common Eiders on their wintering range in west Greenland. This long-term dataset has been expanded over the years and has been used as a baseline in response to various other concerns raised by northern communities and environmental assessments, including resource development in the area (Environment and Climate Change Canada 2016c). This study examines the impacts of weather, harvest, Polar Bear predation, and physiology on eider reproductive decisions in the absence of shipping activity.

Studies in 2016 focused on identifying key seabird marine habitats to mitigate potential issues related to development and shipping, understanding the link between climate variability, reproduction and survival of arctic breeding migratory birds, and investigating the direct effects of changing sea-ice on eider populations (Environment and Climate Change Canada 2016c).

2.6.6 HABITAT AND DENSITY MODELS

This section summarizes the methods and results of habitat modelling for bird species selected as Key Indicators for the assessment of potential effects of the Phase 2 Proposal. The habitat suitability models developed in 2011 for the Mary River Project Bird Baseline Report (EDI Environmental Dynamics Inc. 2011) for Peregrine Falcon, Red-throated Loon and King and Common Eider as well as the density map developed for Lapland Longspur were updated. The Snow Goose model was discarded given that use of the TRSA by this species is primarily as a stop-over area during migration and that only a small portion of the TRSA overlaps with the known moulting area (Reed et al. 1993). New habitat suitability models were developed for Red-necked Phalarope and Red Knot and a density map based on at-sea observations was developed for Thick-billed Murre. Other than Thick-billed Murre which was selected as a Key Indicator within the MRSA (described further in Section 3), all habitat models were developed for the TRSA.

2.6.6.1 Red-throated Loon Habitat Model

Habitat suitability modeling for Red-throated Loon, King and Common eiders, and Red-necked Phalarope was created based on vegetation cover type using northern land cover (NLC) of Canada data (Olthof et al. 2009), waterbodies and watercourses (1:50,000 CanVec), and slope (30 m Canadian Digital Elevation Model). Each suitability model included two components: a terrestrial component (i.e., nesting) and an aquatic component (i.e., brood rearing) combined into a single model for habitat use during the nesting season. Model inputs were rated from 0 to 1 and combined to produce the habitat suitability model. Modelling outputs were then categorized as Nil (<0.05), Low (0.05–0.25), Medium (0.25–0.75) or High (>0.75) quality habitat.

The habitat suitability model for Red-throated Loon was developed based on vegetation cover type, distance to water (terrestrial only), slope and distance to shore (aquatic only). Table 23 provides a summary of the habitat ratings for the Red-throated Loon model.

Table 23. Red-throated Loon Habitat Suitability Model Inputs

Habitat Variable	Model Component	Summary of Rating
Vegetation Cover Type	Terrestrial	Vegetation cover types were rated for their value to nesting Red-throated Loon. High value cover types included Wetlands, and Wet Sedge. Tussock Graminoid Tundra, Moist to Dry Non-Tussock Graminoid/Dwarf Shrub Tundra, Dry Graminoid Prostrate Dwarf Shrub Tundra, and Prostrate Dwarf Shrub Tundra were rated as moderate.
Distance to Water	Terrestrial	Distance to water rated terrestrial habitats based on their proximity to fresh water bodies of various sizes (i.e., lakes, ponds, rivers etc.). Ratings decreased with increasing distance from fresh water.
Slope	Terrestrial	The model assumed that Red-throated Loon restricted their use of habitats to those with a slope of 5% or less.
Distance to Shore	Aquatic	Distance to shore was applied separately and rated aquatic habitats based on the type of water body and the distance to shore. All river habitats were weighted as 0.3. Weighting for fresh water lakes varied by size with smaller ponds\lakes (0-1 ha) rated the highest (1), while larger ponds\lakes (> 1 ha) were rated slightly lower (0.7). Marine habitats were rated as 1 within 500 m of the shore and were considered to have no value beyond 500 m.

The habitat suitability model indicated that less than 1% of the TRSA contains high value habitat for Red-throated Loon, and only 9% of the TRSA contains moderate quality habitats (Table 24). The majority (86%) of the TRSA is assumed to have no value to Red-throated Loons. High quality habitats typically consist of smaller fresh water ponds/lakes and terrestrial habitats near marine and fresh water bodies; these are most concentrated in the southern and west-central regions of the TRSA (Map 9).

Table 24. Habitat Suitability Modelling Results for Red-throated Loon

Density Class	Area (km²)	% TRSA
High	186	0.9%
Moderate	1,939	9.2%
Low	873	4.1%
Nil	18,056	85.8%

2.6.6.2 King and Common Eider Habitat Model

Like the model for Red-throated Loon, the habitat suitability model for eider included both an aquatic and terrestrial component. The aquatic component was based on the distance to shore which accounted for both the type of water body and the 'distance to shore'. The terrestrial component incorporated vegetation cover type, distance to water, and slope. Additionally, the model assumed a selection for habitats within 6 km of the marine coastline, or within 1 km of a larger fresh water lake (> 5 ha); high value terrestrial habitats were limited to these areas, with all other terrestrial habitat capped at moderate. Table 25 provides a summary of the habitat ratings for the eider model.

Table 25. Eider Habitat Suitability Model Inputs

Habitat Variable	Model Component	Summary of Rating
Vegetation Cover Type	Terrestrial	Vegetation cover types were rated for their value to nesting eiders. High value cover types included Moist to Dry Non-Tussock Graminoid/Dwarf Shrub Tundra, Dry Graminoid Prostrate Dwarf Shrub Tundra, Tussock Graminoid Tundra, Wet Sedge and Wetlands.
Distance to Water	Terrestrial	Distance to water rated terrestrial habitats based on their proximity to water bodies of various sizes (i.e., lakes, ponds, rivers etc.). The model assumed that eiders would be most likely to choose nest sites within 50 m of a water body, but that nests could be found more than 1 km from water.
Slope	Terrestrial	The model assumed that eider preferentially selected habitats on more gradual slopes; slopes of 10% or less were rated as 1, while slopes greater than 10% were rated as 0.3.
Proximity to Coastline	Terrestrial	The model assumed that sites within 6 km of the marine coastline were preferred for nesting (particularly by Common Eider) or with 1 km of inland lakes (> 5 ha; primarily King Eider). High value terrestrial habitats were limited to these areas, all other terrestrial habitats were capped at moderate.
Distance to Shore	Aquatic	Distance to shore was applied separately and rated aquatic habitats based on the type of water body and the distance to shore. All river habitats were weighted as 0.25. Weighting for fresh water lakes varied by size with smaller ponds\lakes (0-1 ha) rated 0.5, and ponds\lakes 1-5 ha rated as 1. Larger lakes (> 5 ha) and marine habitats were rated as 1 within 200 m of the shore and were of less value further from shore.

Habitat suitability modelling for King and Common Eider indicated that approximately 6% and 11% of the TRSA contains high and moderate value habitat for eiders, respectively (Table 26). High quality habitats are concentrated along the marine shoreline, particularly along Steensby Inlet, and around the larger lakes and ponds in the west-central portions of the TRSA (i.e., in the area around Angajurjualuk Lake and Nina Bang Lake, Map 10).

Table 26. Habitat Suitability Modelling Results for Eiders

Density Class	Area (km²)	% TRSA
High	1,176	5.6%
Moderate	2,358	11.2%
Low	10,035	47.7%
Nil	7,485	35.6%

2.6.6.3 Red-Necked Phalarope Habitat Model

As with the previous models, the habitat suitability model for Red-necked Phalarope included a terrestrial and aquatic component and was based on vegetation cover type, distance to water (terrestrial only), slope and distance to shore (aquatic only). Table 27 provides a summary of the habitat ratings for the Red-necked Phalarope model.

The habitat suitability model demonstrated that the majority of the TRSA is assumed to have no value to Red-necked Phalarope; only about 7% of the TRSA provides high and moderate value habitat for Red-necked Phalarope (Table 28). High and moderate quality habitats generally consist of smaller fresh water ponds and are most concentrated in the west-central portions of the TRSA (Map 12).

Table 27. Red-necked Phalarope Habitat Suitability Model Inputs

Habitat Variable	Model Component	Summary of Rating
Vegetation Cover Type	Terrestrial	Vegetation cover types were rated for their value to nesting Red-necked Phalarope. High value cover types included Wetlands, Wet Sedge and Tussock Graminoid Tundra.
Distance to Water	Terrestrial	Distance to water rated terrestrial habitats based on their proximity to fresh water bodies of various sizes (i.e., lakes, ponds, rivers etc.). Ratings decreased with increasing distance from fresh water and assumed that phalaropes would not nest in habitats >100 m from water.
Slope	Terrestrial	The model assumed that Red-necked Phalarope restricted their use of habitats to those with a slope of 5% or less.
Distance to Shore	Aquatic	Distance to shore was applied separately and rated aquatic habitats based on the type of water body and the distance to shore. All river habitats were weighted as 0.3. Weighting for fresh water lakes varied by size with smaller ponds\lakes (0-1 ha) rated the highest (1), while larger ponds\lakes (> 1 ha) were rated slightly lower (0.6). Marine habitats were considered to have no value for nesting phalarope.

Table 28. Habitat Suitability Modelling Results for Red-necked Phalarope

Density Class	Area (km²)	% TRSA
High	33	0.2%
Moderate	1,451	6.9%
Low	1,088	5.2%
Nil	18,482	87.8%

2.6.6.4 Red Knot Habitat Model

For Red Knot a habitat model was created using the Circumpolar Arctic Vegetation Map (CAVM; (CAVM Team 2003)). The model was developed based on an analysis of Red Knot habitat use within the Canadian Arctic done by Environment Canada. Red Knot sighting throughout the Canadian Arctic were analysed in relation to CAVM habitat type and survey coverage to determine in which habitats types Red Knots were most commonly observed (Smith and Rausch 2013). For the habitat model, habitat preferences demonstrated in the Environment Canada analysis were used to group vegetation classes into one of two habitat categories: Suitable (i.e., those habitat types determined to be preferred by Red Knots) and Less Suitable (i.e., those habitat types not preferred). No other habitat variables were incorporated in the Red Knot habitat model.

The habitat suitability model indicated approximately 39% of the TRSA contains habitat types that are deemed suitable for breeding Red Knots (Table 29). These habitats are concentrated in the western sections of the TRSA (Map 13).

Table 29. Habitat Suitability Modelling Results for Red Knot

Density Class	Area (km²)	% TRSA
Suitable	8,149	38.7%
Less Suitable	10,663	50.6%
Not Suitable	2,243	10.7%

2.6.6.5 Peregrine Falcon Resource Selection Function Model

As part of graduate research (thesis pending) conducted through the work at Mary River by Arctic Raptors Inc., a habitat model for Peregrine Falcon nesting was developed. Known nest sites from the 2006 to 2008 and 2011 to 2013 studies were used to build a habitat selection model using logistic regression (RSF) to identify areas most likely to harbour breeding pairs of Peregrine Falcon. The model was then used to facilitate searching for additional nest sites within the TRSA.

Habitat selection was quantified using a "used-available" design at the scale of the expected home range size for Peregrine Falcon. Expected home range size was estimated using the mean nearest neighbour distance (5 km) calculated from known nest sites. To characterize habitat associated with "used expected home ranges", each known nest site (i.e., point locations) was buffered by a circular plot (5 km radius) centered on nest locations. For "available expected home ranges," a single random point location for every used nest site (i.e., ratio of 1:1 used to available) was generated, and similarly buffered by a circular plot with 5 km radius centered on the random point. Waterbodies were excluded from the "available" area. For all used and random "expected home ranges", 13 candidate RSFs were generated and ranked using Akaike's Information Criterion (ΔAICc) and Akaike weights (w). Prior to model fitting, multi-collinearity and correlation among all variables were evaluated. The resulting model was integrated within GIS to predict the relative probability of occurrence of a breeding pair in each 30X30 m cell across the monitoring study area.

To facilitate visualisation and interpretation of resulting maps, predicted values of the RSF were reclassified into five probability classes: Lowest ($0 \geq 0.2$), Low ($0.2 \geq 0.4$), Average ($0.4 \geq 0.6$), High ($0.6 \geq 0.8$), Highest ($0.8 \geq 1.0$).

The RSF model for Peregrine Falcon demonstrated that approximately 43% of the TRSA represents habitat classed as very high or high for Peregrine Falcon nesting (Table 30). These habitats are concentrated in bands along the inlet shorelines and major valleys within the TRSA (Map 11).

Table 30. Resource Selection Function Modelling Results for Peregrine Falcon

Density Class	Area (km²)	% TRSA
Very High	4,190	19.9%
High	4,958	23.5%
Moderate	4,078	19.4%
Low	3,473	16.5%
Very Low	4,355	20.7%

2.6.6.6 Lapland Longspur Population Density Map

Habitat suitability modeling was not completed for Lapland Longspur or any other songbird species. So in order to assess habitat availability for these species for the FEIS, a map of Lapland Longspur habitat was created based on observed and estimated densities documented during the pre-development data collection period. This mapping was updated based on the results of the PRISM surveys conducted in 2012 and 2013 to better reflect Lapland Longspur densities and distribution within the TRSA. To create the map of Lapland Longspur habitat use, the PRISM survey results were analysed in relation to NLC habitat classes to derive the densities of Lapland Longspur observed in each NLC habitat class surveyed. The observed densities were then grouped into classes of High, Moderate, Low and Nil, and applied to the NLC map layers. Some NLC habitat types present within the TRSA were not surveyed during field surveys (or were surveyed less than five times); for these, densities were estimated based on observed densities during the pre-development baseline work, documented densities at other study areas in the Canadian Arctic, and the professional judgment of project biologists. Table 31 outlines the density ratings used in the mapping of Lapland Longspur habitat.

The resulting habitat map (Map 14) shows that high value habitats are disbursed throughout the TRSA but are most concentrated in the west-central regions of the TRSA. Approximately 7% of the TRSA can be expected to host high densities (>45 birds/km²) of Lapland Longspur, while moderate densities (30–45 birds/km²) may be found in approximately 26% of the TRSA (Table 32).

Table 31. Density Classes used for Mapping Lapland Longspur Habitat in the TRSA based on the 2012/2013 PRISM Survey Results

NLC Label	NLC Habitat Description	% of RSA	# PRISM Plots Completed	Average Density of Lapland Longspur per km² ± S.D.	Density Class[1]
0	No Data	2.5%	0	Not surveyed. Assumed to be nil.	Nil
1	tussock graminoid tundra	4.2%	6	70.8 ± 50.8	High
2	wet sedge	2.4%	6	45.8 ± 29.2	High
3	moist to dry non-tussock graminoid/dwarf shrub tundra	7.5%	11	25.8 ± 30.2	Low
4	dry graminoid prostrate dwarf shrub tundra	<0.1%	0	Not surveyed. Estimated at 57.3[2]	High
7	prostrate dwarf shrub	16.6%	21	37.3 ± 32.3	Moderate
8	sparsely vegetated bedrock	28.0%	18	24.1 ± 29.4	Low
9	sparsely vegetated till-coluvium	9.7%	4	0.0 ± 0.0	Low [3]
10	bare soil with cryptoogam crust	10.1%	14	29.8 ± 25.3	Low
11	wetlands	1.0%	2	87.5 ± 29.5	Moderate [3]
12	barren	8.0%	3	36.1 ± 33.7	Moderate [3]
13	ice/snow	0.5%	0	Not surveyed. Assumed to be nil.	Nil
14	shadow	0.6%	0	Not surveyed. Assumed to be nil.	Nil
15	water	8.9%	0	Not surveyed. Assumed to be nil.	Nil

[1] Densities were classed as: Nil (<1/km²), Low (1 – 30/km²), Moderate (30 – 45/km²), and High (>45/km²).

[2] Not surveyed in pre-FEIS or post-FEIS surveys. Densities in graminoid dwarf shrub tundra: 57.3/km² (Henry and Mico 2002)

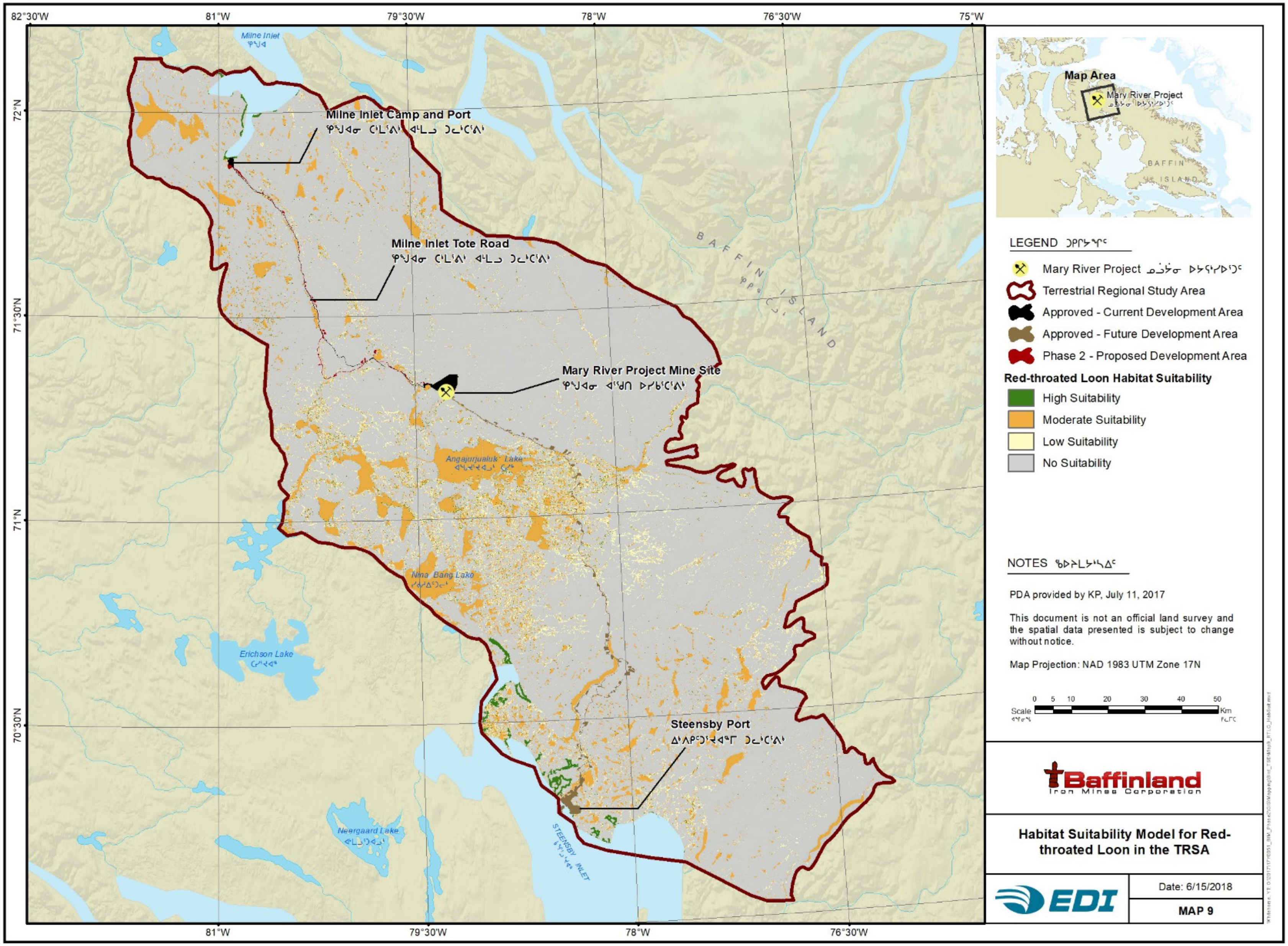
[3] Due to a limited number of PRISM plots completed in these habitats, the density class also considered pre-FEIS survey data, and documented densities at other similar study areas — e.g., densities in sedge marsh habitat = 9.7/km², densities in sedge wetland habitat = 13/km² (Latour et al. 2005).

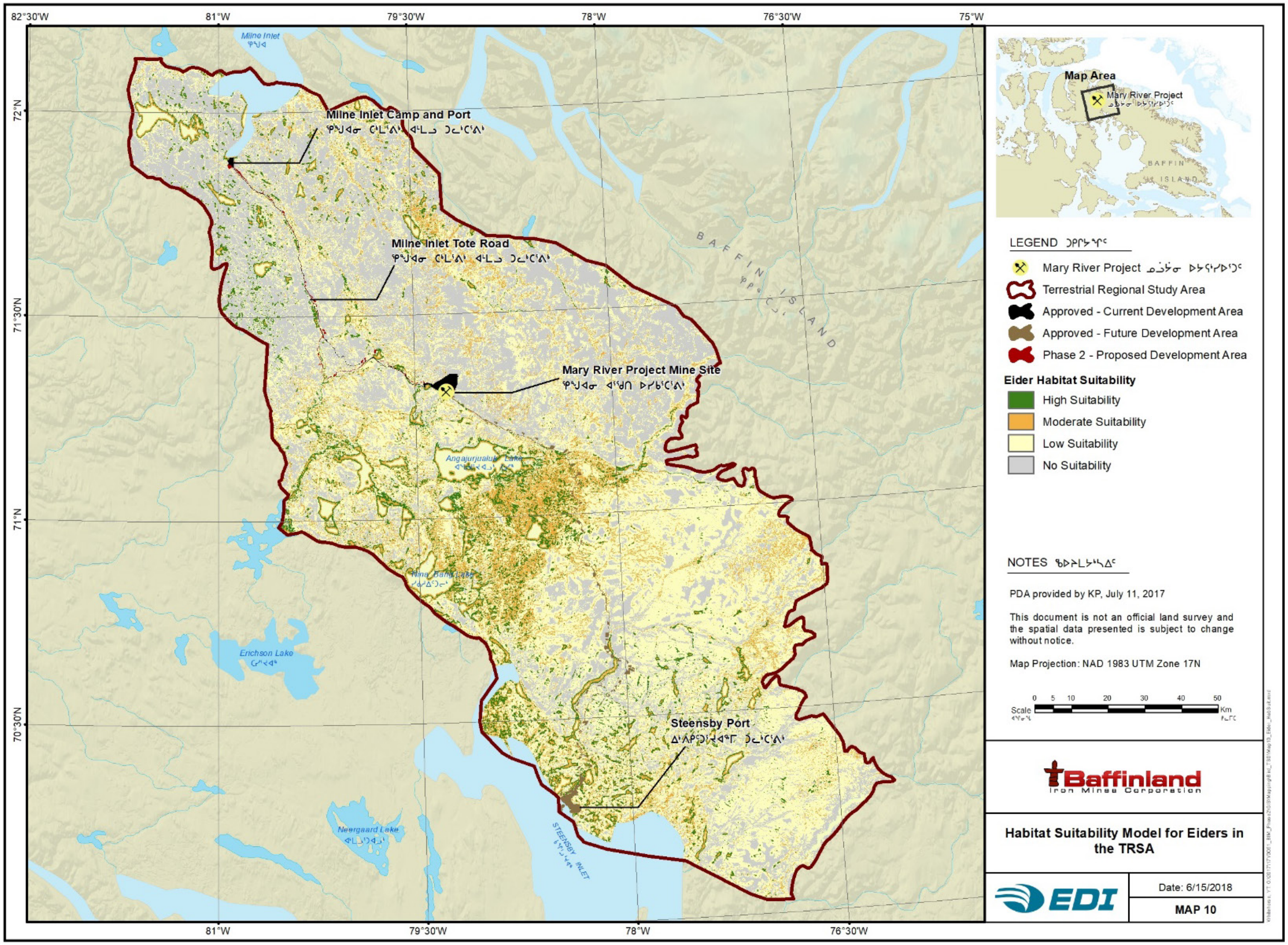
Table 32. Results of the Density Map for Lapland Longspur

Density Class	Area (km²)	% TRSA
High	1,389	6.6%
Moderate	5,394	25.6%
Low	11,652	55.3%
Nil	2,618	12.4%

2.6.6.7 Thick-billed Murre At-Sea Observations Density Map

Like Lapland Longspur, a habitat suitability model for Thick-billed Murre was not developed. Instead, Thick-billed Murre observations within the MRSA were used to create a map showing areas of where Thick-billed Murre use was concentrated. The density analysis was produced based on Project survey data (from pre-development marine surveys) and observations from vessel-based surveys at sea (Hyrenbach et al. 2012). The resulting map shows the higher levels of use near the Cape Graham Moore colony on Bylot Island and along sections of the Hudson Strait (Map 15).


82°30'W
81°W
79°30'W
78°W
76°30'W
75°W
72°N
71°30'N
71°N
70°30'N
Milne Inlet
Milne Inlet Camp and Port
Milne Inlet Tote Road
Mary River Project Mine Site
Angajurjualuk Lake
Nina Bang Lake
Erichson Lake
Neergaard Lake
Steensby Port
STEENSBY INLET
BAFFIN ISLAND
Map Area
Mary River Project
BAFFIN ISLAND
LEGEND
Mary River Project
Terrestrial Regional Study Area
Approved - Current Development Area
Approved - Future Development Area
Phase 2 - Proposed Development Area
Red-throated Loon Habitat Suitability
High Suitability
Moderate Suitability
Low Suitability
No Suitability
NOTES
PDA provided by KP, July 11, 2017
This document is not an official land survey and the spatial data presented is subject to change without notice.
Map Projection: NAD 1983 UTM Zone 17N
Scale
0 5 10 20 30 40 50
Km
Baffinland
Iron Mines Corporation
Habitat Suitability Model for Red-throated Loon in the TRSA
EDI
Date: 6/15/2018
MAP 9



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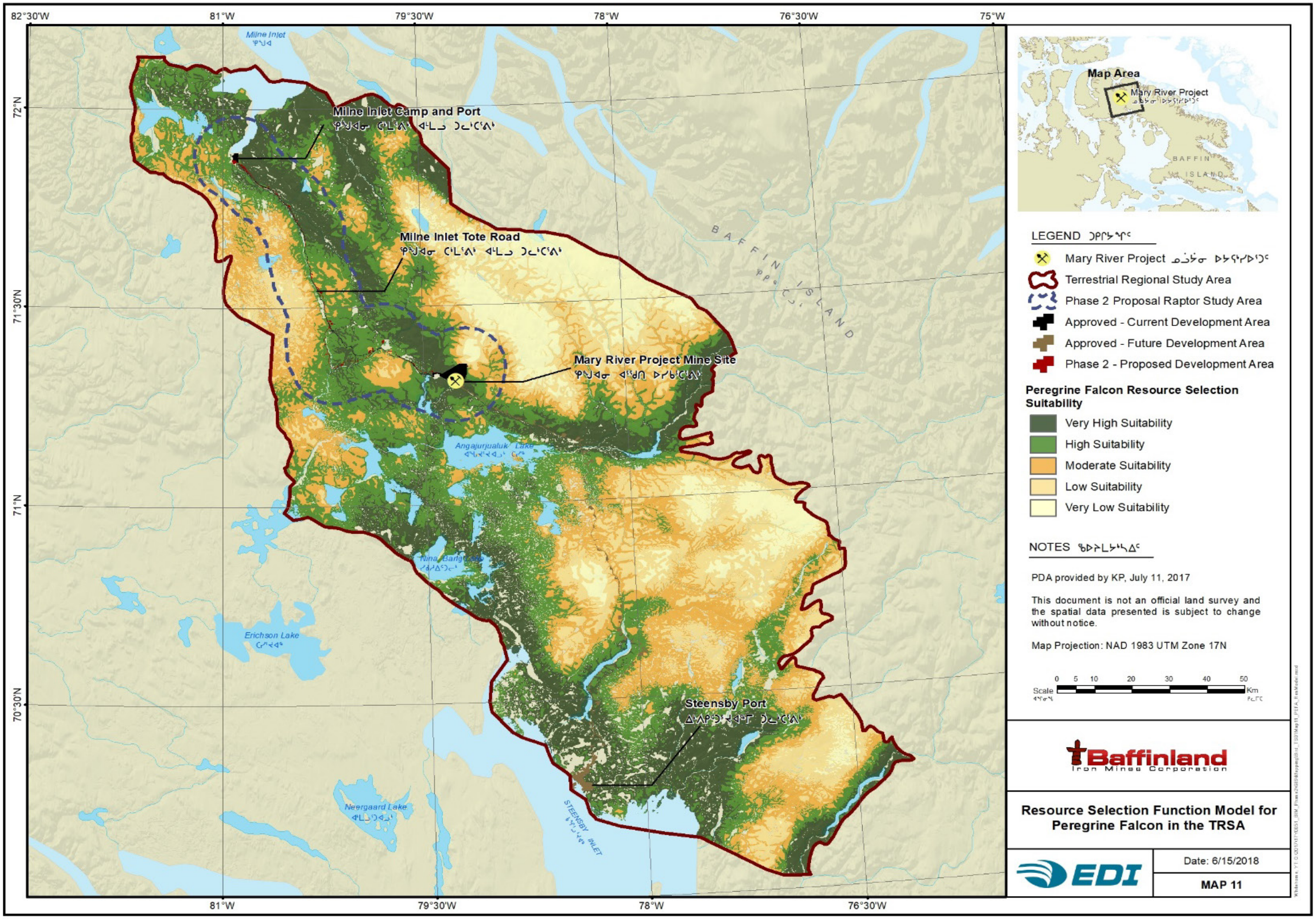
72°N
71°30'N
71°N
70°30'N
Milne Inlet
Milne Inlet Camp and Port
Milne Inlet Tote Road
Mary River Project Mine Site
BAFFIN ISLAND
Angajurjualuk Lake
Nina Bang Lake
Erichson Lake
Steensby Port
Neergaard Lake
STEENSBY INLET
Map Area
Mary River Project
BAFFIN ISLAND
LEGEND
Mary River Project
Terrestrial Regional Study Area
Approved - Current Development Area
Approved - Future Development Area
Phase 2 - Proposed Development Area
Eider Habitat Suitability
High Suitability
Moderate Suitability
Low Suitability
No Suitability
NOTES
PDA provided by KP, July 11, 2017
This document is not an official land survey and the spatial data presented is subject to change without notice.
Map Projection: NAD 1983 UTM Zone 17N
0 5 10 20 30 40 50
Scale
Km
Baffinland
Iron Mines Corporation
Habitat Suitability Model for Eiders in the TRSA
EDI
Date: 6/15/2018
MAP 10


82°30'W
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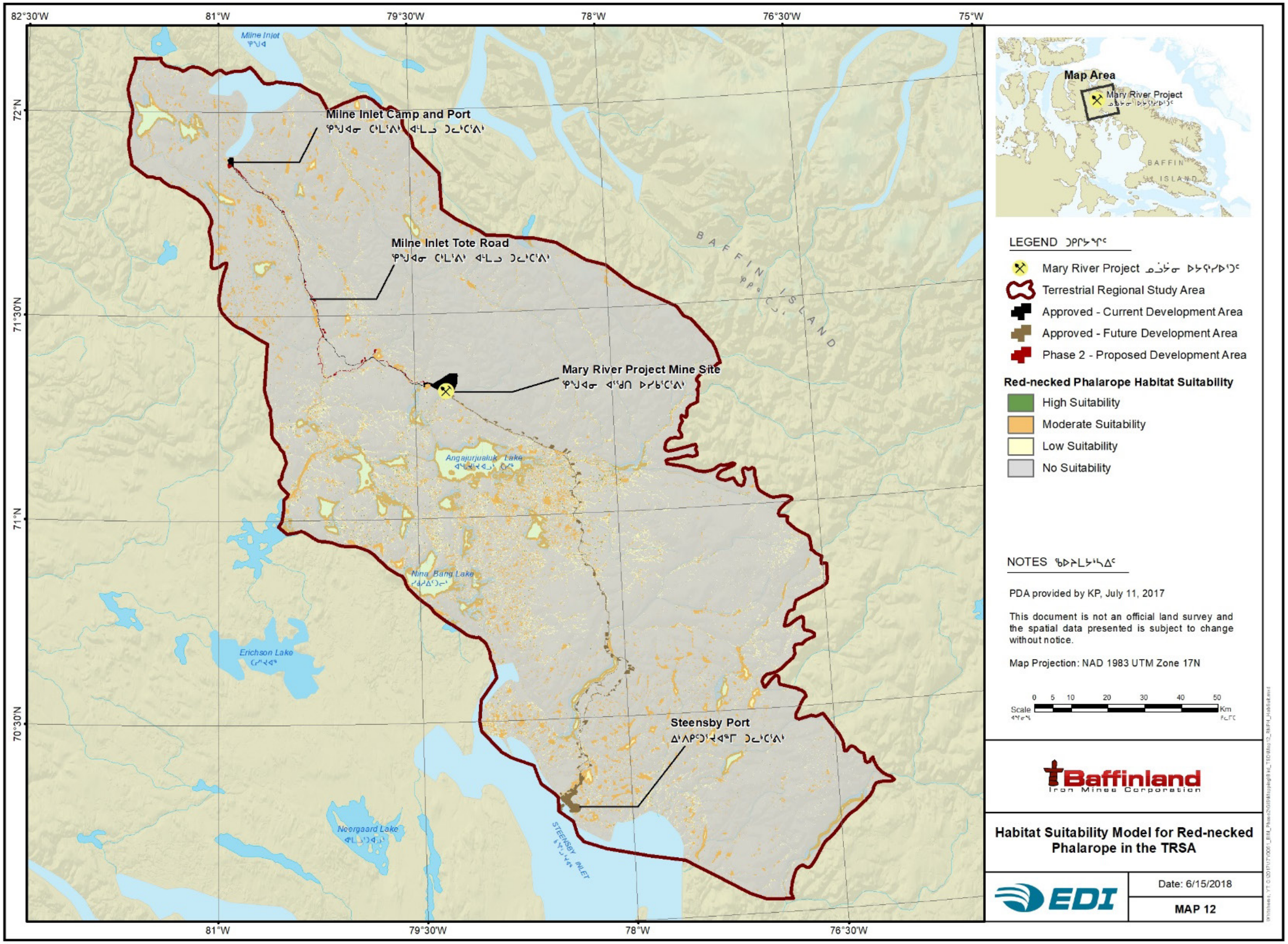
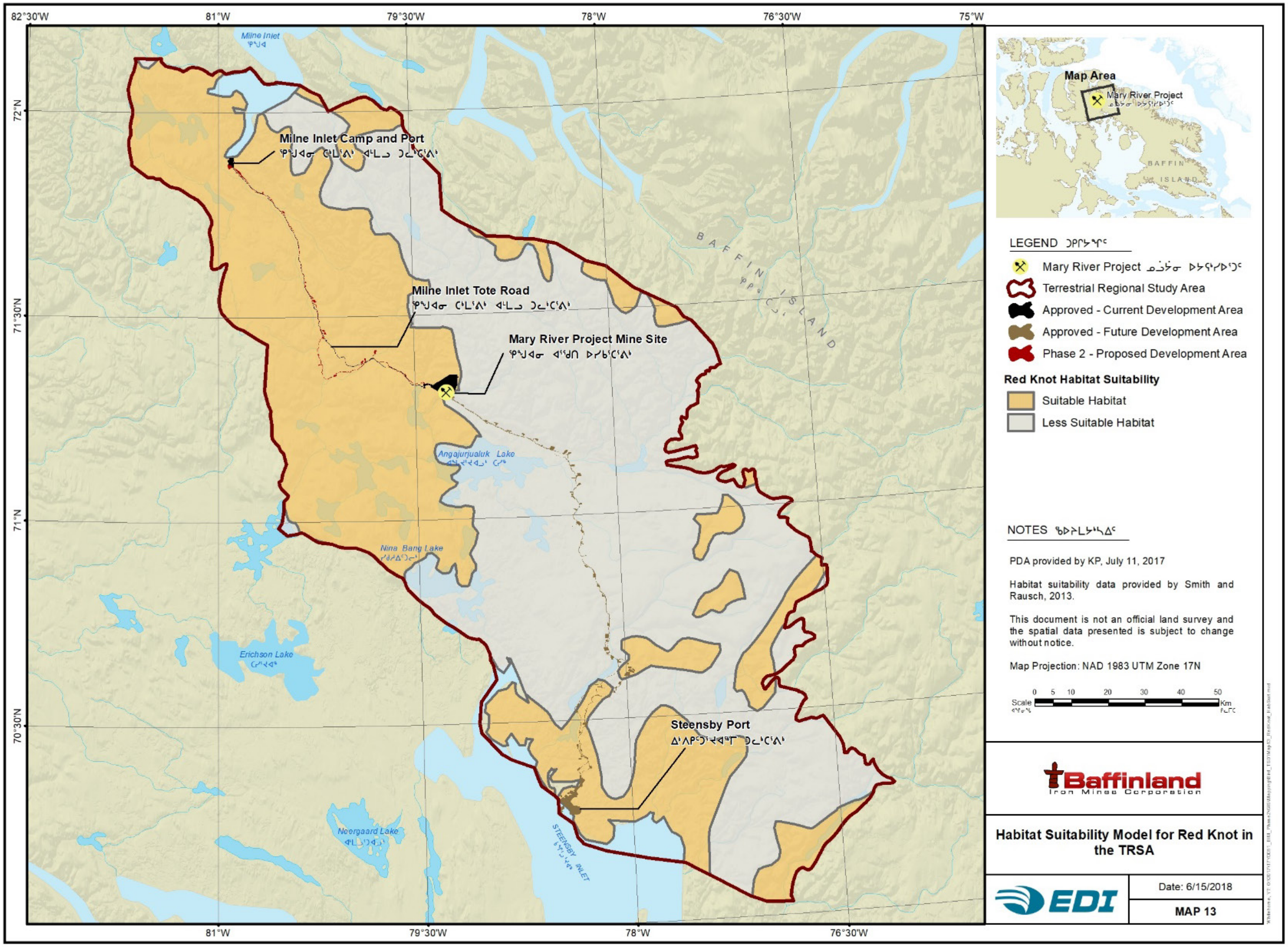
72°N
71°30'N
71°N
70°30'N
Milne Inlet
Milne Inlet Camp and Port
Milne Inlet Tote Road
Mary River Project Mine Site
Steensby Port
BAFFIN ISLAND
Angajurjualuk Lake
Nina Bang Lake
Erichson Lake
Neergaard Lake
STEENSBY INLET
Map Area
Mary River Project
LEGEND
Mary River Project
Terrestrial Regional Study Area
Phase 2 Proposal Raptor Study Area
Approved - Current Development Area
Approved - Future Development Area
Phase 2 - Proposed Development Area
Peregrine Falcon Resource Selection Suitability
Very High Suitability
High Suitability
Moderate Suitability
Low Suitability
Very Low Suitability
NOTES
PDA provided by KP, July 11, 2017
This document is not an official land survey and the spatial data presented is subject to change without notice.
Map Projection: NAD 1983 UTM Zone 17N
Scale 0 5 10 20 30 40 50 Km
Baffinland Iron Mines Corporation
Resource Selection Function Model for Peregrine Falcon in the TRSA
EDI
Date: 6/15/2018
MAP 11



Milne Inlet Camp and Port
Milne Inlet Tote Road
Mary River Project Mine Site
Steensby Port
Angajurjualuk Lake
Nina Bang Lake
Erichson Lake
Neergaard Lake
Milne Inlet
Steensby Inlet
BAFFIN ISLAND
Map Area
Mary River Project
LEGEND
Mary River Project
Terrestrial Regional Study Area
Approved - Current Development Area
Approved - Future Development Area
Phase 2 - Proposed Development Area
Red-necked Phalarope Habitat Suitability
High Suitability
Moderate Suitability
Low Suitability
No Suitability
NOTES
PDA provided by KP, July 11, 2017
This document is not an official land survey and the spatial data presented is subject to change without notice.
Map Projection: NAD 1983 UTM Zone 17N
Scale
Km
Baffinland
Iron Mines Corporation
Habitat Suitability Model for Red-necked Phalarope in the TRSA
EDI
Date: 6/15/2018
MAP 12



82°30'W
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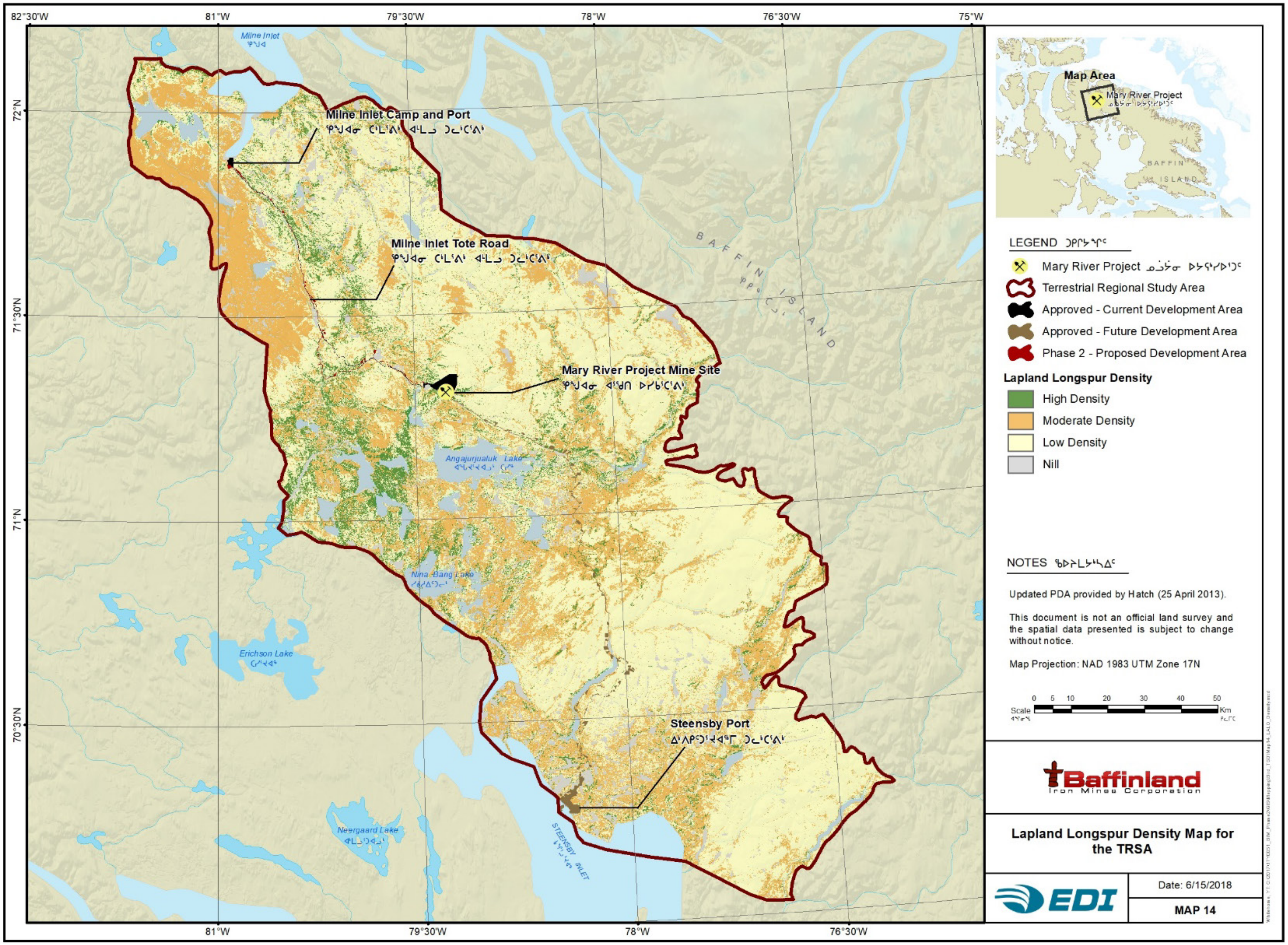
Milne Inlet
Milne Inlet Camp and Port
Milne Inlet Tote Road
Mary River Project Mine Site
Angajurjualuk Lake
Nina Bang Lake
Erichson Lake
Neergaard Lake
Steensby Port
STEENSBY INLET
BAFFIN ISLAND
Map Area
Mary River Project
LEGEND
Mary River Project
Terrestrial Regional Study Area
Approved - Current Development Area
Approved - Future Development Area
Phase 2 - Proposed Development Area
Red Knot Habitat Suitability
Suitable Habitat
Less Suitable Habitat
NOTES
PDA provided by KP, July 11, 2017
Habitat suitability data provided by Smith and Rausch, 2013.
This document is not an official land survey and the spatial data presented is subject to change without notice.
Map Projection: NAD 1983 UTM Zone 17N
Scale
0 5 10 20 30 40 50
Km
Baffinland
Iron Mines Corporation
Habitat Suitability Model for Red Knot in the TRSA
EDI
Date: 6/15/2018
MAP 13



82°30'W
81°W
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76°30'W
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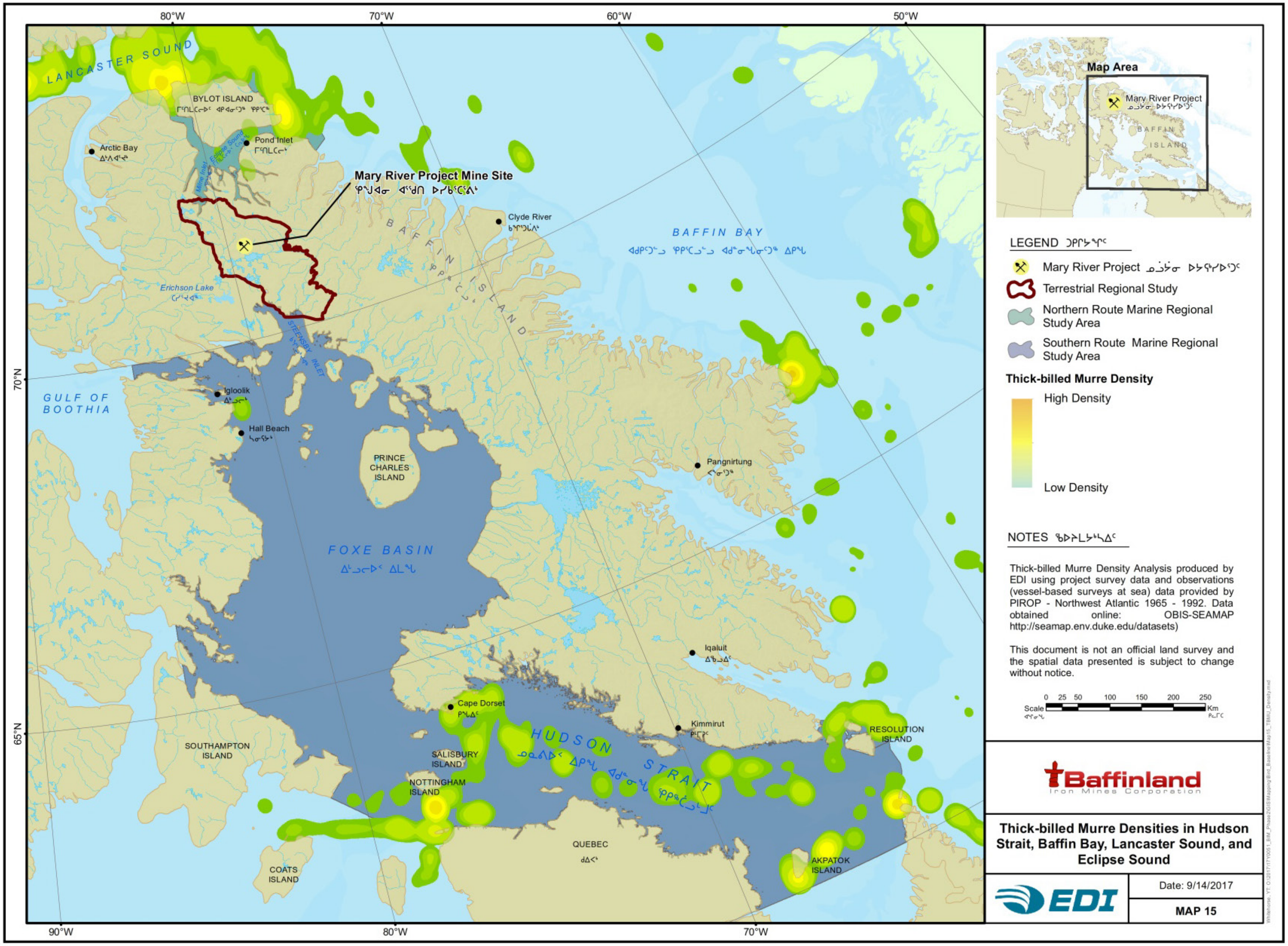
71°N
70°30'N
Milne Inlet
Milne Inlet Camp and Port
Milne Inlet Tote Road
Mary River Project Mine Site
Angajurjualuk Lake
Nina Bang Lake
Erichson Lake
Neergaard Lake
Steensby Port
STEENSBY INLET
BAFFIN ISLAND
Map Area
Mary River Project
LEGEND
Mary River Project
Terrestrial Regional Study Area
Approved - Current Development Area
Approved - Future Development Area
Phase 2 - Proposed Development Area
Lapland Longspur Density
High Density
Moderate Density
Low Density
Nill
NOTES
Updated PDA provided by Hatch (25 April 2013).
This document is not an official land survey and the spatial data presented is subject to change without notice.
Map Projection: NAD 1983 UTM Zone 17N
Scale 0 5 10 20 30 40 50 Km
Baffinland Iron Mines Corporation
Lapland Longspur Density Map for the TRSA
EDI
Date: 6/15/2018
MAP 14


80°W
70°W
60°W
50°W
90°W
80°W
70°W
70°N
65°N
LANCASTER SOUND
BYLOT ISLAND
Pond Inlet
Arctic Bay
Mary River Project Mine Site
Clyde River
BAFFIN BAY
BAFFIN ISLAND
Erichson Lake
STEENSBY INLET
GULF OF BOOTHIA
Igloolik
Hall Beach
PRINCE CHARLES ISLAND
Pangnirtung
FOXE BASIN
Iqaluit
Cape Dorset
Kimmirut
RESOLUTION ISLAND
HUDSON STRAIT
SOUTHAMPTON ISLAND
SALISBURY ISLAND
NOTTINGHAM ISLAND
QUEBEC
COATS ISLAND
AKPATOK ISLAND
Map Area
Mary River Project
BAFFIN ISLAND
LEGEND
Mary River Project
Terrestrial Regional Study
Northern Route Marine Regional Study Area
Southern Route Marine Regional Study Area
Thick-billed Murre Density
High Density
Low Density
NOTES
Thick-billed Murre Density Analysis produced by EDI using project survey data and observations (vessel-based surveys at sea) data provided by PIROP - Northwest Atlantic 1965 - 1992. Data obtained online: OBIS-SEAMAP http://seamap.env.duke.edu/datasets)
This document is not an official land survey and the spatial data presented is subject to change without notice.
Scale 0 25 50 100 150 200 250 Km
Baffinland Iron Mines Corporation
Thick-billed Murre Densities in Hudson Strait, Baffin Bay, Lancaster Sound, and Eclipse Sound
EDI
Date: 9/14/2017
MAP 15

3 IMPACTS ON BIRDS AND BIRD HABITAT

3.1 INUIT COMMUNITY AND STAKEHOLDER COMMENTS

Migratory birds and their habitats were identified as a Valued Ecosystem Component (VEC) based on potential Project effects on their populations and habitats as well as their ecological, social, and legislated importance. Baffinland conducted a number of public consultation meetings and personal interviews to receive information on baseline data and to scope potential issues of perceived project effects for the Approved Project, (e.g., (Baffinland Iron Mines Corporation 2012) and more recently to introduce the Phase 2 Proposal, gather land use information, discuss community concerns, and to assess and review potential mitigation measures (Jason Prno Consulting Services 2017). The key issues that are addressed for the Project's potential effects on migratory birds were identified through several consultation processes that included the following elements:

- Community scoping meetings;
- Terrestrial wildlife focused community working groups;
- Five community workshops held between March 2015 and May 2016;
- An environmental assessment workshop with the Qikiqtani Inuit Association (QIA) and their community representatives;
- Issues and feedback raised during meetings of the Terrestrial Environment Working Group meetings (2013–present);
- Professional experience from other northern mining projects; and
- Guidance provided by the Nunavut Impact Review Board's (NIRB) project EIS guidelines (Nunavut Impact Review Board 2015).

Community comments, personal interviews and Inuit Qaujimajatuqangit (IQ) were used in combination with the information gained from the above sources and pre- and post-development monitoring studies to develop the previous sections of this report which formed the basis of this assessment.

Although migratory birds are identified as a VEC, they include a wide variety of species that display a great diversity of behaviors and patterns of habitat use. As a result, several Key Indicator species (KIs) were selected to guide the assessment of impacts on migratory birds and their habitats. Four of the KIs selected, Snow Geese, Thick-billed Murre, Common Eider, and King Eider were consistently identified as important species by community members. All four of these species are either harvested and/or eggs collected and consumed by local people and hunters from communities near the Project. Furthermore, all are abundant and interact with existing mining operations and activities proposed for Phase 2.

Baffinland conducted several workshops, interviews, radio call-in shows and written requests to collect baseline information and determine public perceptions and concerns with the Project's interaction with Inuit land use, terrestrial wildlife, and birds (TSD 04). Concerns were varied, but generally focused on the Project's potential to affect the ability of community members to cross the ship's track when ice is present to reach egg gathering and goose hunting areas, effects of disturbance on bird behavior, and the potential for increased bird mortality.

"Birds and eggs are also harvested during this period (late May to July)." Pond Inlet

"Birds including geese and murres are harvested during this season. We also see snow buntings during this time (late May to July)." Pond Inlet

"There are three bird sanctuaries on Bylot Island. We eat the occasional bird, but we are mostly seeking eggs." Pond Inlet

"Egg harvesting stops when embryos form in the eggs. Eider ducks will nest on small islands. Many geese are harvested but many, many more migrate south." Pond Inlet — Group Discussion

"During August we harvest geese with chicks, especially goslings." Pond Inlet

"You can always find them, even when there's snow. By June 6, there are lots of goose eggs." Pond Inlet

"We'll need to cross the ship's track for gathering eggs." Pond Inlet

"In the beginning of July, more people are at the floe edge, and collecting Murre eggs." Pond Inlet

"Petro Canada conducted an oil spill monitoring program at Cape Hat. They made a spill, then cleaned it up. There was no residue left once the cleaning solution sank to the bottom. Birds cannot fly when in oil. When you apply cleaning solution, it can clean up the fuel spills." Pond Inlet

"What about other animals other than caribou on the road? Fox? Canada geese? What do you do in that case?" Pond Inlet

"Regarding migratory birds monitoring – What about raptor studies? I thought I heard about a peregrine nest close to the mine site. Based on the information you have, are the raptor populations increasing or decreasing?" Pond Inlet

"With respect to the bird surveys, what about the spring geese, when they have goslings? Do you see families of geese crossing the tote road in the summer? Or do they avoid the road altogether?" Pond Inlet

"With Nanisivik, we saw more seals as a result of the ships that came in. However, the ice breakers cut off the goose hunting area we used to travel to. Our knowledge of that hunting area was lost as a result of this." Arctic Bay

"In Navy Board Inlet, that area gets busier for egg/goose hunting. People will hunt seals at the same time. May and June." Pond Inlet

"Start from mid-May for Canadian geese and snow geese hunting. Pretty constant." Pond Inlet

"Snow geese egg harvesting beginning the second week of June. In May they start laying." Pond Inlet

IQ offered by participants at community workshops indicated that the Northern Route MRSA and TRSA contain several areas that are used seasonally by large numbers of various bird species. Community elders indicated that most bird species in the area are migratory and typically arrive in late-April, May, and June, and start leaving in August. Breeding occurs throughout the area. Most of the islands within the RSA are used as nesting areas by various species of seabirds and waterfowl, and some large colonies of seabirds are known along marine cliff habitats. Species such as geese, eiders, loons and ducks can be found nesting along coastlines or inland along freshwater lakes. Fall migration occurs between early August to late October depending on the species and the sex. Some birds such as Common Raven, ptarmigan, and sometimes Snowy Owl, winter in the area and some seabirds, such as Black Guillemot, also remain in the area year-round using the open shore leads in the winter.

Inuit community members and hunters indicated that harvesting of birds and their eggs is still an important subsistence and cultural activity during Upirngaaq (late May to late July) but less so than in the past. The species that are most commonly harvested in the Eclipse Sound and Navy Board Inlet area are Snow Goose, Canada Goose, Common and King Eider, and their eggs as well Thick-billed Murre and Black-legged Kittiwake eggs (Table 33). Some Tundra Swan and Sandhill Crane are also harvested. Egg harvesting generally stops when embryos begin forming in the eggs. In August, geese with chicks (goslings) are harvested in several locations on the land and water, although gosling harvest is most popular.

Section 8.1.11 of the NIRB guidelines (Nunavut Impact Review Board 2015) generally reflect many of the concerns identified during Baffinland's consultations, namely impacts on the abundance and distribution of migratory bird populations, sensory disturbance, habitat loss, and health, as well as a desire to predict the overall impacts of the Project on birds and bird habitat.

Table 33. Annual Timetable of Bird and Egg Harvesting Activities by Pond Inlet Residents in the Eclipse Sound and Navy Board Inlet Areas Developed Through the Contemporary Inuit Land Use Workshop in March 2015 (Jason Prno Consulting Services Ltd. 2017)

Bird and Egg Harvesting	Ukiaksaaq		Ukiuq			Upirngaksaaq			Upirngaaq		Aujaq	
	October	November	December	January	February	March	April	May	June	July	August	September
Ptarmigan hunting[a]												
Snow Goose												
Snow Goose, egg harvesting												
Canada Goose												
Geese with goslings (goslings preferred)												
Tundra Swan												
Sandhill Crane												
Common and King Eider (mainly eggs)												
Thick-billed Murre (eggs)												
Black-legged Kittiwake (eggs)												

a - Light blue periods are when the activity was identified to occur. Dark blue periods are when the activity was identified to occur more frequently or intensively.

3.2 KEY INDICATORS

Several Key Indicator species (KIs) were selected to guide the assessment of impacts on migratory birds and their habitats for the Phase 2 Proposal. These species were selected based on input from government biologists (territorial and federal), the IQ studies and workshops, legislative requirements, field observations, and the professional judgment of Project biologists.

Fourteen Key Indicator species were selected for this assessment. Six species were selected based on the criteria listed above (Red-throated Loon, Snow Goose, Common Eider, King Eider, Thick-billed Murre, and Lapland Longspur) and additionally, all eight Species at Risk known to occur or that could potentially occur in the Project area were also selected because of legislative requirements and stipulations under Section 8.1.11.2 of the NIRB project EIS guidelines (Nunavut Impact Review Board 2015). Table 34 and Table 35 outline the rationale for each species selection and further details on each of the Key Indicator species is included in the following subsections.

The status of wildlife populations within Nunavut is assessed by the Nunavut Department of Environment (Canadian Endangered Species Conservation Council 2016) and by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2016). The Canada Species At Risk Act (SARA) (Government of Canada 2002) groups species at risk into one of three Schedules:

- Schedule 1 — the official list of species at risk in Canada, includes species that are either extirpated, endangered, threatened or of special concern;
- Schedule 2 — species designated as endangered or threatened, but that have yet to be re-assessed by COSEWIC under the revised criteria; and
- Schedule 3 — species designated as special concern, but that have yet to be re-assessed by COSEWIC under the revised criteria.

There are seven federally listed Species at Risk under Schedule 1 and one species ranked as Special Concern by COSEWIC (Red-necked Phalarope) that could occur in the Mary River Project MRSA and TRSA. Except for Buff-breasted Sandpiper, all species have been documented in the Project area during field surveys or as incidental observations by other researchers. Harlequin Duck are not expected to interact with proposed Phase 2 activities given that their range is restricted to southern Baffin Island.

Table 34. Key Indicator Species of Birds Selected for the Assessment of the Phase 2 Proposal of the Mary River Project

Key Indicator Species	Rationale for Designation as a Project Key Indicator Species
Red-throated Loon	Loons are good indicators of high quality aquatic habitats and are relatively sensitive to environmental change (Strong 1990, Dickson 1993). Red-throated Loons were the most abundant and widely distributed species of loon found during field surveys. Although IQ studies did not indicate that loons are culturally or economically important to local Inuit communities, a 1992 study on Igloolik Island found that 73% of all Red-throated Loon eggs laid within the 10 km² study site over two breeding seasons were collected by residents of Igloolik (Forbes et al. 1992). Will serve as an indicator species for all four species of loons in the TRSA, as well as other wetland dwelling species (e.g., Long-tailed Duck).
Snow Goose	Local breeder and abundant migrant within the Project Area, the TRSA, and overlaps an important moulting area for the species. IQ studies indicated that harvest of Snow Geese (adults, eggs, and goslings) is important to North Baffin communities. Will serve as an indicator species for other goose and swan species in the TRSA (e.g., Canada Goose, Cackling Goose, Tundra Swan).
Common and King Eider	Although not listed by COSEWIC or SARA, both species have been identified as a 'Species of Interest' by the Canadian Wildlife Service because of an unexplained nationwide decline observed over the past two decades (Powell and Suydam 2012). Abundant migrant within the Project Area. IQ studies indicated that harvest of eiders (adults and eggs) is important to North Baffin communities.
Harlequin Duck	The eastern population is listed as a species of "Special Concern" under SARA (Environment and Climate Change Canada 2017a). Rare breeder in the southern third of Baffin Island but may be found in small flocks along rocky coastlines of Hudson Strait in the Southern Route MRSA. Not expected to interact with Phase 2 Proposal activities.
Peregrine Falcon	The *tundrius* subspecies is listed as a species of "Special Concern" under SARA (Environment and Climate Change Canada 2017a). Abundant and widespread within the TRSA. Will serve as an indicator species for other cliff-nesting raptors (e.g., Rough-legged Hawk, Gyrfalcon).
Red Knot	The *islandica* subspecies is listed as "Special Concern" and the *rufa* subspecies is listed as "Endangered" under SARA (Environment and Climate Change Canada 2017a). Both subspecies may potentially occur in the TRSA. Very rare but reported to breed in the TRSA. Will serve as an indicator species for the "upland" shorebird species guild (e.g., American Golden Plover, Baird's Sandpiper, Dunlin).
Buff-breasted Sandpiper	Listed as a species of "Special Concern" under SARA (Environment and Climate Change Canada 2017a). Breeds unpredictably and sporadically across Canadian Arctic and Alaska; not documented in TRSA but known breeder in surrounding Arctic islands and peninsulas. Rare breeder if present in Project area.
Red-necked Phalarope	Ranked as a species of "Special Concern" under COSEWIC (COSEWIC 2016) but currently has no status under SARA (Environment and Climate Change Canada 2017a).

Table 34. Key Indicator Species of Birds Selected for the Assessment of the Phase 2 Proposal of the Mary River Project

Key Indicator Species	Rationale for Designation as a Project Key Indicator Species
	Very rare but reported to breed in the TRSA. Will serve as an indicator species for the "lowland" shorebird species guild (e.g., Pectoral Sandpiper, Red Phalarope, White-rumped Sandpiper).
Ivory Gull	Listed as "Endangered" under SARA (Environment and Climate Change Canada 2017a). Nearest breeding colonies are on the Brodeur Peninsula, Baffin Island but breeds on other High Arctic Islands north of Baffin Island. Rare but documented in both the Northern and Southern Route MRSAs during Project baselines studies. Northern Route MRSA may be used as a migratory pathway in spring. Some or all of the Canadian High Arctic population may overwinter in Baffin Bay and Davis Strait.
Ross's Gull	Listed as "Threatened" under SARA (Environment and Climate Change Canada 2017a). Rarest breeding gull in North America. Four small nesting colonies have been documented dispersed across the Canadian Arctic, the closest to the Project is located on Prince Charles Island. Very rare but documented in the Southern Route MRSA during Project baselines studies; however, could occur in all marine areas affected by the Project.
Thick-billed Murre	Commonly detected species during marine studies with large and well-known colonies located in the Northern Route MRSA. Exhibits a unique, flightless migration which may interact with project shipping routes. IQ studies indicated that harvest of Thick-billed Murre (especially eggs) is important to North Baffin communities. Will act as an indicator for other seabirds.
Short-eared Owl	Listed as a species of "Special Concern" under SARA (Environment and Climate Change Canada 2017a). Documented in TRSA during baselines studies (non-breeding); however, the northern limit of their normal breeding range is located approximately 1,000 km south of the Project area. May only occur in TRSA in years of high lemming abundance as a non-breeder Not expected to interact with Project activities.
Lapland Longspur	Most commonly detected species of songbird during songbird and shorebird field studies in the TRSA. Occupies a broad range of habitats during the breeding season. Will serve as an indicator species for other songbird species (e.g., American Pipit, Horned Lark).

Table 35. Status of Avian Species at Risk Known to Occur or Potentially Occur in the Terrestrial Regional Study Area (TRSA) and Northern Route Marine Regional Study Area (MRSA) for the Phase 2 Proposal of the Mary River Project

Common Name	Latin Name	Conservation Status			Occurrence within the TRSA or Northern Route MRSA
		Nunavut[1]	COSEWIC[2]	SARA[3]	
Harlequin Duck, eastern population	*Histrionicus histrionicus*	Sensitive	Special Concern	Special Concern (Schedule 1)	Observed in Southern Route MRSA, rare, not likely in Northern Route MRSA given known breeding range
Peregrine Falcon tundrius ssp.	*Falco peregrinus tundrius*	Secure	Special Concern	Special Concern (Schedule 1)	Breeding, common
Red Knot	*Calidris canutus islandica* and *C. c. rufa*	At Risk	*islandica* ssp. – Special Concern *rufa* ssp. - Endangered	*islandica* ssp. – Special Concern (Schedule 1) *rufa* ssp. – Endangered (Schedule 1)	Incidental breeding report, within potential breeding range in TRSA, very rare
Buff-breasted Sandpiper	*Tryngites subruficollis*	Sensitive	Special Concern	Special Concern (Schedule 1)	Never observed but within potential breeding range in TRSA
Red-necked Phalarope	*Phalaropus lobatus*	Sensitive	Special Concern	No Status	Incidental breeding report, within potential breeding range in TRSA, very rare
Ivory Gull	*Pagophila eburnea*	At Risk	Endangered	Endangered (Schedule 1)	Observed in Northern Route MRSA, rare
Ross's Gull	*Rhodostethia rosea*	At Risk	Threatened	Threatened (Schedule 1)	Observed in Southern Route MRSA, very rare, potential in Northern Route MRSA
Short-eared Owl	*Asio flammeus*	Sensitive	Special Concern	Special Concern (Schedule 1)	Observed in TRSA, no breeding records, rare

1 (Canadian Endangered Species Conservation Council 2016), 2 (COSEWIC 2016), 3 Environment and Climate Change Canada 2017

3.2.1 RED-THROATED LOON

It has been well established by studies around the northern hemisphere that loons are good indicators of high quality aquatic habitats and that they are relatively sensitive to environmental change (Strong 1990, Dickson 1993). Many studies have used loons in monitoring programs as a surrogate indicator of changes to the health of aquatic ecosystems in response to various sources of environmental effects. For example, loons have been used as a management indicator species for six U.S. monitoring programs in the Great Lakes (Strong 1990) and by the Canadian Wildlife Service near Tuktoyaktuk, Northwest Territories (Dickson 1993).

All four species of loons found in Canada (Red-throated, Common, Pacific, and Yellow-billed) were recorded breeding within the TRSA; however, Red-throated Loon was the most abundant and widely distributed. The Red-throated Loon is a migratory species that breeds primarily in the Arctic.

They are the smallest of the loon species and although their populations in Canada are currently considered stable, there are indications that they may be starting to decline. They are primarily a fish-eating bird that nest alongside fresh water ponds but are known to stage, forage, and even raise their young in coastal marine waters. Because they typically nest on smaller ponds than other loons that freeze to the bottom in winter, fish are generally not present in the nesting pond/lake. Therefore, adults fly to fish bearing waters to catch fish to bring back to their young (Barr et al. 2000). Their natural predators, particularly of eggs and young, include gulls, jaegers, Common Raven, and Arctic foxes.

Although IQ studies did not indicate that loons are culturally or economically important to local Inuit communities, a 1992 study on Igloolik Island found that 73% of all Red-throated Loon eggs laid within a 10 km² study site over two breeding seasons were collected by residents of Igloolik (Forbes et al. 1992). It can be argued that this species is ecologically important to the local environment based on their abundance, distribution, and position in the food-chain. Combined with their documented ability to demonstrate measurable indications of environmental disturbances, their distribution both in and out of the PDA, and their conspicuous nature making them relatively easy to survey, the Red-throated Loon was selected as a suitable key indicator species to represent all four species of loons in the TRSA, as well as other wetland dwelling species (e.g., Long-tailed Duck).

3.2.2 SNOW GOOSE

Snow Geese breed in the High Arctic from Greenland to Wrangel Island, and from Hudson Bay and Foxe Basin to northern Ellesmere Island, making them one of the most northerly breeding birds in the world (Batt 1998, Mowbray et al. 2000). The presence of Snow Geese within the north Baffin region is well documented and several large nesting colonies are known in the region including Bylot Island (over 669,000 Greater Snow Geese in 1996; (Lepage et al. 1998), the Great Plains of the Koukdjuak (nesting population of >1.7 million Lesser Snow Geese; (Latour et al. 2008), and Prince Charles and Air Force Islands (140,000 Lesser Snow Geese; (Latour et al. 2008) among others.

Baseline studies for the Mary River Project found that the TRSA and Northern Route MRSA see abundant use by Snow Geese throughout spring, summer and fall. Thousands of Snow Geese migrate through and use the area for migratory stop-overs in spring and fall, presumably on the way to and from nesting colonies on Bylot Island. These stop-over locations are most heavily concentrated in the Steensby Inlet region, especially within the marine waters and low-lying tundra areas adjacent to the coastline to approximately 10 km inland; however, Snow Geese can be observed throughout the TRSA where lowland tundra and streams are present. During the breeding season, a relatively small number of Snow Geese appear to nest within the bulk of the TRSA. From mid-July to late August, thousands of geese return to the TRSA to rest, forage, and to moult their feathers before continuing their fall migration. The majority of the moulting observations made during the Mary River baseline surveys were in the southwest section of the TRSA (south of the Mary River mine site). This area partially overlaps with the area of interest identified by Environment Canada based on the results of a 1993 survey conducted by the CWS in this area. The CWS survey yielded an estimated total of 22,145 moulting Greater Snow Geese over the 7,200 km² survey block, most of which were believed to be sub-adults and failed breeders (Reed et al. 1993).

IQ studies indicated that harvest of Snow Geese (birds, eggs, and down) is important to North Baffin communities. Since Snow Geese are both culturally and ecologically important within the TRSA and on Bylot Island which is surrounded by the Northern Route MRSA, and because of their sheer numbers and sensitivity to disturbance (Béchet et al. 2004), this species was selected as a suitable key indicator for grazing geese and swans (e.g., Canada Goose, Cackling Goose, Tundra Swan).

3.2.3 COMMON AND KING EIDER

Common and King Eider are large seaducks that are found across the Canadian Arctic from Baffin Bay to the Beaufort Sea. Both species are often seen flying in large flocks of thousands of individuals and spend most of the year in coastal marine ecosystems at high latitudes; however, they display differing habitat selection during nesting and early brood rearing. Common Eider are closely tied to marine habitats and tend to nest colonially on coastal islands or islets and raise their broods in communal crèches in marine coastal habitats (Goudie et al. 2000). King Eider typically nest inland from the coastline, generally near freshwater lakes and ponds (Powell and Suydam 2012). Like the Common Eider, broods are often raised communally but they are generally raised on freshwater during early brood-rearing and slowly make their way to the ocean over the brood-rearing period. Eiders have been rated as Sensitive by the Government of Nunavut (Canadian Endangered Species Conservation Council 2016) and although they are not listed by COSEWIC and SARA, there is evidence of population declines from both the eastern and western Arctic (Suydam et al. 2000, Gilliland et al. 2009, Powell and Suydam 2012, Bentzen and Powell 2012).

The Mary River bird studies documented large migratory flocks of Common and King Eiders in the coastal waters of both the Northern and Southern Route MRSA during their spring and fall migrations. They also recorded four King Eider nests within the TRSA and hens seen raising broods in Steensby Inlet. Although common along the Southern Route MRSA (Latour et al. 2008), no Common Eider colonies were located by project surveys in the vicinity of the TRSA or the Northern Route MRSA. Three nests were reported along the north coast of Steensby Inlet by other researchers in 2011 (Alexandre Anctil, pers. comm.). IQ studies indicate that harvest of eiders (adults and eggs) is important to northern Baffin communities and some Inuit still use eider feathers in clothes, pillows, and quilts.

3.2.4 HARLEQUIN DUCK (SPECIAL CONCERN)

Canada's eastern population of Harlequin Duck is listed as a species of Special Concern by COSEWIC (COSEWIC 2016) and SARA (Environment and Climate Change Canada 2017a). Harlequin Duck are not common to Canada's Arctic regions. Most of the breeding range of the eastern population is located in Labrador and Quebec; however, they are known to breed on the southern third of Baffin Island and have been seen in small flocks in southern Foxe Basin and Hudson Strait (Mallory et al. 2003, COSEWIC 2013). They nest along fast-moving streams and rivers but are often found foraging along rocky coastlines during other times of the year. Wintering habitat consists of rocky coastlines, exposed headlands and sub-tidal ledges off the southwest coast of Greenland or the eastern coast of North America from Newfoundland south to Maryland (COSEWIC 2013).

Threats to this population include habitat loss and anthropogenic disturbances (e.g., hydroelectric dams, logging) in their breeding range (Robertson and Goudie 1999), fishing nets, aquaculture developments, boating activities, and oiling on their wintering and moulting ranges (COSEWIC 2013). Harlequin Ducks were not observed during bird baseline surveys but were reported within the Southern Route MRSA during pre-FEIS data collection when three individuals were seen in Hudson Strait on April 2008. Harlequin Duck are not expected to interact with Project activities covered under the Phase 2 Proposal given their southern Baffin Island breeding range distribution.

3.2.5 PEREGRINE FALCON (*F. P. TUNDRIUS* — SPECIAL CONCERN)

Peregrine Falcon (*tundrius* subspecies) is considered a species of Special Concern by COSEWIC (COSEWIC 2016) and SARA (Environment and Climate Change Canada 2017a); however, it is one of Canada's most remarkable success story of recovery efforts with populations across northern Canada recovering from near extinction since the late 1960s (Cade et al. 1988, Enderson et al. 1995, COSEWIC 2007a). The tundrius subspecies breed from the north slope of the Yukon, east across the Low Arctic Islands and Nunavut, north to Baffin Island, Hudson Bay, Ungava and northern Labrador (COSEWIC 2007a). They are generally considered abundant and widespread throughout most of their recognized breeding range in Nunavut (Canadian Endangered Species Conservation Council 2016). Peregrine Falcon prey primarily on other bird species such as colonial seabirds, shorebirds, waterfowl, ptarmigan, and songbirds (COSEWIC 2007a), although in some areas, small mammal species such as lemmings and juvenile Arctic ground squirrels (*Spermophilus parryii*) also comprise a major portion of their diet (Court et al. 1988, COSEWIC 2007a). Peregrine Falcon are a common breeder within the TRSA.

The Mary River baseline and post-FEIS surveys found Peregrine Falcon to be widespread throughout the TRSA. As of 2016, up to 89 nesting territories have been occupied annually within the TRSA and up to 56 nesting territories have been occupied annually within a 10 km buffer of the PDA. The number of Peregrine Falcon observed in the area is unexpectedly high given that North Baffin Island is generally considered to be beyond the northern extent of their breeding range (COSEWIC 2007a). Peregrine Falcon breeding habitat is typically limited by the presence of suitable nest sites (usually on a cliff ledge or crevice) near good foraging areas with a sufficient prey base. However, abundant nesting and foraging habitat is present within the study area. Peregrine Falcon's widespread distribution within the TRSA and within 10 km of the PDA allows for monitoring and evaluation of Project effects. Peregrine Falcon will also serve as a key indicator for other cliff-nesting raptors in the area, namely Rough-legged Hawk and Gyrfalcon, which have similar nesting habitat requirements.

3.2.6 RED KNOT (*C.C. ISLANDICA* - SPECIAL CONCERN; *C.C. RUFA* — ENDANGERED)

Red Knot populations are well studied in North America, with three subspecies present in Canada (COSEWIC 2007b); of these, two have the potential to be located in the TRSA. The *islandica* subspecies (*Calidris cantus islandica*) is considered a species of Special Concern and the *rufa* subspecies (*C.c. rufa*) is considered Endangered (COSEWIC 2007b, 2016, Environment and Climate Change Canada 2017a). The breeding range of the *islandica* subspecies is found in the High Arctic regions of northeastern Canada and Greenland, including parts of Bylot Island and the northwestern end of Baffin Island. The breeding range of the *rufa* subspecies is located entirely within the Central Canadian Arctic and includes areas within Foxe Basin and southern Baffin Island(COSEWIC 2007b). Previous studies in the region have documented Red Knot on Prince Charles and Air Force Islands (Johnston and Pepper 2009), Igloolik Island (Forbes et al. 1992), Arctic Bay, Baffin Island (Renaud et al. 1979), and Bylot Island (Lepage et al. 1998); however, only the Bylot Island studies found evidence of breeding. Nesting habitat for Red Knots typically consists of barren areas (often with less than 5% vegetation cover) such as windswept ridges, slopes or plateaus, generally at elevations less than 150 m above sea level and less than 50 km from the coast (COSEWIC 2007b). During the breeding season, they will also forage in damp or barren habitats up to 10 km from the nest site (COSEWIC 2007b). Wintering areas used by the *islandica* subspecies are located on the European seaboard, while the winter range of the *rufa* subspecies is located mostly in Tierra del Fuego (COSEWIC 2007b). Red Knots were observed incidentally in the TRSA on one occasion (August 2007) when a group of nine (2 adults and 7 newly fledged young) were observed near the sandbar of a river near the Mine Site (on the west end of Camp Lake). In addition to being a species at risk, the Red Knot was selected as a suitable key indicator species for the "upland" shorebird species guild nesting in the area (e.g., American Golden Plover, Baird's Sandpiper, Dunlin).

3.2.7 BUFF-BREASTED SANDPIPER (SPECIAL CONCERN)

Buff-breasted Sandpiper is a species of Special Concern (COSEWIC 2016, Environment and Climate Change Canada 2017a). In North America, they breed sporadically in Arctic tundra uplands from the northern Alaska coast to Devon Island in Nunavut (Lanctot and Laredo 1994, COSEWIC 2012). Elsewhere in Canada, they are generally observed in migration in the overlap area between the Mississippi and Central flyway and along the Atlantic flyway. Their wintering range is located primarily in South America, predominantly in Venezuela, Uruguay, and Brazil, where they rely extensively on pastures and wetlands with short vegetation (Lanctot and Laredo 1994, COSEWIC 2012). They have been poorly studied across their breeding range because they show poor breeding site fidelity and their occurrence is temporally and spatially unpredictable. Buff-breasted Sandpiper are unique among shorebirds in having a lek mating system (Lanctot and Laredo 1994). Males defend a small territory used for displays that attract females who nest and raise chicks elsewhere. On their Arctic breeding range, they are generally considered part of the upland species guild because of their dependence on dry sloping areas or polygon tundra with either raised edges or centers (Lanctot and Laredo 1994).

Buff-breasted Sandpiper is one of few shorebird species that do not shift habitat use during the brood rearing period (Lanctot and Laredo 1994). Market hunting in the late 1800s and early 1900s nearly brought the species to extinction, and although their population have recovered since the ban of market hunting, numbers are much lower than those observed before market hunting began (COSEWIC 2012). There is evidence of population decline over the past decades but the data necessary to monitor population trends is lacking (COSEWIC 2012). The major threat to this species is habitat loss at migration stop over sites and on wintering grounds due to conversion of native short-grass prairie habitats to cultivated farmland and ranching land (COSEWIC 2012). Buff-breasted Sandpiper have never been observed in the Project Area but they have been documented to breed north on Bylot Island (Cadieux et al. 2008) and Devon Island (Lanctot and Laredo 1994), west at Creswell Bay on Somerset Island (Latour et al. 2005) and on the Boothia Peninsula, and south on the Melville Peninsula (Lanctot and Laredo 1994).

3.2.8 RED-NECKED PHALAROPE (SPECIAL CONCERN)

Although they have no status under SARA (Environment and Climate Change Canada 2017a) at the present time, Red-necked Phalarope is considered a species of Special Concern by COSEWIC (COSEWIC 2014, 2016). They are found throughout Canada, as either breeders or migrants. In Nunavut, they are common breeders as far north as Victoria Island and southern Baffin Island, and observations have been reported for northern Baffin Island (COSEWIC 2014). Red-necked Phalaropes breed in Arctic and sub-Arctic wetlands or in vegetation near other sources of freshwater, constructing a shallow depression in the ground and pulling vegetation overhead for enhanced concealment from above. They exhibit a strong affinity for water, where most foraging and social interactions take place. During migration, this species is primarily pelagic, but may stop over on inland wetlands or other non-riverine water bodies. Red-necked Phalarope stage in large concentrations in small areas which makes them vulnerable to local threats and changes (e.g., habitat alteration, declines in prey availability; (COSEWIC 2014). In addition, the harsh and unpredictable conditions associated with nesting in northern environments, combined with their short breeding season, is limiting for this species (COSEWIC 2014). Red-necked Phalarope were observed incidentally in the TRSA on two occasions. Once in July 2007 when one adult male and two young were observed in a sedge-lined pond approximately 1 km south-southwest of the Mary River camp and once in August 2007 when three young were seen on a pond southwest of the airstrip. In addition to being a species at risk, the Red-necked Phalarope was selected as a suitable key indicator species for the "lowland" shorebird species guild nesting in the area (e.g., Pectoral Sandpiper, Red Phalarope, White-rumped Sandpiper).

3.2.9 IVORY GULL (ENDANGERED)

Ivory Gull is listed as an Endangered species by both COSEWIC (COSEWIC 2016) and SARA (Environment and Climate Change Canada 2017a). Very little is known about the Ivory Gull and its general biology (COSEWIC 2006, Mallory et al. 2008) and they have only been observed occasionally in the Northern Route MRSA in the past ten years (in Eclipse Sound; Mark Mallory, Pers. Comm.). Ivory Gull are known to nest on the Brodeur Peninsula on northern Baffin Island as well as on Ellesmere, Devon, Seymour, and Cornwallis islands (Gilchrist and Mallory 2005, Latour et al. 2008). Some Ivory Gull are thought to migrate through Foxe Basin and Hudson Strait each year as a few individuals have been seen migrating through Igloolik and Cape Dorset (Mark Mallory, Pers. Comm., (Forbes et al. 1992). However, the majority of Ivory Gulls that nest on the Brodeur Peninsula are believed to winter either north of Bylot Island or in southwestern Baffin Bay and Davis Strait (Renaud and McLaren 1982, Mallory et al. 2008) and migrate there through Lancaster Sound or Eclipse Sound (Renaud and McLaren 1982). Three hundred and seventy-five individuals were seen along floe edges near Pond Inlet during spring migration in 1979 (Renaud and McLaren 1982) and 75 were seen in this same location in the spring of 1994 (Lepage et al. 1998). Therefore, it appears that portions of the Northern Route MRSA may be used as a migratory pathway by this species but very little else is known about the life history of this species in the region. During pre-development surveys, Ivory Gulls were observed in several locations within the Northern Route MRSA including: Milne Inlet (1 bird in September 2007; 5 birds in August 2008) and Eclipse Sound (1 bird in August 2008); and Southern Route MRSA including: Hudson Strait (one (1) bird in April 2008; one (1) bird in October 2008), West Foxe Basin (three (3) birds in October 2008) and East Foxe Basin (one (1) bird in October 2008).

3.2.10 ROSS'S GULL (THREATENED)

Ross's Gull is one of the rarest breeding gulls in North America and is considered Threatened in Canada (COSEWIC 2016, Environment and Climate Change Canada 2017a). Very little is known about this species and no long-term studies exist for it in Arctic Canada. They have been recorded nesting in four locations in Canada, one of which is on Prince Charles Island in Foxe Basin along the approved southern shipping route. The other three locations are: Cheyne Islands, Nunavut; an unnamed island in Penny Strait, Nunavut; and Churchill, Manitoba (Mallory et al. 2006, COSEWIC 2007c). A single pair of breeding Ross's Gulls was discovered on Prince Charles Island in 1984 by Tony Gaston (CWS) and in 1997 by both Vicky Johnson (CWS) and Béchet et al. (2000*b*). Despite intensive surveys on Prince Charles and neighbouring Air Force Island in 1996 and 1997, no additional birds were found (Johnston and Pepper 2009). As well, a single adult Ross's gull in breeding plumage was recorded on Bylot Island in 1979 by both Renaud et al. (Renaud et al. 1981) and Lepage et. al. (Lepage et al. 1998), independently. Ross's Gull breed in a variety of habitats including marshy wetlands, boreal, subarctic and high arctic tundra, and gravel reefs, but require open access to water at the nest site (COSEWIC 2007c). Most of the world's population of Ross's Gulls is thought to breed in northeastern Siberia and Canada's Ross's Gulls are thought to spend the winter in the Chukchi Sea, between Alaska and Russia (COSEWIC 2007c).

During the pre-FEIS baseline studies, Ross's Gulls were observed in the Southern Route MRSA in a few locations including: Steensby Inlet (one bird in August 2008), and West Foxe Basin (17 birds in September

2008 and a minimum of 26 birds in October 2008). If these observations are accurate, the Mary River baseline surveys resulted in the largest ever observation of Ross's Gulls in Canada (Mark Mallory, Pers. Comm.) reflecting the potential for more nesting sites than previously known, and perhaps the paucity of observational seabird data in East Foxe Basin. Although no Ross's Gull were ever observed in the Northern Route MRSA, all marine habitats found in the area could potentially be used by Ross's Gull.

3.2.11 THICK-BILLED MURRE

Thick-billed Murre are one of the most abundant and well-studied species of marine bird in the northern hemisphere (Gaston and Hipfner 2000); their total population in the eastern Canadian Arctic is estimated at 1.95 million birds (Wiese et al. 2004). Thick-billed Murre nest in large colonies on coastal cliffs (Tuck 1961). There are two well documented seabird colonies located on Bylot Island, one near Cape Hay at the northwest end of the island and the other near Cape Graham Moore at the southeast end of the island. Combined, 170,000 breeding pairs of Thick-billed Murre and 23,000 breeding pairs of Black-legged Kittiwake nest at these colonies (Gaston and Hipfner 2000, Mallory and Fontaine 2004). Additionally, a significant number of non-breeding birds attend the colonies. Bylot Island is completely enclosed by the Northern Route MRSA. Other large seabird colonies are found along the northeastern coast of Baffin Island and along coastlines all through Lancaster Sound (Mallory and Fontaine 2004).

Thick-billed Murre first appear in the area in early May and begin nesting in late June and early July. Nests are generally located out in the open on a cliff ledge. Clutch size is one egg but replacement clutches may be laid if the first is destroyed early in the breeding season (Tuck 1961). Incubation requires 30–35 days and young begin to hatch in mid-July. Fall migration movements of Thick-billed Murre from the Bylot Island colonies are poorly understood (Huettmann and Diamond 2000). Thick-billed Murre complete a unique, flightless migration following the direction of surface currents from the breeding colonies through Baffin Bay and Davis Strait to wintering areas in the Labrador Sea which may interact with project shipping routes. One of the adults accompanies the flightless chick when it leaves the nest 18–25 days after hatch, typically from mid-August to early September. These migrations can extend over distances of as much as 1,000 km before the chick matures enough to fly and migration can be rapid with movements up to 40 km/day (Gaston 1982). Acknowledging this data deficiency on this aspect of Thick-billed Murre's life cycle, Baffinland is contributing to research performed by the Canadian Wildlife Service to better understand these migratory movements.

Key marine foraging habitats for Thick-billed Murre are typically located within 30 km of the breeding colony (Johnson et al. 1976, Mallory and Fontaine 2004) but some may forage up to 175 km away from it (LGL Ltd 1982). During the spring and summer months, they are usually associated with the edge of land-fast ice (Bradstreet 1979, 1982). Their primary diet is fish and marine macro-invertebrates (Tuck 1961, Croll et al. 1992).

Through May and June, the ice edge around both Cape Hay and Cape Graham Moore is a critical staging and feeding area for Thick-billed Murre as well as for Black-legged Kittiwake, Northern Fulmar, and Black Guillemot, perhaps because this is the nearest open water to the colonies further south along the Baffin coast and further west along the coastlines of Lancaster Sound (Brown and Nettleship 1981, McLaren 1982, Mallory and Fontaine 2004). Up to 18 species of birds have been observed in May and June at the ice edge near the colonies (Bradstreet 1982). This marine region is occupied by seabirds from mid-April through October and significant concentrations of marine birds may be distributed throughout the area, depending on the annual patterns of ice breakup and the distribution of prey (McLaren 1982, Dickins et al. 1990, Riewe 1992). Nesting sea birds are sensitive to disturbance and the pollution of their feeding areas. The shoreline area around both Cape Hay and Cape Graham Moore is listed as being of "extreme sensitivity" from May to October for impact of oil spills. The offshore area is listed as being of "moderate sensitivity" from September through April, but of "high sensitivity" from May through August (Dickins et al. 1990, Mallory and Fontaine 2004).

Given their abundance at the nesting colonies on Bylot Island, Thick-billed Murre were observed throughout the Northern Route MRSA during aerial surveys. IQ studies indicated that harvest of Thick-billed Murre, especially their eggs, is important to North Baffin communities. A traditional hunting camp from which murre eggs are harvested is located at Button Point, a few kilometres southwest of Cape Graham Moore (IQ studies; (Riewe 1992). Thick-billed Murre was selected as a suitable key indicator species for other seabirds because of their cultural and ecological importance within the Northern Route MRSA, because of their abundance and sensitivity to disturbance, and because of potential interaction between their feeding areas and flightless migration with the Project shipping routes.

3.2.12 SHORT-EARED OWL (SPECIAL CONCERN)

Short-eared Owl is a species of Special Concern (COSEWIC 2016, Environment and Climate Change Canada 2017a). They are found throughout most of Canada, except for parts of the High Arctic (Wiggins et al. 2006, COSEWIC 2008). Short-eared Owl typically inhabit open habitats such as grasslands, tundra, bogs, marshes, and agricultural areas, and feed primarily on small mammals (Wiggins et al. 2006, COSEWIC 2008). In Arctic regions, they are usually found in lowland tundra and estuaries with higher concentrations in coastal tundra areas during years of lemming outbreak. They are an irruptive breeder and nesting success appears to be, in part, a response to local small mammal populations. The primary limiting factor affecting their populations is habitat loss and alteration (COSEWIC 2008). Declines in Short-eared Owl populations appears to be mostly related to habitat loss and degradation on their wintering range, with continuing habitat loss and degradation in the southern regions of their breeding range (Wiggins et al. 2006, COSEWIC 2008). During the pre-FEIS baseline studies, Short-eared Owl were documented in the TRSA on six occasions, three each in July/August 2007 and June 2008; however, no evidence of nesting was found and within year observations were located close to one another and may represent repeat observations of a single individual. Interestingly, in 2008, Short-eared Owl were also observed on Bylot Island for the first time in over 20 years of study (Therrien 2010).

Although their breeding range is believed to include southern Baffin Island (Wiggins et al. 2006), to the best of our knowledge, they had not been documented on northern Baffin Island prior to the Project's baseline studies.

3.2.13 LAPLAND LONGSPUR

Lapland Longspur is one of the most visible and abundant terrestrial bird breeding throughout the Arctic (Hussell and Montgomerie 2002). It was the most commonly detected songbird species during the 2012 and 2013 PRISM surveys in the TRSA, with densities ranging from 6.0 to 53.6 birds per km² (average 31.9 per km²). In good and medium habitats, densities observed in the Mary River TRSA were more than double those reported in other studies located at Prince Charles and Air Force Islands (Johnston and Pepper 2009). Within their breeding range, Lapland Longspurs are most commonly found in wet, hummocky, tundra meadows, typically on relatively flat ground; however, they will also use drier, well-vegetated slopes, including areas dominated by willows, heather or avens (Hussell and Montgomerie 2002). They feed primarily on seeds (particularly grass seeds); however, invertebrates are an important component of the summer diet (Hussell and Montgomerie 2002). Because of their conspicuous nature that makes them relatively easy to survey and of their abundance and distribution within the TRSA, Lapland Longspur was selected as a suitable key indicator species for other songbird species nesting in the area (e.g., American Pipit, Horned Lark).

3.3 POTENTIAL INTERACTIONS WITH BIRDS AND BIRD HABITAT

There are several pathways through which the Phase 2 Proposal activities could impact migratory bird KIs that use the Project area for part or all the year. These include:

For terrestrial species:

- Loss of habitat or habitat alteration due to the Phase 2 Proposal footprint or activities within the PDA;
- Reduced habitat effectiveness due to frequent but brief and localized disturbance of migration, nesting, foraging and brood-rearing areas due to Project activities at the mine site, camps, and port infrastructure as well as vehicle and train traffic along the northern transport corridor;
- Direct mortalities due to collisions with Project vehicles, aircraft, wind turbines, and permanent structures;
- Indirect mortalities due to increased access to the area by hunters;
- Indirect mortality due to increased predator population around the mine facilities because of increased availability of human food waste and other petroleum-based attractants, and/or an increase in the availability of nesting, roosting and denning habitat;
- Indirect mortality due to effects to bird health through contamination of the surrounding environments; and
- Because of the effects above, reduction in survival, reproductive success and population recruitment.

And for marine species:

- Frequent but brief and localized disturbance of open-water marine migration, nesting, foraging and brood-rearing areas due to ship traffic along the shipping lanes;
- Direct mortalities due to collisions with ships and port infrastructure;
- Catastrophic accidents and release of oils or chemicals near colonies or feeding areas resulting in direct (the birds themselves) or indirect (e.g., prey item) mortalities and long-term loss of foraging and brood-rearing habitat;
- Chronic leakage of fuel and lubricants into the marine environment resulting in direct or indirect mortality; and
- Because of the effects above, reduction in survival, reproductive success and population recruitment.

Species with mixed semi-terrestrial and aquatic life histories could be affected by a combination of the pathways and mechanisms described above for predominantly terrestrial and marine species.

Although there are a variety of pathways through which Project interactions could occur, potential Project impacts can generally be grouped into three measurable parameters:

- Habitat
- Mortality
- Health

Potential Phase 2 Proposal interactions with KI species are summarized for those that that have predominantly terrestrial life histories (Peregrine Falcon, Red Knot, Buff-Breasted Sandpiper, Short-eared Owl, Lapland Longspur) are summarized in Table 36; for those that have predominately marine life histories (Common Eider, Ivory Gull and Ross's Gull) in Table 37; and for those with a combination of terrestrial and marine life histories (Red-throated Loon, Snow Goose, King Eider, Red-necked Phalarope) in Table 38.

Table 36. Potential Phase 2 Proposal Interactions with and Effects on Peregrine Falcon, Red Knot, Buff-Breasted Sandpiper, Short-eared Owl, Lapland Longspur and their Habitats

Project Interaction	Marine Shipping	Milne Port	Northern Transportation Corridor	Mine Site
Project Development Area: Direct habitat loss (i.e., footprint)	No	Yes	Yes	Yes
Project Development Area: Indirect habitat loss (e.g., change in vegetation)	No	Yes	Yes	Yes
Sensory disturbance from Project activities (e.g., noise)	No [1]	Yes	Yes	Yes
Collisions with Project infrastructure, vehicles, and aircraft	No [1]	Yes	Yes	Yes
Increased predation	No [1]	Yes	Yes	Yes
Increased harvest [2]	No	No	No	No

Table 36. Potential Phase 2 Proposal Interactions with and Effects on Peregrine Falcon, Red Knot, Buff-Breasted Sandpiper, Short-eared Owl, Lapland Longspur and their Habitats

Project Interaction	Marine Shipping	Milne Port	Northern Transportation Corridor	Mine Site
Acute environmental contamination (e.g., major fuel spill)	No	Yes	Yes	Yes
Chronic environmental contamination (e.g., metals from dust deposition)	No [1]	Yes	Yes	Yes

Notes:

1. Very low probability but potential interaction with Peregrine Falcon nesting on coastal cliffs in Milne Inlet.
2. None of the terrestrial species covered in this table are harvested by hunters from the local communities.

Table 37. Potential Phase 2 Proposal Interactions with and Effects on Common Eider, Harlequin Duck, Ivory Gull, Ross's Gull, Thick-billed Murre and their Habitats

Project Interaction	Marine Shipping	Milne Port	Northern Transportation Corridor	Mine Site
Project Development Area: Direct habitat loss (e.g., docks)	No	Yes	No	No
Project Development Area: Indirect habitat loss	No	Yes	No	No
Sensory disturbance from Project activities (e.g., ship passage)	Yes	Yes	No	No
Collisions with Project infrastructure, aircrafts, and ships	Yes	Yes	No	No
Increased predation	No	No	No	No
Increased harvest [1]	No	No	No	No
Acute environmental contamination (e.g., major fuel spill)	Yes	Yes	No	No
Chronic environmental contamination (e.g., leakage of fuel and lubricants)	Yes	Yes	No	No

Notes:

1. Although Thick-billed Murre, Common Eider, and their eggs are harvested by hunters from local communities, none of the Project activities could result in increased harvest either in the marine environment or at nesting colonies.

Table 38. Potential Phase 2 Proposal Interactions with and Effects on Red-throated Loon, Snow Goose, King Eider, Red-necked Phalarope

Project Interaction	Marine Shipping	Milne Port	Northern Transportation Corridor	Mine Site
Project Development Area: Direct habitat loss (i.e., footprint)	No	Yes	Yes	Yes
Project Development Area: Indirect habitat loss (e.g., change in vegetation)	No	Yes	Yes	Yes
Sensory disturbance from Project activities (e.g., noise)	Yes	Yes	Yes	Yes
Collisions with Project infrastructure, vehicles, aircrafts, and ships	Yes	Yes	Yes	Yes
Increased predation	No	Yes	Yes	Yes
Increased harvest [1]	No	No	No	No
Acute environmental contamination (e.g., major fuel spill)	Yes	Yes	Yes	Yes
Chronic environmental contamination (e.g., metals from dust deposition)	Yes	Yes	Yes	Yes

Notes:

1. Although King Eider, Snow Goose, and their eggs are harvested by hunters from local communities, none of the Project activities could result in increased harvest either in the marine environment or at nesting sites near the communities. Although travel corridors elsewhere have been found to facilitate hunter harvest, the Tote Road is very remote (>150 km away) and more productive migratory bird harvesting areas can be found near the communities.

3.3.1 HABITAT

Habitat can be impacted by the Project either directly or indirectly: direct habitat loss occurs when areas are physically altered by activities, and indirect habitat loss occurs when activities (e.g., noise, visual, or physical disturbance) result in birds avoiding areas close to the Project footprint. In general, indirect effects persist only when Phase 2 activities are occurring, while direct effects in Arctic settings generally extend well beyond the life of a development given the slow recovery of habitats at these latitudes (i.e., poor soil development, short growing seasons, cold climate).

Loss of habitat due to Phase 2 Proposal activities will be restricted to the PDA (direct habitat loss) and a surrounding ZOI (indirect habitat loss).

Since the 2006–2008 and 2011–2017 baseline studies indicated that there are no concentrated bird nesting colonies (e.g., Thick-billed Murre, Snow Geese) near the proposed PDA, habitat loss will be restricted to species that generally establish nesting territories or that nest solitarily (e.g. Red-throated Loon, Lapland Longspur). Loss of coastal marine and terrestrial habitat for staging, foraging and brood-rearing will also likely be local scale effects restricted to the proposed PDAs and a surrounding ZOI. Based on the pre- and post-development bird monitoring surveys, there appears to be an abundant supply of suitable staging, foraging and brood-rearing habitat available within the RSAs (i.e., not saturated with conspecifics).

Shipping activity may result in indirect but periodic and temporary habitat loss related to the disturbance caused by ship passage. Frequent disturbance away from preferred foraging areas could have energetic and fitness consequences on marine birds. Shipping activities part of the Phase 2 Proposal will not affect ice because shipping will occur only through the open water season. During the height of shipping activity, Phase 2 proposed shipping activity through Eclipse Sound is expected to be about 3.5 ship passages per day.

Canada's *Migratory Birds Convention Act* (Government of Canada 1994) regulates the protection and conservation of migratory birds and prevents the disturbance or destruction of these birds, their nests, eggs, and habitats. Similarly, Nunavut's *Wildlife Act* (Government of Nunavut 2005) protects non-migratory and other bird species that fall under the legislative authority of provinces and territories such as Common Raven, ptarmigans, and birds of prey. All species recorded in the RSAs are protected by these Acts and therefore, will warrant special consideration and protection during all Phase 2 Proposal activities conducted between late May and September. It is expected that migrating birds arriving through late May and June while Phase 2 construction or operation activities are in progress would avoid nesting in disturbed areas and select areas away from disturbance or with a lower frequency of disturbance. Some birds affected by disturbances in the PDA may forego breeding for a year while they spend time seeking new breeding habitat and establishing a nesting territory or they may simply be able to move to nearby suitable habitat. These considerations will be discussed further below.

3.3.2 MORTALITY

Direct mortalities can occur from collisions with vehicles, aircraft, ships, wind turbines, and permanent infrastructure. Vehicle collisions can potentially occur with most bird species present in the PDA but are more likely for songbird and shorebird species due to their flight behaviour and flying heights and with birds that are flightless through the moult period such as geese. Although the risk of collisions with aircraft is low for all species, the potential for such collisions is greater for bird species that migrate through the TRSA and MRSA in large flocks such as Snow Goose. The potential for collisions with ships is relevant to all marine bird species that may collide with ships during adverse weather conditions (e.g., fog) or that may be attracted by ship lights at night (only from late August to October; (Merkel and Johansen 2011). To date, only one probable bird collision with a Project vehicle has been documented; a goose (unknown species) was found dead on the road in August 2016.

Ships may also collide with flightless young and adults of marine species such as Thick-billed Murre and Common Eider while they are on the water surface. Collisions with permanent infrastructure (e.g., buildings, towers) have been well documented throughout North America (Longcore et al. 2012) and can occur for all species present in the PDA. However, the risk of collisions with Project infrastructure is reduced compared to more southern locations given that daylight or twilight is nearly continuous while migratory birds are present in the TRSA. Species that fly fast and low to the ground such as eiders and Long-tailed Duck and species that migrate at night such as some songbirds are more vulnerable to collisions with infrastructure. Inclement weather (e.g., fog or snow), infrastructure lighting, and guy wires all increase the likelihood of collisions. To date, 11 bird collisions with Project infrastructure resulting in mortalities have been documented; two Long-tailed Duck (single event) flew into a crane piling at Milne Port in September 2014, one duck (unknown species) flew into an ore haul truck in June 2016, and 8 King Eider (single event) flew into a building at the Mine Site in October 2016.

The expansion of linear travel corridors like roads in an area often facilitates the use of that area by hunters due to the improved ease of access. In turn, this can lead to an increase in hunter harvest in the area. The development of the Tote Road and other access roads could result in an increase in use of the Project area by hunters from the local communities. However, the potential for increased harvest would be limited to species that are typically harvested by local communities (i.e., ducks, geese, and their eggs) as reported by community participants during IQ studies, public meetings, and workshops. Such effects would be limited to terrestrial environments. There are no roads connecting the two nearest communities to the Project road network and the linear distances from Pond Inlet and Arctic Bay to the Project are 134 km and 191 km, respectively. Actual travel distances from both communities would be much longer.

Similarly, Project activities and infrastructure can facilitate predation. Denning or perching areas created by Project infrastructure and food wastes produced by camp personnel when not disposed of properly may attract predators and scavengers to the Project Area. This higher density of predators can result in an increased risk of predation for birds nesting and raising their young in proximity to the Project footprint. This effect can be compounded by disturbance if it causes incubating birds to leave their nests. Tolerance to disturbance varies widely between species; however, there is a lack of information describing the level of disturbance required to cause birds to flush from or abandon their nest. Most information regarding nest disturbance relates to human approaches (within a few meters) of the nest, the capture of adults or young by researchers for banding purposes, the handling of eggs by researchers, and military aircraft overflights. There does not appear to be any literature discussing bird responses to ship movements near the nest site or nesting colonies in northern biomes, and only limited information regarding non-military aircraft-related disturbances.

In general, when adult birds leave the nest due to a disturbance, it exposes the eggs or nestlings to an increased probability of death through predation and exposure to cold and wet environments. For cliff-nesting species, eggs or young being knocked off the nesting ledge is an additional danger. Reduced nesting success has been linked to disturbance for many bird species including Black Guillemot, Thick-billed Murre, Northern Fulmar, Long-tailed Duck, and Common Eider (Cairns 1980, Ollason and Dunnet 1980, Johnson et al. 1987, Chardine and Mendenhall 1998, Gaston and Hipfner 2000). In contrast, nest disturbance appears to have little effect on the reproductive success of Glaucous Gull (Gilchrist 1995).

3.3.3 HEALTH

The accidental introduction of deleterious contaminants such as metals (i.e., from ore dust released during loading and transport operations) or hydrocarbons (e.g., oil and fuel spills) into the environment can have serious consequences for birds. Effects can be manifested through direct contact with the substance or indirectly through uptake of the substance via the food chain. Generally, populations of solitary nesting birds are at less risk to this type of effect because smaller numbers of individuals are likely to be exposed. In contrast, colonial nesting species are at greater risk because a larger proportion of the population is concentrated into a small area and, if that area is contaminated, a large number of birds would be vulnerable to exposure (Mallory and Fontaine 2004).

Potential contaminants to the food chain from metals associated with ore dust include minor concentrations of arsenic, cadmium, copper, lead, selenium, and zinc. However, vegetation and soil trace metals monitoring found that concentrations of these metals are generally well below thresholds at sampling sites both near and far from the PDA (TSD 09 — Vegetation). Pathways for Total Suspended Particulates (TSP) contaminants to enter the food chain include ingestion of affected vegetation or prey species within the area of deposition. Of the bird species found in the PDA and areas impacted by TSP, those most likely to take up dust contaminants are Canada Goose, Cackling Goose, Atlantic Brant, Snow Goose and Tundra Swan. These herbivorous species might graze on vegetation found in the deposition area around the Mine Site, along the Tote Rote, and around the Milne Inlet Port. Prey species of marine birds, including mollusks and small fish, might also serve as pathways for contaminants. Bivalve mollusks may be consumed in the TSP deposition area by Common Eider, King Eider, and Long-tailed Duck (Goudie et al. 2000, Robertson and Savard 2002, Powell and Suydam 2012). Bivalves like the blue mussel (*Mytilus edulis*) have been effectively used in Greenland to monitor metals in areas with mining activities since they parallel concentrations in surrounding sediment (Boening 1999). Small fish are common in the diets of most other marine birds found near Milne Port; however, the bio-accumulation potential of dust contaminants in fish is low (Ciardullo et al. 2008).

While metal concentrations and other contaminants have been widely investigated in tissues of Arctic birds (Braune et al. 1999, 2005), definitive conclusions on potential toxicity and health effects remain elusive (Fisk et al. 2005). For example, it was suggested that cadmium bio-accumulates in some seabirds (Donaldson et al. 1997) but in other studies, a weak relationship was found between cadmium and health biomarkers, suggesting no influence on the health of birds at the levels observed (Fisk et al. 2005). However, seabirds are useful in monitoring levels of trace element contaminants since they are widely distributed, feed at a high trophic level, and have been well monitored. Examination of organisms at higher trophic levels can provide an integrated view of the food web and bio-accumulation of contaminants is most apparent in these organisms. The Canadian Wildlife Service is also monitoring contaminant levels, including metals, in seabirds at the Cape Graham Moore colony on Bylot Island.

Contamination of the marine environment through large catastrophic oil spills from ships carrying large resupply loads to the port, or from smaller chronic ship or land-based fuel leaks, does have the potential to cause significant and long-lasting negative effects on local marine ecosystems. These effects could also extend beyond the boundaries of the MRSA.

Discharges from ships (e.g., bilge water, grey water, ballast water) can alter water quality and food supplies (lower trophic level biota) in the immediate vicinity of the ship. The potential for effects due to ship discharges can also be minimized with environmentally appropriate operating procedures. Numerous federal and territorial regulations and guidelines are in place to minimize the risk of these types of effects on Canada's marine environments and are enforced under Canada's *Shipping Act* (2001) and Canada's *Arctic Waters Pollution Prevention Act* (1985).

3.4 ASSESSMENT METHODS

3.4.1 HABITAT

The assessment of potential effects on habitats for Key Indicator species was a quantitative assessment based on habitat suitability modeling completed for Red-throated Loon, Common and King Eider, Red-necked Phalarope, and Red Knot, a Resource Selection Function for Peregrine Falcon, and on population density mapping for Lapland Longspur and Thick-billed Murre. Habitat suitability models included nesting site, brood rearing, and foraging components combined into a single model for habitat use throughout the breeding season. Other than Thick-billed Murre which was selected as a Key Indicator within the MRSA, all other models were developed for the TRSA.

Determination of habitat effects resulting from the proposed Project involved:

- Mapping of the Project Development Area (PDA) or Project footprint. This represents the area in which direct habitat loss is expected to occur as part of the Phase 2 Proposal, and included the Milne Inlet port and camp, Tote Road, access roads, the north and south rail alignments, all airstrips, the Mine Site and crushing area, both Mine Site camps and other supporting infrastructure, and the Steensby Inlet Port and camp;
- Creation of Zone of Influence (ZOI) buffers around the PDA using ArcGIS. This represents the area in which indirect habitat loss is expected to occur:
    - For most of the PDA, two ZOI buffers were created, the first from 0 to 250 m, and the second from 250 to 500 m;
    - Around the airstrips, the second ZOI was extended to 3 km on either side of the airstrip and 5.4 km from the ends to account for the auditory and visual disturbance generated by aircraft upon takeoff and landing. The size of the airstrip buffer was based on recommendations from Environment Canada (Environment Canada 2006): 5.4 km is the estimated distance that it would take for a Boeing 737 aircraft to reach a height of 650 m upon take-off and the 3 km buffer on either side of the airstrip was based on a literature review by Environment Canada.
- Overlaying the PDA and ZOI buffers on the habitat suitability or population density values and applying decreased values within these areas:
    - Areas within the PDA were all reclassified as 'Nil' or not suitable for bird use. This is expected to be the worst-case scenario for highly disturbed areas but some areas with lesser disturbance within the PDA may continue to be used by birds;
    - Areas within the first ZOI of the PDA dropped two suitability or density classes (e.g., from High to Low) to a minimum of Low;

  - Areas in the second ZOI of the PDA dropped one suitability or density class (e.g., from High to Medium) to a minimum of Low;
  - Outside of the ZOI buffers, areas were assumed to be not affected by indirect habitat effects and were not reclassified.

- Habitat loss during mine operation was calculated by comparing the baseline habitat and density values within the TRSA to those calculated for the FEIS and Early Revenue Phase and those calculated for the Phase 2 Proposal. These results were then summarized in table format for each of the bird KIs.

There will be no active infrastructure during the closure period. Acknowledging that some plant communities and habitats within the ZOI buffers may be modified over time due to Project effects such as dust deposition (e.g. changes in moss, lichen, and vascular plant communities within 200 m of the Tote Road; (Forbes 1995, Auerbach et al. 1997), habitat suitability values for some areas within the ZOI buffers may not return to pre-development values.

3.4.2 MORTALITY AND HEALTH

The assessment of mortality and health risks for bird KIs was a qualitative assessment based on a review of the relevant literature, the determination of relevant risk factors, the extent of potential effects, and the size of the local population for each of the bird KIs.

3.4.3 CRITERIA FOR ASSESSING SIGNIFICANCE

Significance of the Phase 2 Proposal's potential impact on birds and bird habitat is determined in consideration of one or more of the following sources of information (Canter 1999):

- Guidelines or standards outlined in Nunavut or Federal laws, regulations, policies, etc.;
- Pre-defined thresholds;
- Setting (e.g., is the Project in protected habitat, critical or sensitive habitat, land-use zone with defined land use thresholds);
- The intensity of the effect (e.g., predicted change, and whether the change is within normal variability); and
- Public concern.

Criteria including magnitude, extent, frequency, duration, reversibility (described further in Section 3.8 of the assessment methods volume, FEIS Volume 2, Baffinland Iron Mines Corporation (2012b)) are used to characterize the nature of the residual effects. The criteria are assessed in the context of the mitigation measures and Project design features that will be applied to eliminate or minimize the Phase 2 Proposal impact(s) on the bird KIs. Where legislation, thresholds, standards, or objectives exist to define criteria rating and are relevant to the assessment, they are used. Similarly, quantitative values, if available, are used over qualitative criteria.

Guidelines or Standards — There are no guidelines or standards outlined in Nunavut or Federal laws, regulations, policies, etc. that informed significance criteria or thresholds.

- The Migratory Birds Convention Act and Species at Risk Act do not identify any quantified thresholds of disturbance or significance to birds and their habitats (Government of Canada 1994, 2002).
- There are no thresholds of disturbance to birds reflected in known Government of Nunavut policy (Government of Nunavut, Department of Executive and Intergovernmental Affairs 2017).
- The *Nunavut Wildlife Act* (Government of Nunavut 2005) does not identify specific thresholds of allowable disturbance to birds or their habitats, rather it generally suggests that disturbance shall not occur without licence to do so.

Pre-defined Thresholds — The North Baffin Land Use Plan (Nunavut Planning Commission 2000) does not identify any land use disturbance thresholds related to birds and their habitats that are relevant to Project impact significance determination. Similarly, a review of the scientific literature as well as relevant recovery strategies and management plans (Environment Canada 2007a, b, 2014, 2015, 2016, NAWMP Plan Committee 2012, Environment and Climate Change Canada 2017b) and conservation plans (Donaldson et al. 2000, Milko et al. 2003, Rosenberg et al. 2016) did not identify thresholds relevant to the Canadian Arctic or North Baffin Island.

Setting — The TRSA does not overlap with any protected areas (e.g., National Park, Migratory Bird Sanctuary, and National Wildlife Area) or other critical terrestrial habitats for migratory birds such as Key Terrestrial Habitat Sites (Latour et al. 2008) and Important Bird Areas (Important Bird Areas Canada 2010). The Northern Route and Southern Route MRSAs overlap with multiple critical habitat sites for migratory birds (see Section 2.4); however, the northern shipping route directly interacts only with the Cape Graham Moore Key Marine Habitat Site and the southern shipping route may potentially directly interact only with the Frobisher Bay and Button Islands Key Marine Habitat Sites, if at all (Mallory and Fontaine 2004).

Public concern — Public concerns related to Phase 2 impacts on birds are reflected in Section 3.1. None of the concerns expressed suggested quantifiable significance thresholds.

Therefore, significance of the Phase 2 Proposal on birds relied primarily on the intensity of Project effects. Where empirical knowledge, IQ, or scientific evidence is lacking, professional judgement and experiences from similar projects were used in determining if a criterion is given more or less weight in assigning impact significance. Any weighting and justification of the weighting are described. After considering the criteria, a confidence rating is determined and applied that considers the accuracy and application of analytical tools, an understanding of the effectiveness of mitigation measures, and an understanding of known responses of bird KIs to potential Phase 2 Proposal impacts.

Definitions and rating scales for the criteria for specific bird and bird habitat measurable parameters are described in Table 39. That table lists the upper threshold limits that have been proposed for this Project's Wildlife KIs and their respective potential effects and measurable parameters. This assessment uses the same threshold levels used for the Approved Project (≤10%, >10–25%, and >25% change from that available in the RSAs) for measurable parameters.

The following specific thresholds were also identified:

- Ship collisions and the accidental introduction of deleterious contaminants resulting in the mortality of greater than 1% of the Canadian population of any bird species (e.g., Thick-billed Murre) are considered significant.
- Ship collisions and the accidental introduction of deleterious contaminants resulting in the mortality of greater than 10% of the population of any seabird species at any nesting colony are considered significant (e.g., >10% of Thick-billed Murre or Black-legged Kittiwake nesting at the Cape Graham Moore colony).
- Collisions with ships or Project infrastructure that result in mortality for any Species at Risk are considered significant.
- A single catastrophic event resulting in the release of contaminants to the marine environment is considered significant regardless of effects on species at risk or seabirds.

Table 39. Potential Effects, Measurable Parameters and Significance Ratings for Key Indicators

Effect	Measurable Parameters	Significance Criteria (Magnitude and Extent)
Direct and Indirect Habitat Loss	Changes in the quality and availability of habitat	Level I: Negligible to low change (<10%) Level II: Moderate change (10–25%) Level III: High change (>25%)
	Changes in the density of birds	
	Changes in nest densities, traditional nest site occupancy rates, and breeding success	
Mortality and Health	Changes in population size due to mortalities	Level I: Negligible to low change (<10%) Level II: Moderate change (10–25%) Level III: High change (>25%)

3.5 PHASE 2 PROPOSAL IMPACTS

3.5.1 HABITAT

3.5.1.1 Red-throated Loon

During pre- and post-development surveys, Red-throated Loon nests were found near marine coastlines in Milne and Steensby inlets as well as on freshwater bodies throughout the TRSA. Loons were also observed foraging and raising young throughout the TRSA.

Loons will be affected by direct habitat loss because of Project development as well as indirect habitat loss through noise and visual disturbance from mining activities, aircraft, vehicle traffic, and personnel that will result in decreased use of habitats adjacent to all components of the Project footprint.

The potential effects of sensory disturbance may result in the abandonment of traditional nesting and foraging areas within the zone of influence through the construction, operation, and closure phases followed by reoccupation of these areas into post-closure. However, monitoring during the bulk sampling program suggested that the distance over which this disturbance takes place is generally limited to within 300 m from the development footprint. Baseline surveys and habitat modelling also indicated that there is an abundant supply of suitable habitat for this species within the TRSA. Therefore, displacement of loons from the ZOI to nearby suitable habitats should have little to no effect on their nesting success during all three stages of the Phase 2 Proposal. Post-development, loons are observed to nest within 300 m of the Tote Road and Milne Inlet Port infrastructure and within 500 m of the Mary River Camp. Therefore, the sensory disturbance effects to loons are expected to be low.

A habitat suitability model for Red-throated Loon nesting and foraging habitat was developed for the TRSA. Within the TRSA, there could be a direct loss of 4.21 km² of high and moderate suitability habitat because of the Phase 2 Proposal while 59.45 km² of high and moderate suitability habitat may be affected by sensory disturbance within the ZOI but still available to Red-throated Loon (Table 40). For the total Phase 2 Proposal, this represents a loss and disturbance of 6.01% of the total amount of high and moderate value habitats within the TRSA, to which the Phase 2 change contributes 0.21%. There is a concomitant increase in low and nil quality habitats given that habitat effectiveness is reduced because of direct loss to the PDA and indirectly within a ZOI. Given the slow post-reclamation recovery potential of habitats in Arctic environments, direct habitat loss will extend beyond the life of the Project while the duration of indirect habitat loss within the ZOI will be reversible over time following mine decommissioning. Displacement of this small amount of habitat relative to the total available habitat is not significant.

Table 40. Effects on Red-throated Loon Habitat due to Direct Habitat Loss within the Project Development Area and Reduced Habitat Effectiveness within the Zone of Influence

Habitat Suitability Rating	Baseline TRSA		Approved Project			Phase 2 Change			Total Phase 2 Proposal		
	Area (km²)	% RSA	PDA (km²)	ZOI (km²)	% Habitat Class	PDA (km²)	ZOI (km²)	% Habitat Class	PDA (km²)	ZOI (km²)	% Habitat Class
High	186	0.88	-0.79	-4.67	-2.93	-0.06	-0.10	-0.09	-0.85	-4.77	-3.02
Moderate	1,939	9.44	-3.20	-52.49	-2.87	-0.16	-2.20	-0.12	-3.36	-54.69	-2.99
Low	873	4.15	-3.67	+57.16	+6.13	-0.48	+2.30	+0.21	-4.15	+59.45	+6.34
Nil	18,056	85.76	+7.66	+0.00	+0.04	+0.70	+0.75	+0.01	+8.36	+0.75	+0.05

3.5.1.2 Snow Goose

Thousands of Snow Geese use the Milne and Steensby inlets as well as portions of lowland tundra in the TRSA as stop-over sites during spring migration (late May to early June), for summer moulting (late July to mid-August), and as stop-over sites during fall migration (late August and early September). During these periods, there is potential for disturbance from Project activities including construction, mine operation, port activities, and associated shipping, rail, road and aircraft traffic. Stop-over sites are crucial resting and feeding locations for migrating birds, and moulting is a very energetically expensive process that requires a reliable supply of food with minimal levels of stress from predators or other activities.

Traditional stop-over sites and moulting locations used by large numbers of birds each year obviously provide these essential needs in a predictable fashion and therefore, protection of these areas is often vital to the conservation of species that use them. However, most migrating Snow Geese recorded during the surveys did not stop directly within the port or other Project footprints. Instead, most of these birds were seen resting, foraging, and moulting in nearby areas, particularly south of the Mine site.

Except for a small section in the northeast corner of the Snow Goose area of interest (Map 3) which overlaps with the south rail alignment, the area of interest for Snow Goose is outside of the Project footprint and all associated ZOI buffers including the airstrip buffers. As per PC Condition 71, air traffic will stay a minimum of 1,110 m above ground during the moulting period, and 650 m above ground during the remainder of the migration and breeding season when flying over areas where geese and other migratory birds are concentrated. Other than environmental monitoring and geological surveys, no other Project activities will occur in this area and none of the proposed Phase 2 activities will interact with this area.

During the breeding season, a relatively small number of Snow Geese appear to nest within the bulk of the TRSA and these are mostly concentrated in well-vegetated lowland south and southwest of the Mine site areas as well as near Milne Port. Therefore, some direct habitat loss due to the Project components and activities in these locations are expected. Aerial surveys did locate a breeding colony of over 5,000 Snow Geese on the southwest shore of Steensby Inlet; however, this is outside of the PDA, TRSA, and all associated ZOI buffers (including the airstrip buffers approximating the effect of large aircraft landing and take-off).

Although many Snow Geese will likely be displaced by Project activities, these birds are expected to move to less disturbed areas nearby. Project activities may result in a small shift in their migratory pathways on either side of the Project footprint in response to sensory disturbance, but these changes are not expected to affect their migration or population. Snow Geese are not naïve to disturbance along their migration routes and they are heavily harvested in both spring and fall. Furthermore, Snow Goose populations are no longer limited by habitat availability on their wintering range and the energetic requirements of migration and have expanded to the point where they are causing management concerns and possibly affecting the nesting and foraging habitats of other Arctic breeding species such as shorebirds (Mowbray et al. 2000). Snow Goose habitat loss from both direct and indirect effects is expected to be not significant.

3.5.1.3 Common and King Eider

Hundreds of Common and King Eider use Milne and Steensby Inlets as migratory stop-over sites during their spring (open water areas at the mouths of creeks and rivers) and fall migrations, and dozens of female eiders raise young in the marine waters of Steensby Inlet. Nesting King Eider were observed near freshwater bodies throughout the TRSA and nesting Common Eider were reported along the coastline of Steensby Inlet. However, no large nesting colonies of Common Eider were located along the shorelines or on islands of Milne or Steensby Inlets. Nest sites may be disturbed by project activities such as port construction and ship wake. Nest searches were conducted along shorelines expected to be most heavily impacted by ship wake in Steensby Inlet and Milne Inlet in 2012 and 2013, respectively.

Based on those surveys, it is likely that birds will have fledged before ice has cleared to allow for open-water shipping where wakes may be a concern.

Eiders may be displaced from coastal and terrestrial habitats used for staging, nesting, foraging, and brood-rearing through development of the Project and/or by sensory disturbances in habitats immediately adjacent to the Project footprint during construction, operation, and closure activities. Disturbed eiders may abandon traditional nesting and foraging areas; however, it is predicted that they will simply relocate to less disturbed suitable habitat throughout the remainder of the TRSA and Northern Route MRSA. Pre- and post-FEIS aerial and ground surveys as well as habitat modelling indicated that there is an abundant supply of suitable coastal habitat for Common Eider and inland tundra habitats for King Eider within the RSAs for these species to occupy. In the year following development of any new footprint, it is possible that displaced birds, mainly King Eider, may forego breeding for that year as they establish themselves in new breeding habitats. However, it is expected that most birds would not be affected because a study of marked female King Eider found breeding site fidelity to be within a large area (15 km radius) centered on the nest site of the previous year (Phillips and Powell 2006). Therefore, displacement of Eiders from the PDA and ZOI to nearby areas should have little to no effect on their migratory behavior and nesting success during all stages of the Phase 2 Proposal.

A habitat suitability model for Common and King Eider nesting and foraging habitat was developed for the TRSA. The habitat suitability model created for eiders combined the habitat preferences of King Eider which typically nest near freshwater lakes and ponds within inland Arctic tundra (Powell and Suydam 2012) with the habitat preferences of Common Eider which are usually closely tied to marine habitats and tend to nest on coastal islands or islets (Goudie et al. 2000). Within the TRSA, there could be a direct loss of 14.25 km² of high and moderate suitability habitat because of Project Development while 80.86 km² of high and moderate suitability habitat may be affected by sensory disturbance within the ZOI but still available to Common and King Eider (Table 41). For the sum of Project effects (Total Phase 2 Proposal), this represents a loss and disturbance of 5.98% of the total amount of high and moderate value habitats within the TRSA to which the Phase 2 Change contributes 0.27%. There is a concomitant increase in low and nil quality habitats given that habitat effectiveness is reduced because of direct loss to the Project footprint and indirectly within a zone of influence due to sensory disturbances. Given the slow post-reclamation recovery potential of habitats in Arctic environments, direct habitat loss will extend well beyond the life of the Project while the duration of indirect habitat loss due to disturbance within the ZOI will be reversible over time following mine decommissioning. Displacement of this small amount of habitat relative to the total available habitat is considered not significant. Should Common Eider breeding colonies be discovered along the northern marine shipping route, ship routing will ensure that vessels travel at a minimum distance of 2 km from the colonies wherever possible.

Table 41. Effects on Common and King Eider Habitat due to Direct Habitat Loss within the Project Development Area and Reduced Habitat Effectiveness within the Zone of Influence

Habitat Suitability Rating	Baseline TRSA		Approved Project			Phase 2 Change			Total Phase 2 Proposal		
	Area (km²)	% RSA	PDA (km²)	ZOI (km²)	% Habitat Class	PDA (km²)	ZOI (km²)	% Habitat Class	PDA (km²)	ZOI (km²)	% Habitat Class
High	1,176	5.59	-3.25	-39.99	-3.68	-0.24	-2.11	-0.20	-3.49	-42.10	-3.88
Moderate	2,358	11.20	-10.01	-37.95	-2.03	-0.76	-0.81	-0.07	-10.76	-38.76	-2.10
Low	10,035	47.66	-38.80	+77.94	+0.39	-6.66	+2.92	-0.04	-45.46	+80.86	+0.35
Nil	7,485	35.55	+52.05	+0.00	+0.70	+7.66	+0.00	+0.10	+59.71	+0.00	+0.80

3.5.1.4 Peregrine Falcon

Baseline and Post-FEIS surveys were used to estimate pre- and post-development distribution of Peregrine Falcon and to assess habitat quality and availability within the TRSA. Except for 2009 and 2010 when no cliff-nesting raptor surveys were conducted, raptor nests have been monitored annually throughout the TRSA since 2006. Starting in 2015, raptor monitoring surveys were focused within a 10-km buffer of the PDA and concerted efforts were expended to find all nesting sites within this area and to monitor productivity. Because of these monitoring efforts, the spatial distribution and reproductive parameters of Peregrine Falcon and other cliff-nesting raptors breeding in the TRSA are well documented. The relevant peer-reviewed literature available for this species is also well developed and was used extensively to inform this assessment.

Peregrine Falcon are relatively tolerant to disturbance. They readily nest on artificial structures some of which are associated with high human traffic areas such as concrete ledges on city buildings and bridges (Cade and Bird 1990), smokestacks (Cade et al. 1996b), and power generating stations (Septon et al. 1996). Breeding Peregrine Falcon have also demonstrated a certain degree of tolerance to mining and blasting activities, as evidenced by opportunistic nesting of falcons on the open pit walls at the EKATI™ mine in the Northwest Territories (Banci, pers. comm. with M. Evans). Holthuijzen et al. (1990) experimentally examined the influence of blasting noise at mines on the closely related Prairie Falcon, and recorded no observable effects to 140 dB blasts occurring 500–1,000 m from nests. Blasts in the range of 250–500 m flushed adults from their nests but the average recorded return time to the nest was only 1.4 min after a blast. Palmer et al. (2003) found that noise disturbance to Peregrine Falcon from jet aircraft over-flights 150 m above nests affected activity budgets and nest attendance patterns but did not affect overall food provisioning rates to nestlings. Ellis et al. (1991) found Peregrine Falcon to be tolerant of aircraft noise levels between 85–140 dB and whilst low level jet flights (<1,000 m) caused a flight response in some pairs, nest abandonment or reproductive failure did not occur.

Protective buffers zones of various sizes have been suggested for Peregrine Falcon by various authors. Holthuijzen et al. (1990) recommended a buffer distance between nests and mine blast sites of only 125 m, but in the United States, most states have peregrine management plans that prescribe protective buffers ranging between 150–800 m although one recommends 4,800 m (Ellis 1982, U.S. Fish and Wildlife Service 1982, Hayes and Buchanan 2002). Richardson and Miller (1997) recommended buffers of 800 m based on a review of five Peregrine Falcon studies (although this was considered highly dependent on individual site characteristics) and Fyfe and Olendorff (1976) suggested that aircraft should not approach closer than 500 m above a nest. Based on the results of the previous published studies and reviews as well as on the results of the 2008 bulk sample monitoring program, 500 m no-disturbance buffer zones are suggested to minimize disturbance on cliff-nesting raptors. These buffers may be adjusted on a nest-specific basis according to its management plan (Baffinland Iron Mines Corporation 2016).

Peregrine Falcon are likely to habituate to disturbance although it may take several years to occur (Ratcliffe 1962). Pairs in remote locations that have little to no experience with disturbance from human activities are most reactive to human intrusions (White et al. 2002). Disturbed raptors can react in several different ways, depending on the magnitude of the disturbance and tend to be most sensitive during the breeding season, especially during nest initiation and egg laying stages (Fyfe and Olendorff 1976, Steenhoff 1987, Cade et al. 1996a, COSEWIC 2007a, Environment Canada 2015). Behavioural indications of disturbance include agitation, increased alertness, vocalizing, and flushing from a nest that results in incubation and brooding recesses that can cause thermoregulation stresses to eggs or nestlings, and ultimately, nest abandonment (White et al. 2002, COSEWIC 2007a, Environment Canada 2015).

Even though Peregrine Falcon are known to be relatively tolerant to disturbance, some habitat loss and sensory disturbance to foraging habitats adjacent to the PDA will occur throughout construction, operation, and closure phases of the Project.

The Mine Site will continue to be a focus of activity throughout all Project phases. The existing Mary River camp and the mine infrastructure are in low lying tundra areas that are considered typical falcon foraging habitat. Development of the area has resulted in the direct and indirect loss of suitable foraging habitat. The open pit mine and waste rock stock pile areas are characterized by high elevation and rocky habitat with very little vegetation that are not considered suitable foraging habitat for Peregrine Falcons given low prey densities in such habitats but that do include potential nesting areas. Six nesting sites traditionally occupied by Peregrine Falcon and two nesting sites traditionally occupied by Rough-legged Hawk are located within or near the mine site infrastructure PDA.

Raptor occupancy at most of these nest sites has been inconsistent since intensive raptor nest monitoring began in 2011. Even pre-development, all these nest sites were not occupied annually and some likely represent alternative nest sites of the same nesting pairs. This is corroborated by monitoring surveys which showed that between 2011 and 2017, two or three pairs of Peregrine Falcon have nested annually within or near the mine site infrastructure PDA (although the specific nest sites used varied annually).

Birds attempting to establish nests or nesting at these locations have and will continue to experience disturbances due to air and road traffic, operating machinery, blasting and mining at Deposit No. 1, and by mine personnel. Due to the abundance of suitable foraging and nesting habitat in the vicinity, these disturbances are expected to have minimal effects on peregrine habitats.

The coastal tundra area near Milne Port provides excellent foraging habitat for raptors. The closest raptor nest site to the port infrastructure is a nest site located approximately 750 m east from the rock quarry occupied intermittently by Rough-legged Hawk. There are no other identified raptor nesting sites within or near the Milne Port PDA. The nearest known Peregrine Falcon nest sites are both located approximately 3 km from Milne Port, one northeast along the coast and the other south of port infrastructure. Project activities at the Milne Port are expected to have limited to no effects on Peregrine Falcon nesting habitats and limited to no effects on foraging habitats.

The Milne Inlet Tote Road and the Northern Railway alignment are bound by steep cliffs on both sides for much of their length and provide an abundance of high quality cliff nesting habitat. Large expanses of upland tundra as well as small but numerous areas of lowland tundra that provide excellent foraging habitats for Peregrine Falcon and other birds of prey can also be found along the northern transport corridor. During construction of the Tote Road to Milne Inlet, no raptor nest sites were located within the footprint of the Tote Road to Milne Inlet. However, the road corridor passes within 250 m of two nest sites traditionally occupied by Peregrine Falcon. Both nest sites have been consistently occupied throughout road construction and transport operations. These nesting pairs may experience indirect habitat loss due to disturbance from road traffic given their proximity to the road. However, current operations have not affected nesting at these locations, so it is thought that Project-related road traffic is unlikely to induce Peregrine Falcon to abandon nest sites. Seven raptor nesting sites, including five consistently used by Peregrine Falcon, are located within 500 m of the Potential Disturbance Area resulting from the Phase 2 Proposal consisting predominantly of the North Railway alignment and associated laydown areas, quarries, and borrow pits. No active Gyrfalcon nesting sites were located within the Phase 2 Proposal PDA in any of the survey years. None of the nest sites are located within the footprint such that they will be destroyed. However, nesting pairs that have traditionally occupied these sites may experience some indirect habitat loss due to sensory disturbance. Three of these nesting sites, one of each traditionally occupied by Peregrine Falcon, Common Raven, and Rough-legged Hawk, are located within 100 m of the proposed PDA. However, like road traffic, transport operations on the northern route railway are expected to have minimal effects on nesting raptors once the railway construction is complete.

As part of Project effects monitoring, an analysis of the raptor occupancy and reproductive success data were conducted in relation to distance to disturbance in 2015 and 2016. ESRI ArcGIS for Desktop v.10.3 was used to calculate the distance from raptor nest sites to the nearest mapped disturbance features (e.g., project infrastructure). All known Peregrine Falcon and Rough-legged Hawk nest sites documented within 10 km of the current disturbance (i.e., the Mine Site, Tote Road, and Milne Port) were assigned to four discrete distance-to-disturbance bins (0.0 km ≥ 1.0 km, 1.0 km ≥ 3.0 km, 3.0 km ≥ 5.0 km, 5.0 km ≥ 10.0 km).

The probability of site occupancy, brood size and nest success were modeled for nest sites located up to 10 km from the PDA using generalized linear mixed effects models in R Statistical Environment (R Core Team 2014). More details on methodology and analysis can be found in the 2015 and 2016 Terrestrial Environment Annual Monitoring Reports (EDI Environmental Dynamics Inc. (EDI) 2016, 2017).

As of 2016, 140 unique nest sites have been documented within 10 km of the current disturbance (i.e., the Mine Site, Tote Road, and Milne Port). Analysis of the 2015 and 2016 raptor occupancy and reproductive success data found no evidence that occupancy, nest success or productivity was affected by distance from disturbance (Table 42 and Table 43). Parameter estimates for both species in both years for all measures (occupancy, nest success, number of nestlings) were not significantly different from zero.

Table 42. Site occupancy, nest success, and number of nestlings in relation to increasing distance from the PDA for Peregrine Falcon and Rough-legged Hawk 2015.

	Peregrine Falcon		Rough-legged hawk	
	Estimate (SE)	*p*	Estimate (SE)	*p*
Occupancy[1]	-0.02 (0.08)	0.81	0.01 (0.07)	0.89
Nest success[1]	-0.03 (0.12)	0.78	0.02 (0.13)	0.912
Number of nestlings[2]	-0.01 (0.04)	0.89	0.02 (0.03)	0.47

[1] Logistic regression
[2] Poisson regression

Table 43. Site occupancy, nest success, and number of nestlings in relation to increasing distance from the PDA for Peregrine Falcon and Rough-legged Hawk 2016.

	Peregrine falcon		Rough-legged hawk	
	Estimate (SE)	*p*	Estimate (SE)	*p*
Occupancy[1]	0.01 (0.07)	0.89	0.02 (0.05)	0.69
Nest success[1]	0.09 (0.12)	0.44	-0.12 (0.12)	0.31
Number of nestlings[2]	0.01 (0.02)	0.60	-0.06 (0.05)	0.23

[1] Logistic regression
[2] Poisson regression

In addition to the assessment of distance effects, an assessment of direct and indirect habitat loss to nesting and foraging areas was conducted based on Resource Selection Function modeling (Galipeau et al. In Prep). Approximately 43% of the TRSA is considered high quality Peregrine Falcon habitat (Table 44). A large proportion of nesting cliffs are in proximity to seemingly productive tundra foraging habitat and many of the valleys and canyons occupied by nesting raptors have a high abundance of Snow Bunting and Arctic Hare. Within the TRSA, there could be a direct loss of 39 km² of high and 52 km² very high suitability habitat because of Project Development while 21 km² of high and 187 km² of very high suitability habitat may be affected by sensory disturbance within the ZOI but still available to Peregrine Falcon (Table 44).

For the sum of Project effects (Total Phase 2 Proposal), this represents a loss and disturbance of 6.91% of the total amount of high and very high value habitats within the TRSA to which the Phase 2 Change contributes 0.81%. There is a concomitant increase in moderate, low, and very low-quality habitats given that habitat effectiveness is reduced because of direct loss to the Project footprint and indirectly within a zone of influence due to sensory disturbances. Given the slow post-reclamation recovery potential of habitats in Arctic environments, direct habitat loss will extend well beyond the life of the Project while the duration of indirect habitat loss due to disturbance within the ZOI will be reversible over time following mine decommissioning. Displacement of this small amount of habitat relative to the total available habitat is not significant.

Overall, there appears to be abundant supply of suitable cliff-nesting habitat within the TRSA with adjacent productive tundra foraging habitat. The availability of nesting habitat for Peregrine Falcon and other cliff-nesting species does not appear to be limiting and it is suspected that any birds disturbed by Project activities may readily relocate to areas away from potential disturbances.

Table 44. Effects on Peregrine Falcon Habitat due to Direct Habitat Loss within the Project Development Area and Reduced Habitat Effectiveness within the Zone of Influence

Habitat Suitability Rating	Baseline TRSA		Approved Project			Phase 2 Change			Total Phase 2 Proposal		
	Area (km²)	% RSA	PDA (km²)	ZOI (km²)	% Habitat Class	PDA (km²)	ZOI (km²)	% Habitat Class	PDA (km²)	ZOI (km²)	% Habitat Class
Very High	4,190	19.90	-47.29	-178.70	-5.39	-4.73	-8.43	-0.31	-52.02	-187.13	-5.71

Table 44. Effects on Peregrine Falcon Habitat due to Direct Habitat Loss within the Project Development Area and Reduced Habitat Effectiveness within the Zone of Influence

Habitat Suitability Rating	Baseline TRSA		Approved Project			Phase 2 Change			Total Phase 2 Proposal		
	Area (km²)	% RSA	PDA (km²)	ZOI (km²)	% Habitat Class	PDA (km²)	ZOI (km²)	% Habitat Class	PDA (km²)	ZOI (km²)	% Habitat Class
High	4,958	23.55	-30.27	-4.99	-0.71	-8.28	-16.31	-0.50	-38.55	-21.31	-1.21
Moderate	4,078	19.37	-7.25	+85.39	+1.92	-1.21	+11.59	+0.25	-8.46	+96.98	+2.17
Low	3,473	16.49	-1.72	+98.30	+2.78	+0.00	+13.15	+0.38	-1.72	+111.45	+3.16
Very Low	4,355	20.68	+86.54	n/a	+1.99	+14.22	+0.00	+0.33	+100.76	n/a	+2.31

3.5.1.5 Red Knot

Songbird and shorebird surveys consisting of point count and transect surveys from 2006 to 2008 and 2011, PRISM and transect surveys in 2012 and 2013, and focused Red Knot surveys in the Milne Port area in 2014, did not detect Red Knot at any survey location within the TRSA. However, Red Knots were observed incidentally in the TRSA on one occasion (3 August 2007) when a group of nine (2 adults and 7 young) were observed near the sandbar of a river near the Mine Site (on the west end of Camp Lake). Given timing of this observation, it's possible these birds may have come from elsewhere since most Red Knot fledge by the end of July (Baker et al. 2013). Therefore, determination or project interactions with Red Knot must rely on the relevant information found in literature and broad habitat modelling. If present, the species is expected to nest in barren areas such as windswept ridges, slopes or plateaus with sparse vegetation cover. Nests are often associated with mountain aven (*Dryas integrifolia*) mats. Observations at Bylot Island (n=4) indicated that the species may be selecting gravelly habitats for nesting (Lepage et al. 1998).

Potential effects to Red Knot habitat resulting from the Phase 2 Proposal is direct habitat loss because of Project development as well as indirect habitat loss through visual and noise disturbance from all Project activities in habitats adjacent to the Project footprint. Sensory disturbance may result in the abandonment of nesting and foraging areas within the zone of influence through the construction, operation, and closure phases followed by reoccupation of these areas into post-closure. However, the habitat model indicates that there is suitable habitat for this species within the TRSA and displacement of Red Knot from the zone of influence to nearby suitable habitats should have little to no effect on their nesting success during all three phases of the Project. The sensory disturbance effects to Red Knot are expected to be low.

A coarse scale habitat suitability model for Red Knot nesting and foraging habitat was developed for the TRSA using the Circumpolar Arctic Vegetation Map (CAVM Team 2003) as requested by ECCC. Within the TRSA, there could be a direct loss of 78.35 km² of suitable habitat because of Project Development while 257.22 km² of suitable habitat may be affected by sensory disturbance within the ZOI but still available to

Red Knot (Table 45). For the sum of Project effects (Total Phase 2 Proposal), this represents a loss and disturbance of 4.12% of the total amount of suitable value habitats within the TRSA to which the Phase 2 Change contributes 0.63%. There is a concomitant increase in less suitable and nil quality habitats given that habitat effectiveness is reduced because of direct loss to the Project footprint and indirectly within a ZOI due to sensory disturbances. Given the slow post-reclamation recovery potential of habitats in Arctic environments, direct habitat loss will extend well beyond the life of the Project while the duration of indirect habitat loss due to disturbance within the ZOI will be reversible over time following mine decommissioning. Displacement of this small amount of habitat relative to the total available habitat is not significant.

Table 45. Effects on Red Knot Habitat due to Direct Habitat Loss within the Project Development Area and Reduced Habitat Effectiveness within the Zone of Influence

Habitat Suitability Rating	Baseline TRSA		Approved Project			Phase 2 Change			Total Phase 2 Proposal		
	Area (km²)	% RSA	PDA (km²)	ZOI (km²)	% Habitat Class	PDA (km²)	ZOI (km²)	% Habitat Class	PDA (km²)	ZOI (km²)	% Habitat Class
Suitable	8,149	38.70	-63.94	-220.23	-3.49	-14.41	-36.99	-0.63	-78.35	-257.22	-4.12
Less Suitable	10,663	50.64	-21.53	+220.23	+1.86	+0.00	+36.99	+0.35	-21.53	+257.22	+2.21
Not Suitable	2,243	10.65	+85.47	+0.00	+3.81	+14.41	n/a	+0.64	+99.88	n/a	+4.45

3.5.1.6 Buff-breasted Sandpiper

Although the Project Area is not within their recognized breeding range, Buff-breasted Sandpiper are known to nest on nearby High Arctic islands. Songbird and shorebird surveys consisting of point count and transect surveys from 2006 to 2008 and 2011 as well as PRISM and transect surveys in 2012 and 2013 did not detect Buff-breasted Sandpiper at any survey location within the TRSA. However, Baird Sandpiper, a shorebird species often associated with Buff-breasted Sandpiper, were regularly observed in upland tundra habitats. Therefore, determination or project interactions with Buff-breasted Sandpiper must rely on the relevant information found in the literature. If present, the species is expected to nest on dry sloping areas or polygon tundra with either raised edges or centers. Given that they inhabit upland habitats like Red Knot, direct and indirect Phase 2 effects on habitats are expected to be not significant.

3.5.1.7 Red-necked Phalarope

Songbird and shorebird surveys consisting of point count and transect surveys from 2006 to 2008 and 2011 as well as PRISM and transect surveys in 2012 and 2013 did not detect Red-necked Phalarope at any survey location within the TRSA. However, Red-necked Phalarope were observed incidentally in the TRSA on two occasions. Once on 28 July 2007 when one adult male and two newly fledged young were observed in a sedge-lined pond approximately 1 km southwest of the Mary River camp. And a second time on 5 August 2007 when three newly fledged young were observed on a pond southwest of the airstrip. Given the timing of these observations and that the young had fledged, it's possible these birds may have migrated to the Project Area from elsewhere else across their breeding range. If present, the species is expected to nest and forage along the margins of small lakes and ponds or in vegetation near other freshwater sources. Therefore, determination or project interactions with Red-necked Phalarope must rely on the relevant information found in literature and habitat modelling.

Potential effects to Red-necked Phalarope habitat resulting from the Phase 2 Proposal is direct habitat loss because of Project development as well as indirect habitat loss through visual and noise disturbance from all Project activities in habitats adjacent to the Project footprint. Sensory disturbance may result in the abandonment of nesting and foraging areas within the zone of influence through the construction, operation, and closure phases followed by reoccupation of these areas into post-closure. However, habitat modelling indicated that there is suitable habitat for this species within the TRSA and displacement of phalaropes from the zone of influence to nearby suitable habitats should have little to no effect on their nesting success during all three phases of the Project. The sensory disturbance effects to phalaropes are expected to be low.

A habitat suitability model for Red-necked Phalarope foraging habitat was developed for the TRSA. Within the TRSA, there could be a direct loss of 3.03 km² of high and moderate suitability habitat because of Project Development while 53.61 km² of high and moderate suitability habitat may be affected by sensory disturbance within the ZOI but still available to Red-necked Phalarope (Table 46). For the sum of Project effects (Total Phase 2 Proposal), this represents a loss and disturbance of 7.82% of the total amount of high and moderate value habitats within the TRSA to which the Phase 2 Change contributes 0.38%. There is a concomitant increase in low and nil quality habitats given that habitat effectiveness is reduced because of direct loss to the Project footprint and indirectly within a zone of influence due to sensory disturbances. Given the slow post-reclamation recovery potential of habitats in Arctic environments, direct habitat loss will extend well beyond the life of the Project while the duration of indirect habitat loss due to disturbance within the ZOI will be reversible over time following mine decommissioning. Displacement of this small amount of habitat relative to the total available habitat is not significant.

Table 46. Effects on Red-necked Phalarope Habitat due to Direct Habitat Loss within the Project Development Area and Reduced Habitat Effectiveness within the Zone of Influence

Habitat Suitability Rating	Baseline TRSA		Approved Project			Phase 2 Change			Total Phase 2 Proposal		
	Area (km²)	% RSA	PDA (km²)	ZOI (km²)	% Habitat Class	PDA (km²)	ZOI (km²)	% Habitat Class	PDA (km²)	ZOI (km²)	% Habitat Class
High	33	0.16	-0.09	-1.16	-3.79	-0.02	-0.05	-0.22	-0.11	-1.21	-4.01
Moderate	1,451	6.89	-2.76	-50.27	-3.66	-0.16	-2.13	-0.16	-2.92	-52.40	-3.81
Low	1,088	5.17	-2.78	+51.43	+4.47	-0.41	+2.18	+0.16	-3.18	+53.61	+4.63
Nil	18,482	87.79	+5.63	n/a	+0.03	+0.58	n/a	+0.00	6.21	n/a	+0.03

3.5.1.8 Ivory Gull and Ross's Gull

The assessment of Ross's and Ivory Gull is combined because project interactions and potential effects are considered identical for these species. Observations were rare but both species were observed during bird surveys in marine environments associated with the Project. Ivory Gull were observed in the Northern Route MRSA including Milne Inlet and Eclipse Sound while Ross's Gull were observed in the Southern Route MRSA including Steensby Inlet and West Foxe Basin. However, both species could occur in the Northern Route and Southern Route marine environments affected by the Project. Neither species are known to breed in the Project area or in coastal areas bordering the northern shipping route. However, both species may migrate through the marine and terrestrial environments associated with the Project to reach breeding colonies elsewhere in the Arctic such as the Brodeur Peninsula or use nearby marine environments during and outside of the breeding season.

The winter distribution of Ivory Gull and Ross's Gull is poorly known. Ivory Gull are thought to winter along the southern edge of Arctic pack ice in the waters of the North Atlantic (e.g., Davis Strait, Labrador Sea) and of the North Pacific (e.g., Bering, Chukchi, and Bering seas; (COSEWIC 2006) although some are known to overwinter in more northern areas along shoreleads and polynyas (Mallory et al. 2008). Similarly, Ross's Gull are thought to winter along the southern edge of Arctic pack ice in the waters of the North Pacific such as the Sea of Okhostk and the Bering Sea (COSEWIC 2007c). Given that all shipping will occur through the open water season, vessels will not travel through shore leads or polynyas where Ivory Gull may be foraging over the winter.

Research conducted in the 1980s was required by Canadian regulatory agencies for granting permits for offshore oil exploration in Hudson Strait, Davis Strait, and Lancaster Sound (LGL Ltd 1982, McLaren 1982, Orr and Parsons 1982, Renaud and McLaren 1982, Orr and Ward 1982). To date, none of the guidelines that may have been produced by Environment Canada at the time of that exploration activity can be located (ECCC: C. Callaghan, J.F. Dufour, H.G. Gilchrist, P.A. Smith, pers. comm.). If guidelines do become available they will be reviewed for their relevance to the Project's shipping activities.

3.5.1.9 Thick-billed Murre

No Thick-billed Murre colonies or large feeding flocks were identified around the shoreline and waters of Milne Inlet or Steensby Inlet during field surveys, nor are any identified within this area in the literature. Therefore, no significant effects to seabirds are expected in Milne Inlet during Project construction, operation, and closure. However, there are two Thick-billed Murre colonies identified on Bylot Island within the Northern Route MRSA. The closest that shipping vessels will sail to a seabird colony is when travelling on the shipping route 19 km south of the Cape Graham Moore colony. All marine habitats within 30 km of the colony are part of Key Marine Habitat Site #15 (Map 2; (Mallory and Fontaine 2004). This Key Marine Habitat Site extends almost to the coast of Baffin Island through which vessels sailing in Eclipse Sound must pass. However, there is no information to suggest that ships passing at such distances from the colony will significantly disturb nesting or foraging Thick-billed Murre. Furthermore, there is limited literature available regarding the effects of shipping traffic on birds at sea and more research on the effects of shipping is required (Schwemmer et al. 2011). The ECCC *Guidelines to Avoid Disturbance to Seabird and Waterbird Colonies in Canada* recommend that vessels on the water maintain a distance of at least 300 m from seabird colonies (Environment and Climate Change Canada 2013).

Shipping activity along the proposed shipping lane is not expected to result in significant indirect habitat loss because the disturbance associated with shipping activities will be restricted to 3 to 4 ship passages per day on average through the shipping season, the disturbance will be of short duration (20 minutes or less per ship passage), and the habitat loss will be temporary because the habitat will return to pre-passage condition once the vessel has left the area. The infrequent requirement to move out of a ship's path should not be a major energetic stress to birds.

Results from the ECCC study examining foraging distribution patterns of Thick-billed Murre marked with GPS at Cape Graham Moore are not yet available to inform this assessment. However, when these results become available, they will be used to implement adaptive management strategies to mitigate the impacts of Project shipping, if any, on nesting and foraging murres of the Cape Graham Moore colony.

3.5.1.10 Short-eared Owl

Although the Project area is well beyond the northern extent of their known distribution (approximately 1,000 km south), three sightings of single birds were recorded in the TRSA in both 2007 and 2008. However, no nesting was confirmed or suspected and the locations and timing of within year observation clusters are suggestive of repeated observations of a single individual. Habitat preference of Short-eared Owl this far outside of their normal range is unknown but is expected to be similar to habitat preferences in more southerly regions which generally consist of lowland and coastal tundra. Habitat availability is not expected to be a limiting factor within the study area. Given their irruptive nesting habits and the location of the Project respective to their normal range, Project activities are not expected to interact with this species and direct and indirect Phase 2 effects on habitats are not significant.

3.5.1.11 Lapland Longspur

The Project has the potential to adversely affect Lapland Longspur populations by reducing the availability of habitat due to the Project footprint and disturbance effects in habitats adjacent to the Project footprint. Loss of habitat during migration, breeding/nesting and brood-rearing may occur throughout the construction, operation and closure phases of the Mary River Project. Lapland Longspur are abundant and ubiquitous throughout much of the TRSA.

The assessment of habitat effects for Lapland Longspur was based on population density mapping completed for the TRSA. Within the TRSA, there could be a direct loss of 36.19 km² of high and moderate suitability habitat because of Project Development while 142.18 km² of high and moderate suitability habitat may be affected by sensory disturbance within the ZOI but still available to Lapland Longspur (Table 47). For the sum of Project effects (Total Phase 2 Proposal), this represents a loss and disturbance of 6.63% of the total amount of high and moderate density habitats within the TRSA to which the Phase 2 Change contributes 0.92%. There is a concomitant increase in low and nil quality habitats given that habitat effectiveness is reduced because of direct loss to the Project footprint and indirectly within a zone of influence due to sensory disturbances. Given the slow post-reclamation recovery potential of habitats in Arctic environments, direct habitat loss will extend well beyond the life of the Project while the duration of indirect habitat loss due to disturbance within the ZOI will be reversible over time following mine decommissioning. Displacement of this small amount of habitat relative to the total available habitat is not significant.

Table 47. Effects on Lapland Longspur Habitat due to Direct Habitat Loss within the Project Development Area and Reduced Habitat Effectiveness within the Zone of Influence

Habitat Suitability Rating	Baseline TRSA		Approved Project			Phase 2 Change			Total Phase 2 Proposal		
	Area (km²)	% RSA	PDA (km²)	ZOI (km²)	% Habitat Class	PDA (km²)	ZOI (km²)	% Habitat Class	PDA (km²)	ZOI (km²)	% Habitat Class
High	1,389	6.60	-8.59	-42.31	-3.66	-2.76	-8.44	-0.81	-11.35	-50.75	-4.47
Moderate	5,394	25.62	-21.10	-88.83	-2.04	-3.74	-2.61	-0.12	-24.84	-91.44	-2.16
Low	11,649	55.33	-55.15	+131.14	+0.65	-7.81	+11.04	+0.03	-62.96	+142.18	+0.68
Nil	2,623	12.46	+84.84	n/a	+3.24	+14.31	n/a	+0.55	+99.15	n/a	+3.78

3.5.2 MORTALITY

3.5.2.1 Collisions

Direct mortality of migratory birds due to collisions with road vehicles or rail traffic can potentially occur for most bird species present in the TRSA. Songbirds like Lapland Longspur and birds that are flightless through the moult period like Snow Geese are more vulnerable to this type of mortality. These species are also abundant and well distributed throughout terrestrial habitats along the Tote Road and northern railway alignment. Traffic speeds are limited to a maximum of 50 km/h on the Tote Road and to lower speeds near developed areas like the mine, camps, and port.

Ships travelling through Eclipse Sound and Baffin Bay will pass through waters that are used extensively by marine birds. Thick-billed Murre complete a flightless migration following the direction of surface currents from the breeding colonies across the Canadian Arctic to wintering areas (Gaston and Hipfner 2000) which may interact with project shipping routes. Flightless adults and juvenile birds departing from the Cape Hay and Cape Graham Moore nesting colonies on Bylot Island may not be able to avoid oncoming ship traffic in parts of Eclipse Sound and its entrance to Baffin Bay within the Northern Route MRSA. We cannot quantify the mortality resulting from ship collisions with flightless birds. However, Thick-billed Murre are not naïve to ship traffic given their longevity (up to 29 years) and the distribution of their wintering range in the Labrador Sea, the Gulf of St-Lawrence and other coastal waters of the northeastern seaboard (Gaston and Hipfner 2000) which undergoes heavy ship traffic. Furthermore, the potential additive mortality resulting from the Project's marine shipping compared to existing shipping throughout their migration route and wintering areas would be insignificant. Annual shipping activity through Baffin Bay and Davis Strait because of the Project is estimated at 138 ships and, except for 6 re-supply and re-fueling ships, will not travel through wintering areas given their route around southern Greenland to northern Europe.

Comparatively, ship traffic through wintering areas in Atlantic Canada is measured in tens of thousands of ship passages annually. Despite this intense shipping activity, populations throughout the eastern Canadian Arctic are believed to be stable or increasing (Gaston and Hipfner 2000, Gaston et al. 2012).

The probability of flightless broods or moulting adult eiders or Snow Geese being hit by ships within the Northern Route MRSA is very low. Common Eider are generally found around coastal islands, islets, narrow points of land, and marine shoals and feed in shallow water areas where wave action and tide result in extensive intertidal zones, generally within the 10 m depth contour (Goudie et al. 2000). King Eider are generally found further offshore and over deeper water (15-20 m) than Common Eider (Powell and Suydam 2012). Also, only a portion of the regional King Eider population will moult and fledge within marine environments. When present in coastal habitats, Snow Geese prefer tidal marshes although flocks can sometimes be observed loafing in shallow marine waters. However, the draft of Panamax vessels (maximum 12 m) and Cape size vessels (19 m or more) would require these ships to avoid areas preferred by eiders and geese.

Marine birds like Ivory Gull and Ross's Gull and other birds that use marine environments outside of the breeding season (e.g., Red-throated Loon) are all capable of avoiding the relatively slow-moving ships. However, marine birds may collide with ships during poor visibility conditions (e.g., fog, snow) or when attracted to ship lights at night (Merkel and Johansen 2011). Species that fly fast and low over the water such as eiders, Long-tailed Duck, Black Guillemot, and Thick-billed Murre are more vulnerable to collisions with ships than other marine birds (Merkel and Johansen 2011). The use and types of lights on ships navigating Canadian waters is mandated by regulations and is essential for safe navigation (Government of Canada 2014). The potential for collisions with ships at night will be restricted to late August to October which falls outside of the continuous day or twilight conditions found at these northern latitudes.

Direct mortalities due to collisions with aircraft during take-offs and landings at the Mine Site airstrip are possible, especially for species like Snow Goose that migrate through the TRSA in large flocks. However, these would be avoided to the greatest extent possible due to personnel safety concerns. As recommended by Environment Canada to minimize aircraft disturbance (Environmental Impact Screening Committee 2014) and when not required to fly at low elevations due to the nature of the work being conducted (e.g., raptor nesting surveys), PC Condition no. 71 states that Baffinland will, subject to safety, fly at 650 m AGL for areas likely to have birds and 1,100 m AGL for known colonies or moulting areas. These flying elevations also contribute to reducing the likelihood of bird collisions with aircrafts.

Direct mortalities due to collisions with permanent structures and facilities on land and at Milne Port can occur for all terrestrial and marine bird species present in the Project Area. However, the risk of collisions with Project infrastructure is low compared to more southern locations given that daylight is nearly continuous while migratory birds are present in the TRSA while infrastructure lights may affect birds along marine environments at the Port site from late August to early October (few migratory birds would remain within the TRSA by September). Collisions with infrastructure are more likely to occur during inclement weather (e.g., fog or snow) for species that fly fast and low to the ground such as eiders or by migrating birds attracted to lights. For perspective, eiders have also been documented to fly into terrain during poor visibility conditions (Mallory et al. 2001).

In a study examining the risk of avian collisions with communication towers, tower height had a greater effect on bird mortality than the type of lighting, towers greater than 300 meters tall being responsible for nearly 13 times more bird mortalities relative to towers 116 to 146 meters in height (Gehring et al. 2009). In comparison, communication towers in the Project area are 30 meters tall, one third the height of the shortest towers examined in the above study. Additionally, the studies on communication towers were conducted along the coast of the eastern United States, an area known as a significant migratory corridor for numerous bird species. Nevertheless, following these considerations Baffinland installed bird diverters on the guy wires of communication towers as per the requirements of PC Condition 68 to mitigate the risk of collisions. Baffinland is also considering modifying lights at the Milne Port facilities where possible to reduce the potential for collisions through the early fall months. Measures being considered include replacing white light sources with red or green lights sources through the installation of filters or replacing the bulbs entirely (Wiese et al. 2001, Poot et al. 2008) and installing shields where white light is required to focus light downwards (Reed et al. 1985). Both methods have been shown to reduce bird mortalities.

Avian mortality risk in association with wind turbines is influenced by bird species and density, landscape features in the vicinity of the wind turbines, and weather conditions (Powlesland 2009). It is assumed that most bird collisions are with the rotating turbine blades (American Wind Wildlife Institute (AWWI) 2016); however, even in poor weather conditions most collisions at wind farms involve single birds (Powlesland 2009). For upland species, long-distance and nocturnal migrants are more likely to be killed by collisions with artificial structures, including wind turbines, as compared to resident birds or diurnal migrants (Kingsley and Whittam 2001, Powlesland 2009, Arnold and Zink 2011), with potentially increased collision risk if turbine sites are situated near stopover sites (National Wind Coordinating Collaborative (NWCC) 2010). For waterbirds, proximity to wetlands, important waterfowl areas, or large numbers of waterfowl does not necessarily increase mortality risk to waterbirds or indicate large number of fatalities will occur (Kingsley and Whittam 2001, Erickson et al. 2002, Grodsky et al. 2013). For raptors, topography is likely the most important factor influencing collision risk with wind turbines (Kingsley and Whittam 2001, Powlesland 2009). Raptors take advantage of topographical features, such as ridge tops and upwind sides of slopes, as wind currents generated in these areas aid hunting and travelling (National Wind Coordinating Collaborative (NWCC) 2010). In favourable weather conditions, most migrants fly above turbine heights; however, collision risk increases during poor weather conditions that force them to fly lower (Powlesland 2009, National Wind Coordinating Collaborative (NWCC) 2010, American Wind Wildlife Institute (AWWI) 2016). During periods of low cloud cover, birds may lower their flight altitudes through the Project area, increasing the risk of collision with wind turbines.

Mining developments in the Arctic typically do not result in significant direct mortality for migratory birds. Few cases of birds colliding with infrastructure or hit by vehicles have been recorded over the life of the Project to date. Mitigation measures that have already been implemented by Baffinland such as traffic speeds, aircraft flying heights, bird diverters, as well as implementation of new measures such as modification to light sources at Milne Port will continue to reduce the probability of collision incidents. Overall, direct mortality of both terrestrial and marine birds because of collisions with infrastructure at Milne Port and the Mine site and with Project vehicles, trains, or vessels are predicted to affect a few individuals of a limited number of species annually through the construction, operation, and closure phases of the Project. Given that the bird species most susceptible to this type of mortality are abundant and well distributed throughout the area (e.g., eiders, Long-tailed Duck, Snow Geese), a few individual mortalities would represent a very low percentage of their local populations. The probability of collision mortality for species rarely observed in the PDA such as Red Knot or Red-necked Phalarope is very low.

3.5.2.2 Facilitated Predation

Indirect mortality of adult birds or their eggs and young because of increased predator abundance could occur because of project development. Some natural resources development projects in other northern settings have been associated with increased predation of prey species (Environment Canada 2007c). Baffinland remains committed to reduce the potential for project infrastructure and activities to facilitate predation by continuing to implement recommendations of the guidelines for Preventing Wildlife Attraction to Northern Industrial Sites (Environment Canada 2007c). To prevent use of the infrastructure by nesting avian predators such as Common Raven, bird spikes have been installed on horizontal surfaces near heat sources and buildings are designed to minimize the number of sheltered surfaces where nests could be established. To deter use of the Project infrastructure for denning and shelter by terrestrial predators (e.g., Arctic fox), all buildings have been fitted with skirting that extends flush to or into the ground. Food subsidies to predators and scavengers are prevented through a ban on staff feeding wildlife and appropriate domestic waste (i.e., wildlife proof containers and incineration) and food sources management.

Waste management is the primary mitigation to reduce the Project's interaction with terrestrial carnivores. These measures have been implemented to avoid changes to the carrying capacity of the habitat for predators and scavengers immediately adjacent to the Project footprint. Baffinland is confident that operational standards and management plans, and, where practical, the incorporation of the recommendations in the guidelines for Preventing Wildlife Attraction to Northern Industrial Sites (Environment Canada 2007c) will mitigate the potential for increased predation on avian prey species.

3.5.2.3 Hunter Access

Although Common Eider, King Eider, Snow Goose, and their eggs are harvested by hunters from local communities, none of the Project activities could result in increased harvest either in the marine environment, at nesting sites near the communities, or in the Project Area. Although travel corridors elsewhere have been found to facilitate hunter harvest, development of the road access network in the Project Area is not expected to facilitate use of the area by hunters from the two local communities. There are no roads connecting the two nearest communities to the Project roads and the linear distances from Pond Inlet and Arctic Bay to the Project are 134 km and 191 km, respectively. Actual travel distances from both communities would be much longer. Furthermore, more productive migratory bird harvesting areas can be found nearer the communities. The Project has a no-hunting policy for all mine workers and workers are not permitted to disturb wildlife under any circumstances. Therefore, the Project is not expected to result in increased harvest of eiders, geese, or their eggs by hunters from the nearest communities through increased site access or any other means.

3.5.3 HEALTH

Within the Northern Route MRSA, the main threat to Thick-billed Murre, Common Eider, King Eider, Ivory Gull, Ross's Gull, Red-throated Loon and other migratory birds that use the marine environment for all or part of their life cycle comes from the potential for chronic and/or catastrophic release of oils and other contaminants which could cause direct and indirect mortality. Chronic release of contaminants from the ore carriers and supply vessels is mitigated through regulatory compliance and state-of-the-are design. The Canada Shipping Act, 2001 (Government of Canada 2001) applies to Canadian vessels operating in all waters and to all vessels operating in Canadian waters. The section on environmental protection clearly describes the responsibilities of large vessel operators in terms of waste management requirements and potential discharge of toxic substances. These are regulatory requirements for any ship navigating in Canadian Waters. Baffinland expects partner shipping companies to meet or exceed these standards. Although release of contaminants is heavily regulated, a small probability remains that ships related to the Project can accidentally release contaminants such as oils into the marine environment used by foraging or migrating seabirds, waterbirds, and waterfowl.

Environmental protection included in the various acts and regulations related to the mitigation potential pollutants in marine environments include:

- Limits to sewage discharges
- Ship-board oil pollution plans on certain non-oil barges carrying oil trucks or tanks
- International Sewage Pollution Prevention Certificates for non-Canadian ships travelling to a Canadian port
- Garbage management plans and up-to-date Garbage Record Books for certain ships (as specified in the Regulations)
- Limits to the sulphur content of any fuel oil used on a ship, set at 4.5 per cent
- Quality standards for fuel oil used for combustion
- International or Canadian Air Pollution Prevention Certificates for certain ships
- International Anti-fouling System Certificates or self-declarations for certain ships
- Paint containing tributyl tin removed or encapsulated from the coating of ships

Potential influences on health for migratory bird KIs breeding in the terrestrial and freshwater habitats of the TRSA are similar for all species. Construction, operation, closure and post-closure activities may result in the release of metals and contaminants into the Project area and surrounding environments. The Project will increase the exposure of birds breeding in proximity of the PDA to metals from ore dust generated during mining, crushing, hauling, and loading of mined materials. However, based on the limited area of dust deposition, low dust deposition rates, and the low concentrations of metals observed in soils and vegetation (TSD 09 — Vegetation), and the low bio-accumulation potential of TSP contaminants, it is unlikely that accumulation of contaminants in bird species in the RSA will differ from current measurements elsewhere in the Arctic (Wayland et al. 2001, Savinov et al. 2003)

Other potential sources of contaminants that may be introduced into the environment include those from accidental spills of oil, gas or chemical products, and emissions from diesel generators and other equipment. The introduction of these contaminants could have negative effects on the health of exposed individuals. Migratory Bird KIs may be exposed to metals and other contaminants through direct contact with or ingestion of contaminants or indirectly through bioaccumulation in the food chain. Direct exposure may occur through ingestion of contaminated plants, soils, and water, epidermal contact with contaminated plants, soils and water, or direct inhalation of contaminated air and dust. Indirect exposure may occur through ingestion of organisms or prey that have been exposed to or ingested contaminated substrates (i.e., bioaccumulation).

The construction and operation of the Project components will include procedures to control emissions and discharges from Project activities, as well as measures to avoid uncontrolled releases. Spill contingency plans, emission reduction measures, water treatment protocols and dust control measures will help to guard against unacceptable contaminant levels in the surrounding environment, and therefore effluent, dust and air emissions are expected to have minor to no effect on the health of birds.

3.5.4 SIGNIFICANCE OF RESIDUAL EFFECTS

3.5.4.1 Terrestrial Species

Mitigation

The population densities of migratory birds with predominantly terrestrial life histories such as songbirds, shorebirds, and raptors (e.g., Peregrine Falcon, Red Knot, Lapland Longspur) breeding in the TRSA are highly variable and dependent on the availability of high quality habitats specific to each species. Although the impact assessment has concluded that the Project will have no population level effects, the potential for disturbance of nesting birds remains and proper mitigation procedures will be put in place to minimize these effects. Potential effects are expected to be localized to areas found directly within or adjacent to the Project footprint, particularly areas adjacent to the Mine Site, Tote Road, Milne Port, and the proposed northern route railway alignment. The focus of mitigation measures is threefold, minimizing habitat loss (e.g., nesting and foraging habitat), avoidance by Project personnel and equipment, and minimizing behavioural disturbances (e.g., disruption of migratory, foraging and nesting behavior).

Some of the mitigation measures implemented to limit Project effects on breeding and migrating birds are described in Sections 3.3.4 to 3.3.6. However, the complete suite of mitigation measures for birds and their habitats are described in detail in the Terrestrial Environment Mitigation and Monitoring Plan (Baffinland Iron Mines Corporation 2016). Some examples of these include:

- Reducing Project footprint thus minimizing direct and indirect loss of habitat;
- Applying dust suppression along roads and at the mine site when necessary to limit the deposition of dust on adjacent vegetation that could expose birds to elevated minerals and impact their health as well as the vegetation cover that is part of their habitats;

- Increasing turbine visibility (e.g., UV paint or lights) or shutting turbines down during times of low visibility (e.g., dense fog);
- Prohibiting project employees from transporting and operating firearms for harvesting birds and enforcement of a no-hunting policy (PC Condition 62);
- Waste management strategies to prevent attraction of carnivores and scavengers and minimize depredation of active nests within the ZOI (PC Condition 64);
- Awareness training for all employees regarding the importance of avoiding nests, nesting areas, and concentrations of birds (PC Condition 65) as well as waste management;
- Establishment of zones of avoidance where Species at Risk or their nests are encountered (PC Condition 66);
- Installation of bird diverters on the guy wires of communication towers and flashing red lights to mitigate the risk of collisions (PC Condition 68);
- Pre-clearing nest surveys, implementation of activity setback distance buffers specific to species groupings for active nest sites, and development of nest management plans including specific guidelines and procedures for nests located within recommended distance buffers (PC Condition 70);
- Guidelines relating to air traffic altitude above ground when flying over area where migratory birds are present (PC Conditions 59, 71, and 72).

Adaptive management measures will be applied to nests of cliff-nesting raptors and Species at Risk located within specified distance thresholds of Project activities (Baffinland Iron Mines Corporation 2016). Given the long-term use of nesting sites by cliff nesting raptors (Peregrine Falcon, Rough-legged Hawk, Gyrfalcon), a site-specific assessment will be conducted, and a management plan will be prepared for each nest located within 1 km of the PDA. Each management plan will provide details on applicable horizontal and vertical distance buffers as well as restrictions on the type and scheduling of Project activities. These plans will allow distance buffers to be varied based on topography, line-of-site, bird response to disturbance, and the history of disturbance at the nest site. Efforts will also be made to identify foraging areas located near nest sites and to implement avoidance strategies for these areas.

Seven raptor nesting sites are located within 500 m of the North Railway alignment and associated laydown areas and quarries. Of these, none are located within the Project footprint such that they would be destroyed, and three nesting sites are located within 100 m of the proposed PDA. The potential to disturb breeding pairs and affect nesting success is high at nests within the 500 m setback during construction. However, monitoring of nests along the Tote Road during mine operation suggests that nesting success is unlikely to be affected by railway operation.

PC Condition No. 70 (Nunavut Impact Review Board 2014) requires that: "*the Proponent shall protect any nests found (or indicated nests) with a buffer zone determined by the setback distances outlined in its Terrestrial Environment Mitigation and Monitoring Plan* [i.e., 500 m in the TEMMP]*, until the young have fledged. If it is determined that observance of these setbacks is not feasible, the Proponent will develop nest-specific guidelines and procedures to ensure bird's nests and their young are protected*."

Baffinland's Terrestrial Environment Mitigation and Monitoring Plan (Baffinland Iron Mines Corporation 2016) states the following: *"Due to the importance of specific sites for nesting peregrine falcon and other cliff-nesting raptors (i.e. sites are re-used year after year), a nest-specific assessment and management plan will be developed for every known cliff-nesting raptor nest site within 1 km of Project activities. Where possible, a site-specific no-disturbance buffer (of approximately 500 m) will be implemented for both Project personnel and equipment around active nests during the nesting period (mid-April to mid-August) – this will be achieved by relocating Project activities at a minimum of 500 m from the nest or rescheduling Project activities to occur outside the nesting period."*

Potential options to mitigate effects of construction on raptor breeding pairs with nest sites located within 500 m of the North railway alignment include:

- Relocating project activities at least 500 m from the nest;
- Limiting construction activities within the nesting period (June 1 to August 31);
- Temporarily making the nest site inaccessible during the nesting seasons potentially affected by construction;
- Hazing nesting pairs of birds to discourage nesting at the affected nest site;
- Monitoring nesting activities and success when other mitigation measures are not feasible.

The first two mitigation options are difficult to implement since relocating the railway embankment is not a feasible option from an engineering and cost standpoint while avoiding construction of the North railway during the nesting period is not practical given that the construction season will be short and must be concentrated around the short summer and shoulder seasons. However, some proposed quarries may be excluded or relocated to other areas where they will not affect raptor nest sites.

Given the abundance of suitable cliff-nesting habitat in the study area (Galipeau et al. In Prep), temporarily making the nest site inaccessible during the nesting seasons affected by construction activities would compel potentially affected nesting pairs to pick an alternative nest site within their territories thereby increasing the likelihood that affected pairs might reproduce successfully during construction activities. This technique involves altering the preferred nest sites to make them unsuitable for the nesting seasons affected by construction activities (e.g., placing rocks, flagging, raven decoys) and to monitor affected pairs to ensure they are not selecting another site near their preferred site (and alter those too if necessary and so on). Once construction activities are completed, nest sites would be returned to their original condition. Like making nests sites temporarily inaccessible, hazing would compel potentially affected nesting pairs to pick an alternative nest site within their territories. However, this technique involves a high degree of commitment and personnel effort. To be effective, it would require multiple hazing attempts per day for perhaps up to two weeks per nest starting as soon as nesting pairs return to the nest site following spring migration.

Monitoring of nesting success is the last option for mitigation as it does not prevent or mitigate disturbance but would provide useful information on cause-effect relationships that could be used in future assessments.

Engineering solutions and mitigation measures were considered for each nest site potentially affected by construction of the North railway alignment to either eliminate or mitigate this potential sensory disturbance and indirect habitat loss. A description of the interactions and proposed mitigation measures for the seven raptor nests are summarized in Table 48.

Table 48. Description of Interactions and Proposed Mitigation Measures for Cliff-nesting Raptor Nests Located within 500 m of the North Railway Alignment

Nest Site No.	Species	Description of Interactions	Proposed Mitigation Measures
400/450	Peregrine Falcon	Located 35 m and 50 m from the railway embankment, respectively.	Render the nest temporarily inaccessible during nesting season affected by construction.
375	Rough-legged Hawk	Located 15 m from a quarry, 330 m from a laydown area, and 400 m from the railway embankment. The nest site is located between these features.	Render the nest temporarily inaccessible during nesting season affected by construction.
444	Peregrine Falcon	Located 250 m and 320 m from two separate quarries (> 500 m from railway embankment).	Monitor nesting activities and success through construction.
68	Peregrine Falcon	Located 135 m from a quarry and 300 m from railway embankment. The nest is located between the Tote Road and the railway embankment.	Engineering team indicated that this quarry can be excluded.
75/73/339	Peregrine Falcon (75)/Rough-legged Hawk (73/339)	Located 430 m, 550 m, and 620 m from the railway embankment, respectively.	Monitor nesting activities and success through construction.
88	Common Raven	Located 25 m and 240 m from two separate quarries and 300 m from the railway embankment. Previously occupied by Peregrine Falcon and Rough-legged Hawk.	Exclude nearest quarry or render the nest temporarily inaccessible during nesting season affected by construction.
91	Peregrine Falcon	Located 165 m from railway embankment.	Render the nest temporarily inaccessible during nesting season affected by construction.

Residual Effects

Residual effects for birds with predominantly terrestrial life histories may include: No. 1 — the unavoidable loss of nesting, foraging, and migratory stop-over habitats within the Project footprint as well as disturbance to the habitats and effects on reproductive success within a ZOI adjacent to the footprint, No. 2 — direct mortality of a few individuals due to collisions with road, rail and aircraft traffic, No. 3 — direct or indirect mortality or health effects from the chronic release of contaminants in terrestrial environments. For each of the three key issues, the potential residual effect to terrestrial birds (Peregrine Falcon, Red Knot, Buff-breasted Sandpiper, Short-eared Owl, and Lapland Longspur) is not significant. The predicted levels of effects based on the evaluation criteria are provided in Table 49, and a summary of significance is provided in Table 50.

Baseline and post-development surveys and habitat modeling indicated that there is an abundant supply of suitable habitats for predominantly terrestrial species within the TRSA. It is expected that migrating birds such as Peregrine Falcon and Lapland Longspur arriving to nesting areas while construction or operation activities are in progress would avoid nesting in disturbed areas and select areas away from disturbance or with a lower frequency of disturbance.

Some birds affected by disturbance in the PDA may forego breeding for a year while they spend time seeking new breeding habitat and establishing a nesting territory or they may simply be able to move to nearby suitable habitat.

While some individual level disturbance and displacement is expected to occur within the ZOI during some or all the Project phases, no changes to regional bird populations are expected. Therefore, these potential residual effects are considered to have a low likelihood of causing an effect, have a low magnitude, remain within 1 km of the Project footprint, and may be frequent but have short-term effects that are easily reversible. Direct mortality of a few individual birds because of collisions with Project vehicles or infrastructure is expected to occur annually. However, numbers are expected to be very low in relation to population size and to be limited to a few individuals of the most abundant species such as Lapland Longspur. Increase in contaminants levels that could adversely affect bird health are not expected. All potential effects will eventually be eliminated after carefully planned closure and post-closure reclamation procedures although considering the revegetation rate in the Arctic this process may take decades. No residual effects are expected for species potentially occupying the TRSA at low population densities such as Red Knot, Buff-breasted Sandpiper, and Short-eared Owl.

IQ information was gathered during baseline and post-development studies and assisted in the characterization of conditions within the TRSA. This IQ data also played a large role in the assessment. However, feedback from communities regarding the significance of effects was not received. Therefore, these results are based on available information and the professional experience of the assessment team.

Prediction Confidence

Prediction confidence is high for common species such as Peregrine Falcon and Lapland Longspur and moderate for species occupying the TRSA at very low population densities such as Red Knot, Buff-breasted Sandpiper (to date, Buff-breasted Sandpiper have not been documented in the TRSA), and Short-eared Owl. A high level of confidence in the impact prediction is based on the following:

- Multiple years of songbird and shorebird baseline studies that included a high degree of coverage over suitable terrestrial environments. Songbird and shorebird population densities observed in the TRSA were generally consistent with those observed in other regional studies;
- Annual monitoring of cliff-nesting raptor nesting sites using standardized aerial survey methods within all suitable habitats as well as an assessment of the effects of nest distance to the PDA on reproductive parameters;
- Habitat modelling for some KIs;
- A high degree of confidence in the data analyses, consistent with other bird studies;
- Thorough review of relevant literature and examination of results from other mining projects in northern Canada.

Monitoring

Although annual songbird and shorebird monitoring has been deemed unfeasible due to the number of sampling sites required to statistically detect changes in populations, nor are they necessary since no significant adverse effects are expected, Baffinland will work with Environment and Climate Change Canada to conduct additional PRISM and rare shorebird surveys to contribute to regional baseline data. Nest searches will occur prior to any land clearing and nest site mitigations will be implemented if active nests are found. Incidental sightings of rare species will be documented, and supplemental mitigations will be applied where Species at Risk or their nests are observed. The annual monitoring program of cliff-nesting raptors within a 10-km buffer of the PDA will continue. This program is used to assess the accuracy of predictions of disturbance effects on nesting Peregrine Falcon.

Table 49. Effects Assessment Summary for Terrestrial Birds and Habitat

Residual Effect	Residual Effect Evaluation Criteria					Significance of Residual Effect
	Magnitude	**Extent**	**Frequency**	**Duration**	**Reversibility**	
Habitat Loss (direct and indirect)	Level I: local disturbance relative to the extent of the features	Level I: direct disturbance will be limited to Project footprint and indirect to ZOI adjacent to PDA	Level I: effect expected to occur primarily during construction	Level II: effect will continue through operations phase	Level I: habitat losses/ disturbance is comparatively low as alternative sites are available nearby	Not Significant
Mortalities (collisions, increased harvest)	Level I: local disturbance relative to the extent of the features	Level I: disturbance will be limited to Project component footprints	Level I: effect could occur infrequently or occasionally during construction and operations	Level II: effect will continue through operations phase	Level III: effect is not reversible	Not Significant
Health (spills and introduced contaminants)	Level I: local disturbance relative to the extent of the features	Level I: disturbance will be limited to Project component footprints	Level I: effect could occur infrequently during construction and operations	Level II: effect will continue through operations phase	Level II: effect of minor levels of contaminants likely to be reversible while major increase in contaminant levels may persist or be irreversible	Not Significant

Table 50 Significance of Potential Residual Effects on Terrestrial Birds and Habitat

Effect	Significance of Predicted Residual Environmental Effect		Likelihood[a]	
	Significance Rating	Level of Confidence	Probability	Certainty
Habitat Loss (direct and indirect)	N	3 (High) based on multiple years of bird surveys, known measure of habitat loss, habitat models, annual monitoring	na	na
Mortalities (collisions, increased harvest)	N	3 (High). Operational monitoring has observed some collisions of birds, but they have been infrequent and of few individuals. These infrequent occurrences will not have impacts at the population level.	na	na
Health (spills and introduced contaminants)	N	3 (High). There are limited project-related pathways of impacts on terrestrial bird health.	na	na

Key

Significance Rating: S = Significant, N = not Significant, P = Positive

Level of Confidence[1]: 1 = Low; 2 = Medium; 3 = High

[a]Likelihood — only applicable to significant effects

Probability: 1 = Unlikely; 2 = Moderate; 3 = Likely

Certainty[2]: 1 = Low; 2 = Medium; 3 = High

Notes

1. Level of confidence in the assignment of significance
2. Certainty around the assignment of likelihood

3.5.4.2 Marine Species

Mitigation

Within the MRSA, chronic release of contaminants from the ore carriers is mitigated through regulatory compliance. The Canada Shipping Act (Government of Canada 2001) came in force in 2007. It applies to Canadian vessels operating in all waters and to all vessels operating in Canadian waters. The section on environmental protection clearly describes the responsibilities of large vessel operators in terms of waste management requirements and potential discharge of toxic substances. These are regulatory requirements for any ship navigating in Canadian Waters. Baffinland expects partner shipping companies to meet or exceed these standards.

Some of the mitigation measures implemented to limit Project effects on breeding and migrating marine birds are described in Sections 3.3.4 to 3.3.6. The suite of mitigation measures for marine birds and their habitats are described predominantly in the Terrestrial Environment Mitigation and Monitoring Plan (Baffinland Iron Mines Corporation 2016). However, mitigation measures relevant to marine birds and their habitats are described in multiple other management plans. Although these plans do not directly address marine birds, they contain elements that are relevant to mitigating effects on marine bird species (e.g., catastrophic oil spills). These plans are the Surface Water and Aquatic Ecosystems Management Plan (BAF-PH1-830-P16-0026), the

Emergency Response Plan (BAF-PH1-840-P16-0002), the Spill Contingency Plan (BAF-PH1-830-P16-0036), and the Oil Pollution Emergencies Plan — Milne Port (BAF-PH1-830-P16-0013).

Environmental Protection included in the new regulations related to mitigation of potential pollutants in marine habitats include, but are not limited to:

- Limits to sewage discharges;
- Ship-board oil pollution plans on certain non-oil barges carrying oil trucks or tanks;
- International Sewage Pollution Prevention Certificates for non-Canadian ships travelling to a Canadian port;
- Waste management plans and up-to-date Garbage Record Books for certain ships (as specified in the Regulations);
- Limits to the sulphur content of any fuel oil used on a ship, set at 4.5 per cent;
- Quality standards for fuel oil used for combustion;
- International or Canadian Air Pollution Prevention Certificates for certain ships;
- International Anti-fouling System Certificates or self-declarations for certain ships;
- Removal of encapsulation of paint containing tributyl tin from ship coating by January 1, 2008.

Although release of contaminants is regulated, there is a small probability that ships related to the Project can accidentally release contaminants into the marine environment used by foraging or migrating marine birds such as Ivory Gull, Common Eider, and Thick-billed Murre.

Some of the mitigations measures described in the Terrestrial Environment Mitigation and Monitoring Plan (Baffinland Iron Mines Corporation 2016) are also relevant to marine birds. For example

- Prohibiting project employees from transporting and operating firearms for the purpose of harvesting birds and enforcement of a no-hunting policy (PC Condition 62);
- Awareness training for all employees regarding the importance of avoiding nests, nesting areas, and concentrations of birds (PC Condition 65) as well as waste management;
- Establishment of zones of avoidance where Species at Risk or their nests are encountered (PC Condition 66);
- Installation of bird diverters on the guy wires of communication towers and flashing red lights to mitigate the risk of collisions (PC Condition 68);
- Pre-clearing nest surveys, implementation of activity setback distance buffers specific to species groupings for active nest sites, and development of nest management plans including specific guidelines and procedures for nests located within recommended distance buffers (PC Condition 70);
- Guidelines relating to air traffic altitude above ground when flying over area where migratory birds are present (PC Conditions 59, 71, and 72).

Residual Effects

Residual effects for birds with predominantly marine life histories may include: 1) sensory disturbance at nesting colonies and in marine foraging habitats with potential related effects on reproductive success; 2) direct mortality of a few individuals due to collisions with shipping vessels and port infrastructure; and 3) direct or indirect mortality or health effects from the chronic or catastrophic release of contaminants in marine environments. The predicted levels of effects based on the evaluation criteria are provided in Table 51, and a summary of significance is provided in Table 52.

For each of the three key issues, the potential residual effect to marine birds (Common Eider, Harlequin Duck, Ivory Gull, Ross's Gull, and Thick-billed Murre) is not significant. No residual effects from disturbance at nesting seabird or seaduck colonies, feeding areas, or along migration routes are expected. Based on expected compliance with the environmental protection regulations associated with the Canada Shipping Act (Government of Canada 2001), no residual effects of chronic or catastrophic contaminant release are expected.

No large seabird colonies or large feeding flocks were identified around the shoreline and waters of Milne Inlet or Steensby Inlet. Ships travelling in and out of Eclipse Sound must by necessity pass in relative proximity to the large seabird colony at Cape Graham Moore which is used by approximately 30,000 pairs of Thick-billed Murre and 3,000 pairs of Black-legged Kittiwake. The shipping route through Eclipse Sound will be located at a minimum of 19 km from the colony. As a result, ship passage is unlikely to disturb nesting birds. Foraging seabirds will contact ships when foraging in marine waters while seaducks and geese will have minimal contact with ships given the draft of shipping vessels that will prevent them from entering coastal waters preferred by foraging seaducks. However, ship movements along shipping lanes will have negligible effects on foraging marine birds because collisions with ships are unlikely and the periodic requirement to move out of a ship's path should not be a significant energetic stress to birds. Ship passage through marine foraging habitats, while relatively frequent by Arctic waters standards (3 to 4 ship passages per day during the open water season) will be of short duration and habitats will quickly return to pre-disturbance conditions. A variety of vessels (e.g., cargo, Navy/Coast Guard, commercial fishing, and cruise ships) have long been entering Arctic marine waters (e.g., Eclipse Sound, Navy Board Inlet, Lancaster Sound, Baffin Bay, Davis Strait, Hudson Strait, and Foxe Basin) and Thick-billed Murre and other seabirds are not naïve to ship traffic in Arctic breeding areas or wintering areas in the North Atlantic. Furthermore, there have been no reports of noticeable long-term effects of ships to seabird colonies in Arctic environments. Regionally, Harlequin Duck occur only on southern Baffin Island and Project components of the Phase 2 Proposal will not interact with this species. Ivory and Ross's Gulls occur in low numbers in marine environments and encounters with shipping vessels along the shipping corridor should be infrequent.

The likelihood of a large-scale catastrophic fuel spill is unlikely, but nonetheless remains a potential threat during any shipping operation. The potential for smaller fuel spills or chronic leakage from ships is higher, but also remains low overall given regulatory obligations that must be met by shipping companies. Regardless, all marine birds, and seabirds, are vulnerable to even minor exposure to hydrocarbons through contamination of their plumage and ingestion of fuel contaminated food. Oiled feathers can result in the loss of insulation and water-proofing, leading to hypothermia. Ingestion of oil can lead to changes in physiology, internal tissue damage, and death. Birds that feed at the water surface, along the shoreline, or dive under the surface to feed are all highly vulnerable to exposure even in the event of a minor spill. Colonial nesting species and species that form large concentrated feeding aggregations are also highly vulnerable to spills of any size. Therefore, the effect of oil spills in Arctic marine waters along Project shipping routes has the potential to be significant. This effect is assessed in the Section 10.2 of the Phase 2 Proposal EIS.

Prediction Confidence

Prediction confidence is high for all marine bird species such as Thick-billed Murre, Ivory Gull, and Common Eider and the likelihood of significant effects on marine species is considered low. Shipping routes within the MRSA will avoid known nesting colonies. Although the migration routes of Thick-billed Murre and other seabirds are not completely understood, the migration itself appears to occur rapidly, and expected encounters with vessels along the shipping corridor should be infrequent. Ore carriers and cargo vessels will comply with the Canada Shipping Act, and therefore, there is a high probability that the release of contaminants in Thick-billed Murre and other seabird migrating and foraging habitat will not occur. There is a very low probability of a catastrophic event resulting in the release of contaminants. Although Ivory Gull and Ross's Gull breed across some of the High Artic islands, they are uncommon and rarely observed in comparison to other seabirds. The likelihood that nests of these species will be found in the TRSA or in coastal areas of the MRSA is very low.

Monitoring

As for all terrestrial habitats, nest searches will be conducted in the Milne Port area prior to any clearing of land and construction. Nest site mitigations as per the Terrestrial Environment Mitigation and Monitoring Plan (Baffinland Iron Mines Corporation 2016) will be implemented if active nests are found. Baffinland will continue to support ECCC-CWS research efforts to better assess seabird distribution in the eastern Arctic along the shipping routes.

Table 51. Effects Assessment Summary on Marine Birds and their Habitats

Residual Effect	Residual Effect Evaluation Criteria					Significance of Residual Effect
	Magnitude	Extent	Frequency	Duration	Reversibility	
Habitat Loss (direct and indirect)	Level 1: local disturbance relative to the extent of the features	Level 1: disturbance will be limited to Milne Port and marine shipping route	Level 1: effect expected to occur primarily during operations	Level 2: effect will continue through operations phase	Level 1: habitat losses/ disturbance are comparatively low as alternative habitats are available in close proximity	Not Significant
Mortalities (collisions, increased harvest)	Level 1: local disturbance relative to the extent of the features	Level 1: disturbance will be limited to Milne Port and marine shipping route	Level 1: effect could occur infrequently or occasionally during construction and operations	Level 2: effect will continue through operations phase	Level 3: effect is not reversible	Not Significant
Health (spills and introduced contaminants)	Level 1: local disturbance relative to the extent of the features	Level 1: disturbance will be limited to Milne Port and marine shipping route	Level 1: effect could occur infrequently during construction and operations	Level 2: effect will continue through operations phase	Level 2: effect of minor levels of contaminants likely to be reversible while major increase in contaminant levels may persist or be irreversible	Not Significant

Table 52 Significance of Potential Residual Effects on Marine Birds and their Habitats

Effect	Significance of Predicted Residual Environmental Effect		Likelihood[a]	
	Significance Rating	Level of Confidence	Probability	Certainty
Habitat Loss (direct and indirect)	N	3 (High). There will be nest habitat lost to the Project footprint within the PDA. Disturbance of marine habitat is likely due to interaction with shipping routes. Habitat effect is measurable, and ongoing monitoring and studies will continue.	na	na
Mortalities (collisions, increased harvest)	N	3 (High). There have been occasional bird collisions with Project infrastructure, but these occasional occurrences will not have impacts at the population level.	na	na
Health (spills and introduced contaminants)	N	3 (High). Changes to health are unlikely, mitigation measures for spills, effluent, dust, and air emission controls are addressed in various management plans	na	na

Key

Significance Rating: S = Significant, N = not Significant, P = Positive

Level of Confidence[1]: 1 = Low; 2 = Medium; 3 = High

[a]Likelihood — only applicable to significant effects

Probability: 1 = Unlikely; 2 = Moderate; 3 = Likely

Certainty[2]: 1 = Low; 2 = Medium; 3 = High

Notes

1. Level of confidence in the assignment of significance
2. Certainty around the assignment of likelihood

3.5.4.3 Semi-Terrestrial and Aquatic Species

Mitigation

The potential effects on species with mixed terrestrial and aquatic life-histories such as Red-throated Loon, King Eider, and Red-necked Phalarope are expected to be low and localized to water bodies found in the ZOI adjacent to the Project footprint and to coastal marine areas for those species that spend part of their life at sea. Baseline surveys and habitat modelling in the TRSA indicated that there is an abundant supply of nearby suitable habitat for these species. However, very few birds are expected to be disturbed sufficiently to abandon lakes and ponds traditionally used by these species near the PDA. Ponds located along the Tote Road, near the Mine Site, and Milne Port continue to be used by breeding birds through current mining operations.

Mitigation measures applicable to these species are comprised of those described in Sections 3.3.2 to 3.3.4 and of all those relevant to terrestrial and marine species as described in the sections above. Therefore, no additional mitigation measures are proposed for species with mixed life histories.

Residual Effects

Residual effects for species with mixed life histories may include: 1) the unavoidable loss of coastal and terrestrial habitats for staging, nesting, foraging, and brood-rearing as a result of the Project footprint as well as disturbance to the habitats and effects on reproductive success within a ZOI adjacent to the footprint; 2) direct mortality of a few individuals due to collisions with road, rail, ship, and aircraft traffic as well as Project infrastructure; and 3) direct or indirect mortality or health effects from the chronic release of contaminants in freshwater or marine environments. For each key issue, the potential residual effect for bird species with semi-terrestrial and aquatic life histories (Red-throated Loon, Snow Goose, King Eider, and Red-necked Phalarope) is not significant. The predicted levels of effects based on the evaluation criteria are provided in Table 53, and a summary of significance is provided in Table 54.

The assessment of residual effects for mixed life history specie is like those described above for terrestrial and marine species. To summarize: loss of small areas of breeding habitat as a result of Project development is unavoidable; while some individual-level disturbance and displacement is expected to occur within a ZOI adjacent to the PDA during all of the Project phases, no changes to the overall regional bird populations are expected; direct mortality of a few individuals of the most common species as a result of collisions with project vehicles and infrastructure is expected to occur annually; based on expected compliance with the environmental protection regulations associated with the Canada Shipping Act (Government of Canada 2001) and on dust suppression mitigation measures, no residual effects on bird health as a result of chronic contaminant release are expected. Refer to previous sections for additional details. Red-necked Phalarope occur infrequently and at very low densities in the TRSA and are not expected to interact with the Project.

Prediction Confidence

Prediction confidence is high for common species such as Red-throated Loon and King Eider and moderate for species occupying the TRSA at very low population densities such as Red-necked Phalarope. This confidence evaluation is based on:

- Multiple years of baseline and post-development studies that included a high degree of coverage over suitable terrestrial, freshwater, and coastal environments;
- Habitat modelling for some KIs;
- A high degree of confidence in the data analyses, consistent with other bird studies;
- Thorough review of relevant literature and examination of results from other mining projects in northern Canada.

Monitoring

As for all terrestrial habitats, nest searches will be conducted prior to any clearing of land and construction. Nest site mitigations as per the Terrestrial Environment Mitigation and Monitoring Plan (Baffinland Iron Mines Corporation 2016) will be implemented if active nests are found. Incidental sightings of rare species will be documented, and supplemental mitigations will be applied where Species at Risk or their nests are observed. No further monitoring is recommended for mixed-life history species.

Table 53. Effects Assessment Summary on Semi-Terrestrial and Aquatic Species and their Habitats

Residual Effect	Residual Effect Evaluation Criteria					Significance of Residual Effect
	Magnitude	Extent	Frequency	Duration	Reversibility	
Habitat Loss (direct and indirect)	Level I: local disturbance relative to the extent of the features	Level I: direct disturbance will be limited to Project footprint and indirect to ZOI adjacent to PDA and shipping route	Level I: effect expected to occur primarily during construction	Level II: effect will continue through operations phase	Level I: habitat losses/ disturbance are comparatively low as alternative sites are available in close proximity	Not Significant
Mortalities (collisions, increased harvest)	Level I: local disturbance relative to the extent of the features	Level I: disturbance will be limited to Project component footprints and shipping route	Level I: effect could occur infrequently or occasionally during construction and operations	Level II: effect will continue through operations phase	Level III: effect is not reversible	Not Significant
Health (spills and introduced contaminants)	Level I: local disturbance relative to the extent of the features	Level I: disturbance will be limited to Project component footprints and shipping route	Level I: effect could occur infrequently during construction and operations	Level II: effect will continue through operations phase	Level II: effect of minor levels of contaminants likely to be reversible while major increase in contaminant levels may persist or be irreversible	Not Significant

Table 54 Significance of Potential Residual Effects on Semi-Terrestrial and Aquatic Species and their Habitats

Effect	Significance of Predicted Residual Environmental Effect		Likelihood[a]	
	Significance Rating	Level of Confidence	Probability	Certainty
Habitat Loss (direct and indirect)	N	3 (High): direct loss and/or disturbance of some habitat is likely due to their proximity to some project components	na	na
Mortalities (collisions, increased harvest)	N	3 (High): direct mortality of a few individuals of the most common species annually is possible, mitigation measures regarding collisions and wildlife protection are addressed in the TEMMP	na	na
Health (spills and introduced contaminants)	N	3 (High): changes to health are unlikely, mitigation measures for spills, effluent, dust, and air emission controls are addressed in the TEMMP	na	na

Key

Significance Rating: S = Significant, N = not Significant, P = Positive

Level of Confidence[1]: 1 = Low; 2 = Medium; 3 = High

[a]Likelihood — only applicable to significant effects

Probability: 1 = Unlikely; 2 = Moderate; 3 = Likely

Certainty[2]: 1 = Low; 2 = Medium; 3 = High

Notes

1. Level of confidence in the assignment of significance
3. Certainty around the assignment of likelihood

3.5.4.4 Migratory Birds as a Valued Ecosystem Component

Scoping activities contributed to the identification of migratory birds and their habitats as a VEC for the Mary River Project and the baseline and post-FEIS migratory bird studies provided information on local avian populations and their habitat use patterns in the Project area. Fourteen KIs were selected to guide the assessment of impacts on migratory birds and their habitats for the Phase 2 Proposal of the Project. There are several mechanisms or pathways through which the proposed Project could potentially affect migratory birds that use the Project area for part of their annual cycle. These were grouped into three main categories or issues: direct and indirect habitat loss, mortality, and health. These key issues have the potential to affect bird KIs during all phases of the Project, potentially resulting in changes in behavior and/or in population abundance and distribution.

Assessment methods for these issues included determination of measurable parameters and specific thresholds, assessment of project effects, identification of mitigation measures to limit any identified effects, determination of the residual effects, and an assessment of level of confidence that Project biologists have in the assessment based on available data.

The information collected for baseline characterization and post-production (Project monitoring) were sufficient to inform the environmental impact assessment on migratory birds and habitats for the Project.

Project-related activities could potentially alter bird behavior and cause displacement during all Project phases but will be confined to the footprint, a relatively small area in relation to the availability of suitable habitat in the TRSA, to a ZOI adjacent to the PDA, and to marine shipping routes. Densities of bird KIs are expected to decline within the footprint and possibly within adjacent zones of influence. However, these changes are expected to be a result of displacement out of the affected areas and not a result of mortalities to the birds or their offspring. Because of the availability of suitable habitat nearby, the overall effects of the Phase 2 Proposal to the KIs specifically and to all migratory bird species in general are not likely to have serious implications for the regional populations of any species and their habitats. Bird mortalities because of collisions with Project infrastructure and vehicles are expected to be limited to a few individuals of the most abundant species annually and to have no significant effect on regional populations.

Overall the residual effects of the Phase 2 Proposal on the migratory birds and habitats VEC were assessed as not significant. Prediction confidence for migratory birds is generally high. More specifically, prediction confidence was high for common species and moderate for species occupying the TRSA and MRSA at very low population densities. Rare species are expected to interact infrequently with Project activities. Mitigation measures will need to be applied to minimize the effects of collisions with vehicles and infrastructure as well as exposure to contaminants because of the Project and the efficacy of proposed mitigations should be closely monitored.

3.6 POTENTIAL CLIMATE CHANGE EFFECTS

Potential effects from climate change are not traditionally considered within a cumulative effects assessment, but the pathways are similar. Global emissions of greenhouse gases are expected to cause an overall warming trend, with more rapid changes in polar latitudes such as the Arctic (Larsen et al. 2014). Over time, effects to species and ecosystems are likely to be widespread but will vary relative to realized emissions pathways (Field et al. 2014). Potential climate change effects interact with the Project at a level like cumulative effects: they result largely from external activities that are beyond control of the Project but that have the potential to interact with direct and indirect Phase 2 Proposal effects.

Vulnerability to climate change varies broadly by species. Understanding key sources of vulnerability for each species can be facilitated by assessing interactions between climate change and key factors such as habitat, physiology, phenology, and biotic interactions. This helps to rank the relative importance of each of the key factors, assess the uncertainty of existing knowledge and provide an estimate of both the vulnerability of a species as well as the uncertainty associated with that estimate. After conducting these assessments on multiple species, it is then possible to consider the potential effects on birds in a broader ecological context. In this Section, we present a broad overview of this assessment on birds for each key factor.

Habitat vulnerability refers to potential changes in habitat quantity or quality that may affect survival or reproduction. It is largely differentiated into non-breeding, those habitat components that are primarily associated with a species survival, and breeding, those habitat components that are primarily associated with reproduction. Responses to changes in habitat from climate change will vary broadly depending on species. The expansion of shrub distribution through the Arctic, at the expense of other plant types, may negatively impact the nesting habitats of ground nesting species. Predator species that are not flexible in their prey selection will be vulnerable to fluctuations in prey composition and availability. Migratory terrestrial birds are expected to be resilient to climate change within their summer habitat but effects to winter habitat are highly variable depending on location and extent. Migratory marine birds are at risk due to fluctuations in prey availability and ice conditions.

Physiological vulnerabilities are related to direct effects on survival and reproduction, including the potential for exceedances of physiological thresholds, exposure to weather-related disturbance, survival during resource fluctuations and energy requirements. Overall, the greatest physiological vulnerabilities to climate change are primarily associated with exposure to extreme weather events such as increased frequency of heavy rain. These can have both direct and indirect effects on reproductive and foraging success. Behavioural plasticity may confer an advantage to species that can take advantage of warmer temperatures to alter breeding timing and changes in prey sources.

Phenological vulnerabilities can result from mismatches in timing between species' behaviour and biology and critical resources. This can occur where species rely on an environmental cue to initiate activities such as migration or breeding, or where a species' fitness is tied to a discrete resource peak that is expected to change. Phenological processes may be a substantial source of vulnerability, particularly for migratory species and those that time activities to environmental cues or discrete resource peaks. Migratory birds can adapt if environmental cues are present; however, the lag time of behavioural change compared to environmental change may be a concern for some species.

Vulnerabilities relating to biotic interactions stem from changes in interactions with food sources, predators, diseases, symbionts and competitors. Overall, vulnerability associated with changes in biotic interactions mainly relate to food sources. Primarily terrestrial species may see an increase in the abundance of food sources but food quality for some species may diminish. Other biotic interactions such as predators, symbionts, disease and competitors are either not expected to have a large influence on vulnerability or the results are highly uncertain.

Changes in environmental processes because of climate change will occur independently of the Project. Therefore, potential interactions of climate change with the Project and their effects on birds are limited. Changes in vegetation composition and distribution will affect the balance of direct and indirect habitat loss on each species as assessed in this report. It would be difficult at best to predict and quantify these changes at the scale of the TRSA. However, assessments of changes in habitat along with their effects on the habitats of key indicator species can be conducted periodically through the life of the Project. Adaptive management plans could then be implemented if necessary. The current suite of mitigations presented in the TEMMP to alleviate disturbance to nesting birds will prevent exacerbating the effects of physiological vulnerabilities. Vulnerabilities related to phenology and biotic interactions are completely independent of the Project and as a result cannot be mitigated. Their effects on bird species will depend mainly on the plasticity of individual species and their ability to adapt timing of activities (e.g., migration, nesting) through their life cycle. Baffinland will integrate climate change considerations into project planning and operations by continuously seeking to use energy, raw materials and natural resources more efficiently and effectively, and striving to develop new processes and more sustainable practices. Additionally, Baffinland will seek to avoid exacerbating the effects of climate change by pursuing ways to minimize the Project's carbon footprint.

3.7 MITIGATION AND MONITORING PLAN UPDATES

The mitigation measures in place for the Approved Project apply to Phase 2 Proposal activities. Based on the effects assessment for the Phase 2 Proposal, the current Baffinland TEMMP (Baffinland Iron Mines Corporation 2016) requires updates to mitigate Project effects on raptors nesting in proximity to the North railway alignment through construction activities.

These mitigation measures are as follows:

- Seasonal avoidance (schedule construction near nests outside of the nesting season)
- Temporarily making raptor nest sites inaccessible during the nesting seasons potentially affected by construction;
- Hazing nesting pairs to discourage nesting at the affected nest site; and
- Monitoring nesting activities and success when other mitigation measures are not feasible.

Given the abundance of suitable cliff-nesting habitat in the study area (Galipeau et al. In Prep), temporarily making the nest site inaccessible during the nesting seasons affected by construction activities would compel potentially affected nesting pairs to pick an alternative nest site within their territories thereby increasing the likelihood that affected pairs might reproduce successfully during construction activities. This technique involves altering the preferred nest sites to make them unsuitable for the nesting seasons affected by construction activities (e.g., placing rocks, flagging, raven decoys) and to monitor affected pairs to ensure they are not selecting another site near their preferred site (and alter those too if necessary and so on). Once construction activities are completed, nest sites would be returned to their original condition. Like making nests sites temporarily inaccessible, hazing would compel potentially affected nesting pairs to pick an alternative nest site within their territories. However, this technique involves a high degree of commitment and personnel effort. To be effective, it would require multiple hazing attempts per day for perhaps up to two weeks per nest starting as soon as nesting pairs return to the nest site following spring migration.

Monitoring of nesting success does not prevent or mitigate disturbance but would provide useful information on cause-effect relationships that could be used in future assessments.

No other updates specific to birds are required for the Project's existing TEMMP (Baffinland Iron Mines Corporation 2016).

4 REFERENCES

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