11 TERRESTRIAL WILDLIFE AND MARINE BIRDS

11.1 Introduction

Terrestrial wildlife and marine birds were selected as valued components (VCs) because of their potential interactions with project activities; their recreational, ecological, and aesthetic value; and their importance to, and the expressed interest of, Aboriginal groups, regulators, and the public. In this assessment, the Terrestrial Wildlife and Marine Birds VC includes terrestrial wildlife (i.e., mammals, amphibians, reptiles, terrestrial birds, and invertebrates), marine birds (including shorebirds and waterfowl), and their habitats.

Project activities have the potential to affect terrestrial wildlife and marine birds, and include:

- Habitat removal and noise disturbance associated with vegetation clearing during construction and operations
- Increased risk of mortality from increased land and water-based traffic or lighting on infrastructure
- Alteration of movement resulting from the location of project-related infrastructure.

To assess potential effects on terrestrial wildlife and marine birds, information was incorporated from other relevant discipline assessments including Acoustic Environment (Section 8), Ambient Lighting (Section 9), Vegetation and Wetland Resources (Section 10) and Marine Resources (Section 13), as well as technical data reports (TDRs) or assessment reports for Vegetation and Wetlands (Appendix E), Freshwater Acidification and Eutrophication (Appendix J), and Marine Resources TDR (Appendix M). Potential effects on Terrestrial Wildlife and Marine Birds arising from accidents and malfunctions are addressed separately in this EIS/Application (Section 22).

11.2 Scope of Assessment

11.2.1 Regulatory and Policy Setting

The Project is located on federal Crown land that is administered by the federal Prince Rupert Port Authority (PRPA). Management of wildlife resources (mammals, amphibians, reptiles, invertebrates, and terrestrial and marine birds) on federal lands occurs primarily through the *Migratory Birds Convention Act* (MBCA), the *Species at Risk Act* (SARA), and the *Federal Policy on Wetland Conservation*. Provincial regulations and management objectives found within the BC *Wildlife Act* and the 2006 Central Coast and North Coast Land Use Decision (Province of British Columbia) are also considered, where applicable, in the application of mitigation measures on all project components.

Migratory Birds Convention Act—Environment Canada (EC) manages migratory bird populations by regulating and restricting the harvest of individuals and the disturbance of habitat. The MBCA prohibits the disturbance, destruction, or possession of migratory birds, their nests, or eggs (Section 6 of the *Migratory Birds Regulations*). The MBCA also prohibits the deposit of oil, oily waters, or other substances harmful to migratory birds in any areas that they frequent (Section 5[1]).

***Species at Risk Act*—**Through SARA, the Government of Canada manages Endangered and Threatened species-at-risk and their habitat to prevent them from becoming extinct and to aid in their recovery. The SARA also provides management direction for species of Special Concern to prevent them from becoming Threatened or Endangered.

SARA prohibits the capture, possession, harming, harassment, or destruction of a species or its residence listed on Schedule 1 as Threatened, Endangered, or Extirpated. These prohibitions apply to Threatened or Endangered wildlife on federal lands and to migratory birds and aquatic species wherever these species are located. Protections under SARA can be extended to non-federal lands under Section 34(2). Specific prohibitions do not apply to species listed as Special Concern on Schedule 1 of SARA; however status reports prepared by the Government of Canada outline recommended management practices for species designated as Special Concern. The SARA requires the Government of Canada to develop recovery strategies for species listed as Threatened, Endangered, or Extirpated on Schedule 1. Critical habitat (i.e., habitat necessary for the survival or recovery of that species) is identified in each species' recovery strategy. The SARA contains prohibitions against the destruction of critical habitat on federal lands.

***Federal Policy on Wetland Conservation*—**The *Federal Policy on Wetland Conservation* was developed to prevent the loss or degradation of wetlands in Canada and to sustain their ecological and socio-economic functions over time. The policy defines the following ecological functions provided by wetlands with respect to wildlife:

- Habitat for waterfowl, furbearers, and reptiles
- Refuge for species of conservation concern
- Supporting the biodiversity of species.

The Government of Canada complies with the policy by achieving a no net loss of wetland function on federal lands and waters.

***BC Wildlife Act*—**Section 34 of the *Wildlife Act* specifically prohibits disturbance or destruction of any bird or its eggs, or its nest (while occupied by a bird or its eggs). Nests of eagles, peregrine falcon, gyrfalcon, osprey, heron, or burrowing owl are protected year-round (Section 34[c]) in areas where the legislation applies.

***Central Coast and North Coast Land Use Decision*—**Land use planning policies and specific objectives and strategies for managing terrestrial wildlife and marine birds along the north coast of BC are identified in the Strategic Land Use Plan Agreements under the 2006 Central Coast and North Coast Land Use Decision (Province of British Columbia).

11.2.2 Influence of Consultation on the Assessment

The Terrestrial Wildlife and Marine Birds assessment considered concerns raised by the BC Ministry of Environment (BC MOE), Environment Canada, Transport Canada (TC), and Aboriginal groups; no comments were received from stakeholders or the public (Table 11-1).

Table 11-1: Key Issues Raised During Consultation

Issue	Issue Raised By	Influence on the Assessment
Spatial boundaries	Aboriginal groups	▪ The spatial boundary of the marine portion of the RAA was adjusted to include alternate shipping routes.
Characterization of wildlife presence in the LAA and RAA	Aboriginal groups, Environment Canada	▪ The assessment incorporated data from historical literature and regional studies to characterize species abundance, richness, and seasonal use of the RAA.
The assessment applies a comprehensive approach to assessing effects on various species or species guilds	Aboriginal groups, Environment Canada, BC Ministry of Environment	▪ Potential project effects are assessed for individual species, as well as species assemblages based on shared habitat requirements. Application of an ecosystem-based approach is consistent with federal and provincial directives outlined in Hanson et al. 2009, Coast Information Team 2004, and BC MSRM 2005.
Baseline surveys should include focused assessments on terrestrial breeding and marine habitat for marbled murrelet	Environment Canada	▪ Multiple surveys were completed to assess: a) Changes in the quality and quantity of marbled murrelet breeding habitat in the LAA b) Changes in the quality and quantity of marine habitat c) The seasonal presence, abundance, and distribution of marbled murrelet in the local assessment area ▪ Environment Canada's current guidance on assessment of effects and management objectives, outlined in the proposed *Recovery Strategy for the Marbled Murrelet (Brachyramphys marmoratus) in Canada,* was considered in the finalization of the assessment (Environment Canada 2014).
Light-induced avian mortality (including flaring)	Environment Canada	▪ Light-induced mortality (including flares) is considered in Section 11.5.3 and Section 22.

11.2.3 Selection of Potential Effects

Through communication with EC, consultation with Aboriginal groups, and through the professional judgment and experience of the study team, the following potential issues were identified:

- Compliance with the MBCA regarding the destruction of nests and nesting migratory birds
- Compliance with the protection of species, and their residences and defined critical habitat, listed as Threatened or Endangered on Schedule 1 of the SARA
- Management of species, and their habitats, listed as Special Concern on Schedule 1 of the SARA
- Management of wetland ecological functions with respect to wildlife outlined in the *Federal Policy on Wetland Conservation*
- Management of species important to exercising aboriginal rights and traditional land use activities identified during consultation with Aboriginal groups.

Interactions between terrestrial wildlife or marine bird resources and the Project are associated with the construction and operation phases and include habitat removal and sensory disturbance, change in mortality from increased land and water-based traffic or lighting on marine infrastructure, and alteration of movement due to the location of project-related infrastructure (see Section 11.4, Table 11-7). The potential project-specific effects associated with these interactions to be carried forward for assessment includes:

- Change in habitat
- Change in mortality risk
- Alteration of movement.

Change in habitat—Construction and operation of the Project will result in direct loss or alteration of seasonal and year-round breeding, foraging, or shelter habitat for terrestrial wildlife and marine birds. Reclamation of habitat in the project development area (PDA) will be completed, as appropriate, within future land use planning initiatives by the PRPA. Physical and noise disturbance from equipment used for vegetation clearing, facility construction and installation, commissioning, and during project operations may make adjacent terrestrial and marine habitats less suitable for terrestrial wildlife and marine birds.

Change in mortality risk—Potential mortality of terrestrial wildlife (e.g., small mammals and amphibians) is greatest during vegetation clearing. Species with small home ranges and limited means of dispersal may seek refuge when exposed to noise and equipment during vegetation clearing and construction. Large mammals and adult birds (including marine birds) have greater mobility and are likely to avoid direct mortality by leaving an area undergoing construction activities.

Vegetation clearing can potentially destroy bird and amphibian eggs, and the offspring of mammals, birds, and amphibians if clearing is conducted during the breeding seasons identified for these groups. Noise produced by construction activities in adjacent habitats can also cause adult birds to temporarily abandon their nests, potentially increasing mortality to eggs and hatchlings from exposure to cold or predators during the adults' absence (Malt and Lank 2009).

Increased mortality to birds and bats may result from night-time lighting at the marine terminal. Artificial lighting is known to attract and disorient birds, causing them to collide with buildings, light posts, or other structures (Longcore et al. 2013; Rich and Longcore 2006; Black 2005). This effect can be magnified during seasonal migrations (i.e., when large numbers of birds are migrating along the coast), or during overcast or foggy conditions that intensify the dispersal of light (Merkel 2010; Rich and Longcore 2006).

Alteration of movement—Terrestrial wildlife and marine bird movements may be altered if the Project acts as a physical barrier to previously used movement corridors due to construction and operation of the LNG facility, the marine terminal, and the arrival and departure of shipping vessels. Individuals may establish new routes around the PDA to access important breeding or foraging habitats. Noise disturbance associated with construction and operational activities can also induce avoidance behaviour from various wildlife species. Species may expend additional energy to adjust normal or typical movement patterns, or spend less time in preferred habitats, to avoid noisy areas.

11.2.4 Selection of Measurable Parameters

A measurable parameter represents a feature that individually, or in combination with other measurable parameters, can provide scientific evidence or management guidance on status and trends in ecosystem quality, population sustainability, and other variables for assessing effects on wildlife resources. Measureable parameters were selected, where possible, to quantitatively assess the magnitude of both project and cumulative effects on terrestrial wildlife and marine bird resources (Table 11-2). Where specific measureable parameters were not available, qualitative analysis of project and cumulative effects was carried out.

Table 11-2: Measurable Parameters for Terrestrial Wildlife and Marine Birds

Effect	Measurable Parameter(s) and Units of Measurement	Notes or Rationale for Selection of the Measureable Parameter
Change in habitat	▪ Change in amount of habitat (quantified in hectares) of ecological communities and/or high or moderately suitable habitat identified for Endangered or Threatened SARA-listed species	▪ Loss of substantial amounts of habitat can negatively affect species population sustainability
Change in mortality risk	▪ Qualitative estimate of increased mortality from the Project and compliance with applicable regulations	▪ Increased mortality can negatively affect species population sustainability ▪ Project is required to comply with the MBCA and SARA
Alteration of movement	▪ Change in movement patterns in relation to project infrastructure	▪ Barriers to movement can affect wildlife populations by preventing wildlife from travelling between important habitats

11.2.5 Boundaries

The temporal, spatial, administrative, and technical boundaries for the assessment of effects on terrestrial wildlife and marine birds are discussed below.

11.2.5.1 Temporal Boundaries

Potential project-specific effects associated with change in wildlife habitat availability, change in wildlife mortality, and alteration of wildlife movement patterns are expected to occur throughout construction, operations, and decommissioning phases of the Project. Temporal boundaries also consider seasonal sensitivities for terrestrial wildlife and marine birds (e.g., breeding, migration) associated with project activities within each project phase.

Based on the current project schedule, the temporal boundaries for each project phase are:

- Construction: Q1 2015 – Q4 2018
- Operations: Q1 2019 – 2048+
- Decommissioning: 2048+

11.2.5.2 Spatial Boundaries

To assess project-related effects on terrestrial wildlife and marine birds, the spatial boundaries for wildlife resources include a terrestrial and marine component:

- **The project development area (PDA)—**Lelu Island to within 30 m of the average high water mark, the bridge abutments, and access road corridors, and areas covered by the bridge, pioneer dock, materials off-loading facility (MOF), marine terminal, and associated dredging. Terrestrial components of the PDA (i.e., the LNG facility) encompass 164 ha; marine infrastructure (i.e., the bridge, marine terminal, MOF, and pioneer dock) encompass 97 ha.
- **The local assessment area (LAA)**—The LAA extends 1.5 km from the perimeter of Lelu Island, 500 m from the marine terminal, and 2 km on both sides of the proposed primary and alternate shipping route between the marine terminal and Triple Island. Direct effects from clearing are limited to the extent of terrestrial and marine habitats found within the PDA; however, indirect effects associated with habitat alteration and sensory disturbance will extend beyond the project boundary. The spatial extent of the LAA accounts for potential effects of physical and noise-related disturbances to terrestrial wildlife and marine birds and corresponds to compliance with noise level guidelines under the BC Oil and Gas Commission (BC OGC 2009).
    - **Habitat modelling limits:** Ecological community and wildlife habitat suitability modelling was completed within a subset of the LAA to characterize terrestrial habitat at baseline. The baseline modelling was used to support the assessment for change in habitat availability due to construction and operation activities within the PDA. The modelling limits include Lelu Island and extend 1.5 km from the shoreline to include the mainland and adjacent nearshore marine habitats. The extent of the modelling limits consider potential wildlife response to construction and operation activities in the PDA as is discussed in relevant scientific literature (e.g., Bayne et al. 2008; Malt and Lank 2009; McClaren 2004).
- **The regional assessment area (RAA)**—The terrestrial component of the RAA is the Kaien Landscape Unit of the Central and North Coast Ministerial Order (BC MFLNRO 2013a). This Landscape Unit provides a land-use planning boundary that corresponds to quantifiable management objectives for terrestrial wildlife species of management concern in the region. The marine component of the RAA includes the PRPA Boundary and the waters extending 10 km on both sides of the shipping route from the marine terminal to the Triple Island pilotage station (PRPA 2002). The marine component of the RAA provides context for assessing effects of project-related marine activities (including berthed vessels and shipping) in relation to cumulative effects with other terrestrial and marine developments and activities. The RAA encompasses a number of important areas identified in traditional ecological knowledge studies (e.g., Digby, Kinahan, and Lucy islands; Sequin-Anderson 2006; Gitxaala Nation 2013), ecologically sensitive habitats (e.g., Flora Bank, Kitson Island, Important Bird Areas, and marine bird breeding colonies; IBA 2013). Previous studies completed on behalf of PRPA provide multi-year and multi-season baseline data that were incorporated into the assessment on terrestrial wildlife and marine birds to provide a detailed evaluation of project effects within a regional context. This includes occurrence records and habitat suitability for various wildlife species of management concern.

Figure 11-1 illustrates the spatial boundaries for this VC.

11.2.5.3 Administrative and Technical Boundaries

Administrative boundaries for the assessment are established based on applicable legislation described in Section 11.2.1. These boundaries also consider land use objectives described in the *Port of Prince Rupert 2020 Land Use Management Plan,* the 2006 Central Coast and North Coast Land Use Decision (Province of British Columbia), the Central and North Coast Ministerial Order Amendment (PRPA 2002; and BC MFLNRO 2013a), and *Bird Conservation Strategy for Bird Conservation Region 5: Northern Pacific Rainforest* (Environment Canada 2013a).

Technical boundaries for the assessment are established by the availability and validity of data, including regional wildlife population estimates, seasonal abundance and occurrence records, and wildlife habitat requirements. Technical information was obtained from peer-reviewed published literature, government reports, scientific literature, and previous surveys conducted for the PRPA.

11.2.6 Residual Effects Description Criteria

Residual effects are predicted after consideration of proposed mitigation measures, and they are assessed at either the population or ecosystem level based on the level of effect (e.g., number of individuals, areal extent of habitat). Terms used to characterize residual effects are defined in Table 11-3.

Table 11-3: Characterization of Residual Effects for Terrestrial Wildlife and Marine Birds

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Characterization of Residual Effects		
Context	The sensitivity and resilience of the valued component to the residual effect relative to the ecological fragility and degree of disturbance of the area in which the residual effect occurs. Consideration of context draws heavily on the description of existing conditions of the VC, which reflect cumulative effects of other projects and activities that have been carried out, and especially information about the effect of natural and human-caused trends in the condition of the VC. (i.e., low, medium or high resilience)	**Low resilience**—occurs in a fragile ecosystem and/or the level of baseline disturbance can be a contributing factor to reduced sustainability of a local or regional wildlife population **Moderate resilience**—occurs in a stable ecosystem and/or level of baseline disturbance not likely to contribute to reduced sustainability of a local or regional wildlife population **High resilience**—occurs in a viable ecosystem and/or the level of baseline disturbance does not contribute to reduced sustainability of a local or regional wildlife population

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Magnitude	The expected size or severity of the residual effect. When evaluating the magnitude of residual effects, the assessment considers the proportion of the VC affected within the spatial boundaries and the relative effect (i.e., negligible, low, moderate, high)	Where possible, the magnitude of an effect is expressed quantitatively (i.e., hectares affected). Where that is not possible, the effect is characterized qualitatively. **Negligible**—no detectable change on individuals of a regional wildlife population or hectares of habitat **Low**—change detectable on a few individuals or hectares of habitat (i.e., < 10 ha) in a regional population **Moderate**—detectable change on many individuals or hectares of habitat (i.e., 10 to 250 ha) in a regional population **High**—detectable change on the majority of individuals or hectares of habitat (> 250 ha) in a regional population
Extent	The spatial scale over which the residual effect is expected to occur (i.e., within the PDA, LAA or RAA).	**PDA**—effects are restricted to the PDA **LAA**—effects extend beyond the PDA into the LAA but not the RAA **RAA**—effects extend beyond the PDA and LAA into the RAA
Duration	The period of time the residual effect will persist.	**Short-term**—Effect occurs for less than one breeding season or generation (e.g., less than one year) **Medium-term**—Effect occurs for several breeding seasons or generations, or a project phase (e.g., one to five years, or the project construction phase) **Long-term**—Effect occurs across multiple breeding seasons or generations, or multiple project phases (e.g., 6 to 30 years, or the lifetime of the Project) **Permanent**—Effect occurs across multiple breeding seasons or generations and is unlikely to recover following project decommissioning and reclamation
Reversibility	The likelihood that the residual effect can be reversed once the physical work or activity ceases.	**Reversible**—the effect can be reversed during the lifetime of the Project or after project decommissioning and reclamation **Irreversible**—effects will persist after project decommissioning and reclamation
Frequency	How often the residual effect occurs.	**Single event**—effect occurs once **Multiple irregular event**—effect occurs more than once but at an unpredictable interval of time **Multiple regular event**—effect occurs more than once at a regular interval of time **Continuous**—effect occurs continuously
Likelihood of Residual Effects		
Likelihood	Refers to whether or not a residual effect is likely to occur.	**L**—Low probability of occurrence **M**—Medium probability of occurrence **H**—High probability of occurrence

11.2.7 Significance Thresholds for Residual Effects

A residual effect is considered significant if it threatens the long-term local or regional sustainability of an identified wildlife population. For this assessment, long-term local and regional sustainability is defined as a decline in the abundance or diversity, or a change in the distribution, of terrestrial wildlife or marine birds at the extent to which natural recruitment (i.e., species reproduction and immigration) cannot maintain a sustainable population.

Specific thresholds for each potential effect on terrestrial wildlife and marine birds are as follows:

- **Change in Habitat—**A project effect is considered to be significant if habitat loss or alteration is predicted to influence the long-term sustainability of an identified local or regional wildlife population. Management of wildlife populations occurs at a regional level; the extent of which differs among species. The assessment considers the significance of change in habitat on a species-specific basis where management objectives have been identified for individual species (e.g., federal recovery strategies for SARA-listed species).
- **Change in Mortality Risk—**The effect of change in wildlife mortality would also be significant if project-related activities (e.g., vegetation clearing, artificial lighting) are predicted to influence the long-term sustainability of an identified local or regional wildlife population.
- **Alteration of Movement—**A project effect is considered to be significant if project infrastructure or project-related activities are predicted to cause a substantial barrier to movement between important terrestrial or marine habitats (e.g., breeding and foraging) used by local or regional populations.

11.3 Baseline Conditions

Lelu Island is located within the Pacific Maritime ecozone which lies along British Columbia's coast and its border with Alaska. The regional landscape surrounding Lelu Island is characterized by steep fjords and channels where the Coast Mountain Range meets the Pacific Ocean.

Lelu Island is situated within the Very Wet Hypermaritime subzone of the Coastal Western Hemlock (CWHvh2) biogeoclimatic zone (Pojar et al. 1991). Close proximity to the Pacific Ocean moderates temperatures in this region and the CWHvh2 experiences cool summers and mild winters. Mean annual precipitation is very high, averaging 2,228 mm per year. The gently sloping perimeter of Lelu Island supports a moderately productive forest composed of western redcedar (*Thuja plicata*) and western hemlock (*Tsuga heterophylla*). The center of the island is vegetated with a mosaic of shrubby blanket bogs, woodlands and low productivity forests composed of western hemlock, mountain hemlock (*Tsuga mertensiana*), yellow-cedar (*Chamaecyparis nootkatensis*), western redcedar and shore pine (*Pinus contorta contorta*). In some areas of the island, trees grow in stunted "bonsai" forms.

Vegetation communities on Lelu Island and adjacent areas provide forest and wetland habitat for a variety of mammals, birds, and amphibians. Mammals on the island include grey wolf, black-tailed deer, Pacific marten, and red squirrel. Lelu Island provides habitat for number of terrestrial birds, such as American robin, Pacific wren, dark-eyed junco, hairy woodpecker, rufous hummingbird, and bald eagle. Lelu Island can also support a number of amphibian and reptile species where suitable habitat occurs, including northwestern salamander and rough-skinned newt.

The waters around Lelu Island contain productive shallow areas formed by sediment deposited from the Skeena River. Eelgrass beds and tidally exposed mudflats are found to the southwest of Lelu Island at Flora and Horsey banks. Several shallow intertidal passages are located in nearby Inverness Passage and Lelu Slough. Important Bird Areas 122 (Lucy islands), 124 (Big Bay south to Delusion Bay), and 125 (Grey and Green islets) support estuaries, mudflats, and rocky shores sustaining globally significant populations of waterfowl and seabirds (IBA 2013). Lelu Island also neighbours a number of marine bird breeding colonies (Figure 11-1): black-legged kittiwakes have been documented breeding on Holland Rock; and black oystercatchers, glaucous-winged gull, and pigeon guillemot on East and West Kinahan islands.

11.3.1 Existing Data Sources and Desktop Studies

Existing data on terrestrial wildlife and marine bird species and their abundance in the Prince Rupert region were compiled from a number of sources, including scientific literature, historical data collected in the Prince Rupert area, traditional ecological knowledge, and from baseline surveys and subsequent analysis conducted for the Project.

Terrestrial wildlife and marine bird studies have also been completed on nearby Kaien and Ridley islands to support PRPA planning initiatives (JWA 2008; Figure 11-1). Surveys were also completed for the environmental assessment of the Fairview Phase II Terminal Expansion Project (Fairview)(Stantec 2010, 2012), and the environmental impact statement for the Canpotex Potash Export Terminal and Ridley Island Road, Rail, and Utility Corridor Project (Canpotex)(Stantec 2011, 2013). Historical data on breeding songbirds and marine birds are also summarized through a number of volunteer-based programs (Bird Studies Canada 2013), including:

- BC Breeding Bird Atlas
- North American Breeding Bird Survey (Kwinitsa route)
- Christmas Bird Count (a 24 km circle centred on Digby Island)
- eBird (casual sightings by bird watchers recorded year round)
- Great Backyard Bird Count (includes a four-day event in mid-February)
- BC Coastal Waterbird Survey (monthly surveys from September to April but can include all months)
- Project Feederwatch (November to April).

Approximately 359 species (terrestrial mammals, amphibians, and birds) have been recorded in literature for the Prince Rupert region (Radcliffe et al. 1994). Only 128 species have been documented during surveys on nearby Kaien and Ridley islands which share similar habitats to Lelu Island (Appendix H: Terrestrial Wildlife and Marine Birds TDR).

A review of the BC Conservation Data Centre (BC CDC) indicates there is potential for 33 wildlife species of federal or provincial management concern to occur within the LAA (BC CDC 2013; Table 11-4).

Table 11-4: Potentially Occurring Provincially or Federally Designated Species of Management Concern

Species Name	Scientific Name	BC Status	SARA Status	Schedule	Habitat Requirements in the LAA and RAA
Mammals					
Little Brown Myotis	*Myotis lucifugus*	Yellow	Endangered (COSEWIC)	–	Summer roosts in buildings, tree cavities, and under the bark of trees; winter hibernations sites are typically located within 200 km of summer roosting colonies (Nagorsen and Brigham 1993).
Keen's Long-eared Myotis	*Myotis keenii*	Red	Data deficient	Schedule 2/3: Lack of data	Occurs in coastal mature to old-growth forests, as far north as the Stikine River (Klinkenberg 2012) and roosts in tree cavities and caves near, or even below, the high tide line (Boland et al. 2009; Firmen et al. 1993) .
Wolverine, *luscus* subspecies	*Gulo gulo luscus*	Blue	Special Concern (COSEWIC)	Schedule 3: Vulnerable	Occurs from sea-level to alpine where prey is abundant year-round; den sites are typically under avalanche debris or large boulders in undisturbed Engelmann spruce and sub-alpine fir forests (Krebs and Lewis 2000).
Grizzly Bear	*Ursus arctos*	Blue	Special Concern (COSEWIC)	Schedule 3: Vulnerable	Occurs in a range of habitat types from sea-level coastal rainforests to tundra and alpine elevations (COSEWIC 2002). As a habitat generalist, they have large ranges and migrate seasonally with resource distribution (Mace et al. 1999).
Amphibians					
Coastal Tailed Frog	*Ascaphus truei*	Blue	Special Concern	Schedule 1	Year-round resident of cool, fast flowing, rocky streams on the West and East slopes of the Coast Mountains (Mallory 2004). Unlikely to occur on Lelu Island but might occur on the mainland within the RAA.
Western Toad	*Bufo boreas*	Blue	Special Concern	Schedule 1	Breeding occurs in ponds, stream edges and shallow lake margins while tadpoles and toadlets congregate in warm, shallow water (Olsen 2001). Adults will disperse into forested areas, shrublands and subalpine meadows with dense shrub cover and access to moisture (Poll et al. 1984). Has not been documented on Lelu Island but is known to

Species Name	Scientific Name	BC Status	SARA Status	Schedule	Habitat Requirements in the LAA and RAA
					occur on Ridley Island within the RAA.
Birds					
Ancient Murrelet	*Synthliboramphus antiques*	Blue	Special Concern	Schedule 1	Breeds in mature or old-growth coniferous forests on islands from 20 to 2,000 ha in size (Gaston 1994). Nest sites are located within 300-400 m of the shoreline. Occurs in offshore locations of the LAA and RAA where suitable breeding or winter habitat exists.
Band-tailed Pigeon	*Patagioenas fasciata*	Blue	Special Concern	Schedule 1	Breeds in low-elevation (< 1,000 m) mixed wood forests, especially pine-oak, spruce, Douglas-fir, Western Hemlock, Cedar and alder (Braun 1994). Occur within the LAA and RAA year-round.
Barn Swallow	*Hirundo rustica*	Blue	Threatened (COSEWIC)	–	Breeds in abandoned buildings, barns and other and sheltered structures, frequently near water (Hilty and Brown 1986). Occurs during breeding season within the RAA and LAA.
Brandt's Cormorant	*Phalacrocorax penicillatus*	Red	–	–	Winters in fjords along the coast, preferring rocky bays and shorelines; individuals typically observed within 1 km of shore (Wallace and Wallace 1998)
Brant	*Branta bernicla*	Blue	–	–	Wintering areas include intertidal and subtidal habitat in sheltered bays, behind sand spits and estuaries (Reed et al. 1998). Observed during migration in the RAA.
Cackling Goose	*Branta hutchinsii*	Blue	–	–	Cackling geese breed in the arctic and may be present in low numbers along coastal BC during migration or overwinter (Cornell Lab of Ornithology 2013)
California Gull	*Larus californicus*	Blue	–	–	Occurs in pelagic and sheltered water along the BC coast during fall migration (Campbell et al. 1990) and might be an occasional transient within the LAA and RAA.
Cassin's Auklet	*Ptychoramphus aleuticus*	Blue	–	–	Breeds on coastal islands, winters along the BC coast (Terres 1980) and may be present within the LAA or RAA.

Species Name	Scientific Name	BC Status	SARA Status	Schedule	Habitat Requirements in the LAA and RAA
Common Murre	*Uria aalge*	Red	–	–	Breeds on islands close to sea-level, with nests on rocky cliffs, ledges, crevices and other flat sites (Gaston and Nettleship 1981). Occurs along rocky shores during the winter and has been detected during marine bird surveys within the LAA.
Common Nighthawk	*Chordeiles minor*	Yellow	Threatened	Schedule 1	Breeds in open habitat devoid of vegetation, i.e., rocky outcrops, sand dunes, beaches, forest clearings and logged areas (COSEWIC 2007). Occurs in mixed and coniferous forests. One individual detected during baseline studies, although not previously recorded in LAA (Appendix H: Terrestrial Wildlife and Marine Birds TDR).
Double-crested Cormorant	*Phalacrocorax auritus*	Blue	Not at Risk (COSEWIC)	–	Nests on coastal cliffs, on the ground and in trees near freshwater sources (Spendelow and Patton 1988). Forages within sight of land along coast of BC. Detected during baseline studies within the LAA.
Great Blue Heron, *fannini* subspecies	*Ardea herodias fannini*	Blue	Special Concern	Schedule 1	Breeding pairs or small colonies occur in mature forests along the coastline; intertidal and shallow coastal waters are used for feeding (Campbell et al. 1990) Occurs year-round along the coast of the LAA and RAA.
Horned Grebe	*Podiceps auritus*	Yellow	Special Concern (COSEWIC)	–	Occurs along the coast during spring and fall migration and over winter (Stedman 2000).
Long-tailed Duck	*Clangula hyemalis*	Blue	–	–	Congregates along herring spawning grounds along the coast during migration. Winters in protected marine waters (Robertson and Savard 2002).
Marbled Murrelet	*Brachyramphus marmoratus*	Blue	Threatened	Schedule 1	Occur from sea-level to 1,500 m elevation and nest in mature to old-growth forests up to 50 km from shore (Burger 2001). Forage year-round within 2 km of shore. Detected in nearshore habitat within the LAA.

Species Name	Scientific Name	BC Status	SARA Status	Schedule	Habitat Requirements in the LAA and RAA
Northern Fulmar	*Fulmarus glacialis*	Red	–	–	Relatively uncommon in the RAA; fulmars are most common along continental shelf breaks and pelagic habitats during spring and fall migration (Mallory et al. 2012).
Northern Goshawk, *laingi* subspecies	*Accipiter gentilis laingi*	Red	Threatened	Schedule 1	Forest dwelling raptor that requires mature to old-forests for breeding (Doyle 2003) but forages in a wide range of habitat types. May occur within suitable habitat in the RAA and LAA.
Olive-sided Flycatcher	*Contopus cooperi*	Blue	Threatened	Schedule 1	Breeds in mature to old-growth forests with natural openings. Prefers foraging and singing from dead standing trees (AOU 1983).
Pelagic Cormorant, *pelagicus* subspecies	*Phalacrocoras pelagicus pelagicus*	Red	–	–	Occurs year-round in coastal waters of the LAA and RAA (Campbell et al. 1990).
Peregrine Falcon *pealei* subspecies	*Falco peregrinus pealei*	Blue	Special Concern	Schedule 1	Rarely breed on mainland cliffs, more often on rocky island cliffs, usually near seabird colonies and occur year-round feeding in coastal waters within the LAA and RAA (Campbell et al. 1990).
Red-necked Phalarope	*Phalaropus lobatus*	Blue	Special Concern (COSEWIC)	–	Pelagic forager during winter months, breeds outside of the LAA and RAA (AOU 1983)
Rusty Blackbird	*Euphagus carolinus*	Blue	Special Concern	Schedule 1	Breeds in moist coniferous forests near wetlands, bogs or other small bodies of water (AOU 1983).
Short-eared Owl	*Asio flammeus*	Blue	Special Concern	Schedule 1	Breeds in open land with low vegetation, often in fresh and saltwater marshes, dunes near foraging areas with high small mammal densities (Campbell et al. 1990). In winter, roost communally in low brush or shallow depressions in the ground (Clark 1975).Suitable habitat uncommon within the RAA.
Surf Scoter	*Melanitta perspicillata*	Blue	–	–	Nests are protected by vegetation on the ground in bushy tundra, freshwater marshes or wooded areas near water. Occur in marine littoral areas, bays and freshwater lakes and rivers within the LAA and RAA (AOU 1983).

Species Name	Scientific Name	BC Status	SARA Status	Schedule	Habitat Requirements in the LAA and RAA
Western Grebe	*Aechmophorus occidentalis*	Red	Candidate (COSEWIC)	–	Nests on large inland bodies of water near deep water (Ehrlich 1992). Detected along the coast and in sheltered waters and bays within the LAA and RAA during winter season (AOU 1983).
Western Screech-Owl, *kennicottii* subspecies	*Megascops kennicottii kennicottii*	Blue	Special Concern	Schedule 1	Breeds in tree cavities in forests, especially in riparian zones, found at lower elevations (COSEWIC 2002). Detected during baseline studies within the LAA.
Invertebrates					
Black Petaltail	*Tanypteryx hageni*	Blue	–	–	Found in seepage areas and bogs, associated with streams but not usually under forest canopy. Eggs are laid in the soil of a bog (Ramsay and Cannings 2000).

11.3.2 Overview of Baseline Conditions

The following surveys were conducted in 2012 and 2013 to collect baseline information on terrestrial wildlife and marine birds potentially occurring within the LAA:

- Wildlife encounter transects surveys (August 14 to 16, 2012)
- Amphibian surveys (June 14 to 18 and June 28 to July 2, 2013)
- Raptor call-playback surveys (April 23 to 24, June 16 to 19, and June 27 to July 1, 2013)
- Raptor acoustic recording unit surveys (April 24 through July 2, 2013)
- Breeding bird surveys (June 14 to 17 and June 28 to July 2, 2013)
- Wetland bird surveys (June 17, 2013)
- Marine bird stationary count surveys (August 14 and November 7 to 8, 2012; and January 25, April 23 to 24, and June 28 to July 1, 2013)
- Marine bird fixed-width vessel transects (November 7 and 8, 2012; and January 24, April 25, and July 2, 2013)
- Wildlife Habitat Assessments (August 11 to 16, 2012 and May 2 to 6, 2013).

Detailed survey methods and results of terrestrial wildlife and marine bird baseline studies are provided in the Terrestrial Wildlife and Marine Birds TDR (Appendix H).

11.3.2.1 Habitat Modelling

Ecological Community Modelling

Ecological community modelling was used to provide quantitative and qualitative information for assessing the effects of development of the PDA to ecological communities on and near Lelu Island. The modelling limit for ecological communities encompasses Lelu Island and extends 1.5 km from the shoreline of Lelu Island in order to consider potential wildlife response to physical and noise-related project disturbances (see Section 11.2.5; Figure 11-1). Ecological communities under baseline conditions were determined through vegetation assessments and terrestrial ecosystem mapping. Ecological community modelling combines vegetation assessments with baseline data from terrestrial wildlife and marine bird field studies to characterize ecological communities and the associated wildlife species assemblages. Ecological modelling provides a means for assessing project-related effects on wildlife species with shared habitat requirements and ecological traits (i.e., breeding, foraging, migration, and overwinter requirements). Applying ecological modelling also allows the assessment to evaluate potential project effects within similar mitigation and management frameworks (e.g., EC 2013a). These methods are consistent with the approach recommended by Hanson et al. 2009, Coast Information Team 2004, and BC MSRM 2005.

Vegetation assessments were completed by two vegetation ecologists from August 11 to 16, 2012 and May 2 to 6, 2013 following methods outlined in the *Field Manual for Describing Terrestrial Ecosystems* (BC MOFR and BC MOE 2010). Prior to field work, plots were selected to proportionately represent the variety of ecological communities present within the study area. A total of 175 vegetation plots were completed: 151 plots were completed on Lelu Island and 24 plots on the adjacent mainland (Appendix E: Vegetation and Wetlands TDR for full details). Survey plots were 20 m x 20 m; at each plot, observers recorded terrestrial ecosystem mapping (TEM) characteristics (e.g., site, soil, and vegetation; BC MOFR and BC MOE 2010). Detailed TEM data was categorized into broader ecological communities that share common characteristics (e.g., plant species, structural stage, availability of coarse woody debris).

The habitat modelling limit is composed of eleven ecological community types providing unique habitat attributes that are expected to support different assemblages of terrestrial wildlife and marine birds (Figure 11-2; see Appendix H: Terrestrial Wildlife and Marine Birds TDR). Most of the habitat modelling limit is comprised of ocean (48%), estuarine tidal flats (20%), shrub dominated bog (8%), coniferous forest (7%), and seral coniferous forest (7%).

Wildlife Habitat Assessments and Suitability Modelling

Through the SARA, the Government of Canada manages Endangered, Threatened, and Special Concern species-at-risk to prevent them from becoming extinct and to aid in their recovery. The SARA prohibits the harming or destruction of a species, its residence, or its defined critical habitat (i.e., habitat necessary for the survival or recovery if it is listed as Threatened, Endangered, or Extirpated on Schedule 1). These prohibitions apply to Threatened or Endangered wildlife on federal lands and to migratory birds and aquatic species wherever these species are located.

Effects from vegetation clearing are limited to the extent of the PDA; however, indirect effects of habitat alteration from sensory disturbance (e.g., noise production) are likely to extend beyond the project boundary. The modelling limit extends 1.5 km from the shoreline of Lelu Island in order to consider potential wildlife response to physical and noise-related project disturbances based on scientific literature (e.g., Bayne et al. 2008; Malt and Lank 2009; McClaren 2004) (see Section 11.2.5; Figure 11-1).

Wildlife habitat suitability modelling was completed to characterize abundance and availability of suitable habitat for species designated as Threatened or Endangered on Schedule 1 of SARA (Figure 11-1). Species selected for modelling included those that have been previously recorded in the RAA and have habitat requirements that are met by ecological communities present in the LAA (JWA 2008; Stantec 2010, 2011, 2012b, 2013, Bird Studies Canada 2013). Based on these criteria, wildlife habitat assessments were completed on August 11 to 16, 2012 and May 2 to 6, 2013 for the following species and associated life requisites:

- Northern goshawk, *laingi* subspecies (BC Red List; SARA Threatened)—Reproduction requirements (breeding) during spring and summer.
- **Olive-sided flycatcher (BC Blue List; SARA Threatened)—**Reproduction requirements (breeding) during spring and summer.
- **Marbled murrelet (BC Blue List; SARA Threatened)—**Reproduction requirements (breeding) during spring and summer.

In addition to each species being of management concern, they occupy different niches within habitats on or near Lelu Island. These habitats support distinct roles in ecosystem function that are used by a broad spectrum of terrestrial birds, mammals, and amphibians. In combination with ecological community modelling, habitat models provide a strong basis for assessing potential effects of the Project on terrestrial wildlife and marine birds overall.

Wildlife habitat assessments followed methods outlined in the *Field Manual for Describing Terrestrial Ecosystems* (BC MOFR and BC MOE 2010) and the *British Columbia Wildlife Habitat Rating Standards* (RIC 1999a). Prior to field work, plots were selected to proportionately represent the variety of habitat types that exist within the study area. A total of 71 habitat assessment plots were completed on or near Lelu Island.

The habitat use requirements assessed for the Project were selected based on the representative life requisite and season mostly likely to be affected by project activities. These are described in detail for each species in the Terrestrial Wildlife and Marine Birds TDR (Appendix H).

In accordance with RIC (1999b), the habitat suitability rating for each species was assigned using a four-class rating system for species where the provincial government has determined there is a moderate level of knowledge on species' habitat requirements. In the four-class system, habitat is ranked as nil, low, moderate, or high; preferred habitat includes those ranked as moderate or high. The ratings are then paired with data from existing disturbances (e.g., roads, railways, urban areas) and are used to adjust the suitability ratings. Disturbances are characterized based on their zone of influence (ZOI) on the respective habitat and are then assigned disturbance coefficients (DC's). Disturbance coefficients represent the extent to which initial habitat ratings are reduced when paired with a given disturbance type. Zones of influence and disturbance coefficients are applied to habitat suitability ratings which are negatively influenced by adjacent anthropogenic features. For example, northern goshawk breeding habitat is known to be negatively affected by hard edges (e.g., cut blocks, right-of-ways, human settlement) (NGRT 2008). To account for the negative effect, hard edges have a ZOI of 200 m within which habitat suitability is reduced by one rating. Northern goshawk habitat that was rated as having high suitability within 200 m of a hard edge will be reduced to moderate habitat. The DC and ZOI of each disturbance feature for each species are provided in Table 11-5.

Table 11-5: Disturbance Features and Corresponding Zone of Influence and Disturbance Coefficients for Selected Wildlife Species

Feature	Marbled Murrelet[1]		Northern Goshawk[2]		Olive-sided Flycatcher[3]	
	Spring Reproduction		Spring Reproduction		Spring Reproduction	
	ZOI (m)	DC	ZOI (m)	DC	ZOI (m)	DC
LNG Facilities, Buildings and Structures	0-50	-2	0-200	-1	0-50	-1
Marine Terminal and Materials Off-loading Facility	0-50	-2	0-200	-1	0-50	-1
Coal Dump, Gravel Extraction Pit	0-50	-2	0-200	-1	0-50	-1
Minor Road	0-50	-2	0-200	-1	0-100	-1

Feature	Marbled Murrelet[1]		Northern Goshawk[2]		Olive-sided Flycatcher[3]	
	Spring Reproduction		Spring Reproduction		Spring Reproduction	
	ZOI (m)	DC	ZOI (m)	DC	ZOI (m)	DC
Major Road, Road Bridge	0-50	-2	0-200	-1	0-200	-1
Railway	0-50	-2	0-200	-1	0-200	-1
Cutline, Seismic Line, Trails, Foot Bridge	0-50	-1	0-100	-1	0-50	-1
Transmission Line	0-50	-1	0-100	-1	0-50	-1
Clearing	0-50	-2	0-200	-1	0-50	-1
Industrial Pond, Tailing Pond	0-50	-1	0-100	-1	0-50	-1
Logging Area	0-50	-1	0-100	-1	0-50	-1
Residential	0-50	-2	0-200	-1	0-50	-1
Noise	0-700	-1	0-700	-1	0-700	-1

NOTES:
[1] Bellefleur et al. 2009; Malt and Lank 2009; CMMRT 2003; Bayne et al. 2008; Burger 2002
[2] Bayne et al. 2008; McClaren 2004; NGRT 2008
[3] Barber et al. 2009; Bayne et al. 2008; Reinjen and Foppen 1995

The results of the baseline suitability models indicate there are moderate amounts of preferred habitat for marbled murrelet under baseline conditions (306 ha or 34% of the modelling limit; Table 11-6; Figure 11-3). High or moderately suitable habitat was generally located on moderate sloped old-growth coniferous forest (structural stage 7a or 7b) set back from the water and existing disturbance features (e.g., roads, railway; Environment Canada 2014).

Lower amounts of preferred reproduction habitat were calculated for northern goshawk (276 ha or 31% of the modelling limit) and did not include any habitat rated as high suitability (Table 11-6; Figure 11-4). Highly suitable habitat for northern goshawk includes mature and old-growth forests with high canopy closure (McClaren 2004). Old-growth forest patches on Lelu Island generally have an open canopy (closure < 50%).

The LAA contains small patches of high or moderately suitable reproductive habitat for olive-sided flycatcher (394 ha or 44% of the modelling limit; Table 11-6; Figure 11-5). Preferred habitat was located in small patches on Lelu Island, Smith Island, and the mainland where mature and old-growth forest with a moderate amount of openings (e.g., tree snags or wetlands) are available.

Table 11-6: The Amount of Habitat (ha) for Each Habitat Suitability Rating Class for Each Species under Baseline Conditions

Habitat Suitability Rating Class	Amount of Habitat (ha)		
	Marbled Murrelet Spring Reproduction	Northern Goshawk Spring Reproduction	Olive-sided Flycatcher Spring Reproduction
High (76 – 100%)	6.0	0	37.1
Moderate (26 – 75%)	299.7	276.2	356.4
Low (1 – 25%)	344.3	507.3	391.4
Nil (0%)	238.5	105.0	103.6
Total	**888.5**	**888.5**	**888.5**

The remaining 1,815 ha of habitat is characterized as marine ecological communities (i.e., ocean and estuarine tidal flats) and would be considered as unsuitable (e.g., classed as Nil) breeding habitat for each selected species.

11.3.2.2 Field Studies

A full description of methods and results for field studies are included in the Terrestrial Wildlife and Marine Birds TDR (Appendix H). A summary is provided below.

Wildlife Transect Surveys

Wildlife encounter transect surveys were conducted on Lelu Island to determine the presence, abundance and distribution of terrestrial mammals. Transects followed the methods outlined in *Ground-based Inventory Methods for Selected Ungulates: Moose, Elk and Deer* (RIC 1998a).

There were 430 wildlife signs recorded from 22 species during transects. The most common sign were signs of browse, scat, or tracks of black-tailed deer (90%) but included detections of Pacific marten (1%), red squirrel (1%), orange-crowned warbler (1%), and dark-eyed junco (1%). Observations were evenly distributed across Lelu Island with the highest proportion of species identified on transects located in old coniferous forest and treed swamp or bog on the perimeter of the island (Figure 11-6).

Amphibian Surveys

Systematic searches for pond-dwelling amphibians were conducted on Lelu Island to survey the potential presence, abundance and distribution of breeding amphibians. Systematic amphibian surveys followed methods outlined in *Inventory Methods for Pond-breeding Amphibians and Painted Turtle* (RIC 1998b). Nine wetlands with potential amphibian breeding habitat were surveyed (Figure 11-7). Ten northwestern salamander egg masses were found in five wetlands during systematic searches; most (70%) were distributed between stations AMP3 and AMP7 on the southern end of Lelu Island.

Terrestrial Bird Surveys

Raptor Call-Playback Surveys

Raptor call-playback surveys were conducted to survey for diurnal and nocturnal raptor species that have the potential to occur on Lelu Island and adjacent mainland area within the LAA. Surveys were conducted following methods for call-playback surveys outlined in *Inventory Methods for Raptors* (RIC 2001) and *Inventory Methods for Owl Surveys* (RIC 2006). Call-playback surveys were conducted at four stations on Lelu Island and three stations on the mainland (Figure 11-8).

Ten detections of three species were recorded during raptor call-playback surveys. Most detections were diurnal records of bald eagle along Lelu Slough in late June. Merlin was also detected along the slough in April and mid-June. One barred owl was detected calling from the mainland during nocturnal surveys in April.

Acoustic Recording Units

In order to improve detection of nocturnal raptor species potentially breeding on or near the PDA, four Song Meter SM2+ recording units were installed in potential raptor breeding habitat on Lelu Island (Figure 11-8). Each recording unit was programmed to record nightly for 10 minute intervals every 30 minutes between 10:30 p.m. and 4:30 a.m. Units were installed on April 24 and removed by July 2, 2013.

Recording units provided an additional 540 hours of survey effort between April and July, 2013. Four raptor species were recorded: bald eagle, northern saw-whet owl, western screech-owl *kennicottii* subspecies (BC Blue List; SARA Special Concern), and barred owl. Bald eagles were recorded infrequently at stations RAP4, 6, and 7. Northern saw-whet owl was recorded at station RAP6 on June 15 and at RAP5 on June 28. There were two detections of western screech-owl at RAP6 on May 25 and June 1. Barred owl was recorded 64% (45 of 70) nights while the units were deployed; most (96%) of nightly barred owl detections were at the RAP5 station.

Breeding Bird Surveys

Breeding bird surveys were conducted to survey the distribution and abundance of breeding songbirds within the LAA. Biologists completed surveys following methods for point counts outlined in *Inventory Methods for Forest and Grassland Songbirds* (RIC 1999b). Stations were placed a minimum of 200 m from one another to provide effective coverage of habitats within the LAA (Figure 11-6).

Twenty-nine point count stations were surveyed in mid-June (June 14 to 17) and repeated in late June (June 28 to July 2) at 24 stations on Lelu Island and five stations on the adjacent mainland. A total of 607 birds of 40 species were recorded across all surveys. The most commonly detected species were hermit thrush (15%), Pacific wren (12%), northwestern crow (10%), and orange-crowned warbler (8%). No species of management concern were detected during breeding bird surveys.

Wetland Bird Surveys

Call-playback surveys were conducted to survey for the presence of American bittern, Virginia rail, American coot, and sora on Lelu Island and followed methods outlined in the *Inventory Methods for Marsh Birds: bitterns and rails* (RIC 1998c).

Four surveys were conducted preceding amphibian searches on June 17, 2013 at stations MAR1 through MAR4 (Figure 11-6). None of the four target marsh bird species were recorded during call-playback surveys. The species targeted for call-playback surveys generally select shallow wetlands with substantial peripheral and emergent vegetation suitable for nesting and cover (RIC 1998c); these habitats were uncommon on Lelu Island.

Marine Bird Surveys

Stationary count and fixed-width vessel surveys were conducted around Lelu and Stapledon islands to survey the distribution, abundance and seasonal occurrence of marine and shorebird species. Surveys followed methods outlined in *Inventory Methods for Seabirds: cormorants, gulls, murres, storm-petrels, Ancient Murrelet, auklets, and Pigeon Guillemot* (RIC 1997a) and *Standardized inventory methodologies for components of British Columbia's biodiversity: Shorebirds: plovers, oystercatchers, stilts, avocets, sandpipers, phalaropes and allies* (RIC 1997b).

Stationary Count Surveys

Stationary counts were conducted at ten stations along the shores of Lelu Island on August 14 and November 7 to 8, 2012; and January 25, April 23 to 24, and June 28 to July 1, 2013 (Figure 11-9). A total of 772 birds of 42 species were recorded during stationary count surveys, most were of black turnstone (11%), mew gull (9%), mallard (8%), and bald eagle (7%). Detections of federal or provincial species of management concern included California gull (BC Blue List), common murre (BC Red List), double-crested cormorant (BC Blue List), great blue heron *fannini* subspecies (BC Blue List, SARA Special Concern), marbled murrelet (BC Blue List, SARA Threatened), pelagic cormorant *pelagicus* subspecies (BC Red List), surf scoter (BC Blue List), and western grebe (BC Red List).

Fixed-width Vessel Transects

Four fixed-width vessel transect surveys were conducted in nearshore waters surrounding Lelu, Ridley, Stapledon, and Kitson islands including Flora Bank on November 7 and 9, 2012; and January 25, April 25, and July 2, 2013 (Figure 11-9). A total of 704 birds of 38 species were detected; most detections were of green-winged teal (17%), marbled murrelet (9%), bald eagle (8%), and glaucous-winged gull (8%). Seven federal or provincial species of management concern were detected, including California gull (BC Blue List), double-crested cormorant (BC Blue List), great blue heron *fannini* subspecies (BC Blue List, SARA Special Concern), long-tailed duck (BC Blue List), marbled murrelet (BC Blue List, SARA Threatened), pelagic cormorant *pelagicus* subspecies (BC Red List), surf scoter (BC Blue List), and western grebe (BC Red List).

Incidental Observations

Incidental observations were recorded throughout the LAA and include observations recorded from outside of formal survey periods, during travel between survey stations, or during other field programs.

A total of 1,789 detections of 59 species have been recorded incidentally on Lelu Island between August 11, 2012 and July 2, 2013. The majority of detections were of a large flock of brant geese during migration (56%) followed by common loon (5%), gull species (5%), bald eagle (4%), and

herring gull (3%). One active bald eagle nest was identified on the west side of Lelu Island during an aerial reconnaissance survey on May 17, 2013. Detections of federal or provincial species of management concern include California gull (BC Blue List), common murre (BC Red List), common nighthawk (SARA Threatened), double-crested cormorant (BC Blue List), great blue heron *fannini* subspecies (BC Blue List, SARA Special Concern), marbled murrelet (BC Blue List, SARA Threatened), surf scoter (BC Blue List), and western grebe (BC Red List).

Detections of important wildlife habitat features and detections of species of management concern are mapped on Figure 11-10.

11.4 Project Interactions with Terrestrial Wildlife and Marine Birds

This assessment considers potential project effects to change in wildlife habitat availability, change in wildlife mortality and alteration of wildlife movement (Section 11.2.3). Data from baseline surveys and existing data sources was used to apply a ranking to potential effects of concern that could result from interactions between terrestrial wildlife and marine birds and project activities (Table 11-7). Detailed information on project activities is provided in the project description (Section 2). Activities ranked as a 0 are expected to have negligible effects on terrestrial wildlife and marine birds. The assessment examines interactions between activities and specific effects for those activities identified as having project interactions but manageable with standard operating procedures or codified practices (i.e., activities ranked as a 1), and project activities that could cause changes of concern (ranked 2).

Table 11-7: Potential Effects on Terrestrial Wildlife and Marine Birds

Project Activities and Physical Works	Potential Effects		
	Change in Wildlife Habitat	Change in Mortality Risk	Alteration of Movement
Construction			
Site preparation (land-based)	2	2	2
Onshore construction	2	1	2
Vehicle traffic	0	1	1
Dredging	2	2	2
Marine construction	2	2	2
Waste management and disposal	0	1	0
Disposal at sea	2	1	0
Operational testing and commissioning	1	0	0
Site clean-up and reclamation	1	0	0
Operation			
LNG facility and supporting infrastructure on Lelu Island	2	2	2
Marine terminal use	2	2	2
Shipping	2	1	1

Project Activities and Physical Works	Potential Effects		
	Change in Wildlife Habitat	Change in Mortality Risk	Alteration of Movement
Waste management and disposal	0	1	0
Fish habitat offsetting	1	1	0
Wetland habitat compensation	1	1	0
Decommissioning			
Dismantling facility and supporting infrastructure	2	1	2
Dismantling of marine terminal	2	1	2
Waste disposal	0	1	0
Site clean-up and reclamation	0	1	0

KEY:

0 = No interaction.

1 = Potential adverse effect requiring mitigation, but further consideration determines that any residual adverse effects will be eliminated or reduced to negligible levels by existing codified practices, proven effective mitigation measures, or best management practices (BMPs).

2 = Interaction may occur and resulting effect may exceed acceptable levels without implementation of project-specific mitigation. Further assessment is warranted.

11.4.1 Justification of Interaction Rankings

Activities identified in Table 11-7 as having no interaction with terrestrial wildlife and marine birds (ranked as 0), or as having an interaction that can be managed to acceptable levels through standard operating procedures or application of BMPs (ranked as 1), are assessed here. These include:

- Waste management and disposal during all project phases
- Vehicle traffic during construction
- Facility maintenance and testing during construction
- Clean-up and reclamation during construction and decommissioning
- Fish and wetland habitat offsetting or compensation programs.

Based on experience, professional judgment, and ability to mitigate through legislated standards, the effects potentially associated with the activities listed above will be negligible and not considered significant.

The interaction between waste management and disposal and wildlife mortality from interactions with project personnel has been ranked as 1, therefore requiring some mitigation. This interaction is considered here. Improper waste management and disposal procedures attract bears, wolves, and coyotes to the project site. Modern waste management practices focus on reducing the causes of human-wildlife encounters (e.g., food, garbage, and other attractants) as an effective means to limit human injury, property damage, and animal removal (BCCF 2012; Herrero et al. 2005). Because this interaction can be mitigated through the use of modern waste management practices, no additional analysis is warranted.

Vehicle-related wildlife mortality is a contributing factor in the decline of many wildlife species (Daigle 2010; Davis, 2002). Collisions occur if roads are located along traditional migration routes between important habitats or if species are attracted to roadsides that have been artificially seeded or provide easier access for travel (BC MFLNRO 2012; UWCMRT 2006). A total of 197 m of road access will be constructed to connect Lelu Island to Skeena Drive and will not intersect wildlife migration corridors. Construction and operations personnel will use group transportation options to travel to and from the PDA, adhere to posted speed limits, and reduce speed when wildlife are detected. These practices are expected to result in a negligible increase in wildlife mortality due to vehicle collision. Likewise, marine birds can suffer direct mortality due to collisions with transportation vessels. However, in consideration of vessel speeds in the RAA and the underwater mobility of marine birds, mortality events are expected to be rare.

The lifespan of the Project will likely exceed 30 years. Upon closure, a final Decommissioning Plan will be developed consistent with PRPA planning initiatives and the standards and regulations at that time. Mature and old forest that was removed during vegetation clearing for the PDA will require upwards of 600 years to return to pre-construction conditions (Banner et al. 2009); however, the regional extent of disturbance to these ecological communities is expected to be low.

The Project is required to implement fish and wetland habitat offsetting or compensation programs in accordance with:

a) The *Fisheries Act*; which includes prohibitions against causing *"serious harm to fish that are part of or support a commercial, recreational or Aboriginal fishery*" (Section 35) in addition to provisions for flow (Section 20) and fish passage (Section 21) and a framework for regulatory decision-making (Sections 6 and 6.1).

b) The *Federal Policy on Wetland Conservation*.

The Conceptual Fish Habitat Offsetting Strategy (Appendix K) will compensate fish habitat altered or lost as a result of clearing for the LNG facility and construction of the marine terminal, MOF, and bridge. Wildlife that feed on fish (e.g., eagles, gulls, alcids, diving ducks, and herons) will benefit from the recovery of lost foraging habitat created through implementation of the Conceptual Fish Habitat Offsetting Strategy. Similarly, the Wetland Habitat Compensation Plan (Appendix F) will provide compensation for wetland habitats removed as a result of terrestrial components of the Project. A key objective of wetland compensation is to recover biological functions provided by wetland habitat in the PDA for wetland dependent species (e.g., migratory birds, amphibians and reptiles, and mammals). Compensation of wetland habitat is expected to mitigate the change in availability of habitat for wetland dependent wildlife on Lelu Island.

Project activities identified in Table 11-7 that could potentially cause a significant adverse effect were ranked as 2. These activities are carried forward in the assessment on terrestrial wildlife and marine birds and are summarized below. A conservative approach is used in applying rankings, whereby interactions with a meaningful degree of uncertainty were assigned a rank of 2 so that that a detailed effects assessment is conducted addressing those potential interactions.

11.5 Effects Assessment

11.5.1 Analytical Methods

11.5.1.1 Analytical Assessment Techniques

Consideration of potential project effects on terrestrial wildlife and marine bird species is important, but because of the high number of species that live within the Prince Rupert region, it is impractical to consider every species individually.

Effects of the Project on terrestrial wildlife and marine birds were assessed using an ecosystem-based approach to quantify the potential effects of change in habitat availability. Ecological community modelling was used to characterize the change in availability of different ecological communities from baseline by quantifying the amount of habitat removed due to construction of the Project. Ecological modelling provides a means for assessing project-related effects on wildlife and marine bird assemblages with shared habitat requirements and ecological traits (i.e., breeding, foraging, migration, and overwintering requirements). These methods are consistent with the approach recommended by Hanson et al. (2009), Coast Information Team (2004), and BC MSRM (2005).

Through the SARA, the Government of Canada manages Endangered, Threatened, and Special Concern species-at-risk to prevent them from becoming extinct and to aid in their recovery. The SARA prohibits the harming or destruction of a species, its residence, or its defined critical habitat (i.e., habitat necessary for the survival or recovery if it is listed as Threatened, Endangered, or Extirpated on Schedule 1). Wildlife habitat suitability was modelled to characterize and quantify the abundance and availability of suitable habitat for species designated as Threatened or Endangered on Schedule 1 of SARA. Species selected for modelling included those that have been previously recorded in the RAA and have habitat requirements that are met by ecological communities present in the LAA (JWA 2008, Stantec 2010, 2011, 2012b, 2013, Bird Studies Canada 2013). Species meeting these criteria included marbled murrelet (SARA Threatened), northern goshawk *laingi* subspecies (SARA Threatened), and olive-sided flycatcher (SARA Threatened). These species use habitats that support distinct roles in ecosystem function that are shared by a broad spectrum of other terrestrial bird, mammal, and amphibian species. Habitat suitability modelling, in combination with ecological community modelling, provides a strong basis for assessing potential effects of the Project on terrestrial wildlife and marine birds overall.

Modelling results were combined with data from baseline field studies, surveys completed for the PRPA, historical data, and literature in order to qualitatively assess effects of change in mortality and alteration of movement on terrestrial wildlife and marine birds.

11.5.1.2 Assumptions and the Conservative Approach

The assessment is based on conditions as they were determined at the time baseline studies were completed. To complete habitat models, the level of disturbance for anthropogenic features under baseline conditions and from project construction were determined from scientific literature (see Table 11-5). Species-specific effects of disturbance were incorporated as information was available. Project build-out models consider the maximum disturbance scenario to conservatively consider the greatest extent of project-related effects on terrestrial wildlife and marine birds and their habitat.

The assessment of project effects on terrestrial wildlife and marine birds is focused on species that are known or are reasonably expected to occur in the LAA and RAA and therefore have the greatest potential for interaction with project-related activities. Species occurrence has been determined through baseline studies, surveys completed for PRPA planning initiatives, a review of regional data, and published species accounts (Stantec 2010, 2011, 2012b, 2013, Bird Studies Canada 2013; Appendix H: Terrestrial Wildlife and Marine Birds TDR). Species with uncertain occurrence records (e.g., species whose range overlaps with the RAA but whose habitat requirements are not well understood, or have low occurrence records) are included in the assessment where there is potential for interaction with the Project.

11.5.2 Change in Wildlife Habitat Availability

11.5.2.1 Potential Effects

Terrestrial Wildlife

To measure effects of the Project on terrestrial wildlife and marine birds within each ecological community, the area of habitat that will be removed directly due to vegetation clearing or construction of the PDA was calculated. At full build-out, 261 ha of habitat will be removed (including 164 ha terrestrial habitat and 97 ha of ocean and estuarine tidal habitat; Table 11-8; Figure 11-11). Loss of these ecological communities will remain for the duration of project operations and likely persist following project decommissioning based on future land use planning initiatives by the PRPA.

Table 11-8: Total Area of each Ecological Community Removed by Vegetation Clearing within the Project Development Area

Ecological Community	Area (ha) of each Ecological Community at Baseline [a]	Ecological Community Removed	
		Ecological Community Removed by PDA (ha)	% Change in Baseline
Anthropogenic	51	0	0
Forest – Old Coniferous	201	44	22
Forest – Seral Coniferous	199	0	0
Forest – Seral Deciduous	40	0	0
Marine – Ocean	1,290	92	7
Wetland – Aquatic	16	1	6
Wetland – Estuarine Marsh	5	0	0
Wetland – Estuarine Meadow	< 1	0	0
Wetland – Estuarine Tidal Flat	540	5	1
Wetland – Shrub Dominated Bog	211	76	36
Wetland – Treed Swamp or Bog	151	43	29
Total	**2,704**	**261**	**–**

NOTE
[a] Area (ha) of each ecological community is the total available at baseline within the habitat modelling limits.

Within the habitat modelling limit boundaries, vegetation clearing for the PDA will have the greatest effect on shrub-dominated bogs (76 ha or 36% of baseline habitat removed), followed by treed swamp or bog (43 ha or 29% of baseline habitat removed), and old coniferous forest (44 ha or 22% of baseline habitat removed) (see Figure 11-11).

Removal of shrub-dominated bogs and aquatic areas in the interior of Lelu Island will have the greatest effect on species associated with wetland habitats. Breeding and foraging opportunities will be removed within the PDA for black-tailed deer, waterfowl, shorebirds, songbirds, pond-dwelling amphibians, and invertebrates. Removal of treed swamp and old coniferous forest will decrease breeding and overwintering opportunities for migratory and resident songbirds that nest in coniferous forests. Foraging, resting, and denning refuges for small mammals and mustelid species will also be reduced as patches of old forest and woody debris are cleared (Powell et al. 2003). Removal of dead or decaying trees will limit breeding, foraging, and roosting opportunities for cavity nesters such as (e.g., owls, woodpeckers, and chickadees), insectivorous birds, and bats. Clearing of treed swamp and old coniferous forest patches will also create openings in the forest along the boundary of the PDA. Breeding success will decrease for birds that nest within interior forest patches as they are more susceptible to predation by ravens, crows, and jays (Robinson et al. 1995, Burger 2002, Malt and Lank 2007).

The area of ocean and estuarine tidal flat habitats removed for construction of the marine terminal, MOF, and bridge represent a small proportion of these habitats within the modelling limits (7% of ocean and 1% of estuarine tidal flat; Table 11-8). Clearing of marine habitats will have the greatest effect on birds that forage along mudflats (e.g., herons, geese, dabbling ducks, shorebirds) and in shallow, nearshore waters (e.g., diving ducks, alcids, gulls, and bald eagles).

Ecological communities that are either small in size, or are generally located outside the PDA (e.g., estuarine meadow, estuarine marsh, and seral coniferous and deciduous forests; Figure 11-11) will experience the smallest effect in change of available habitat due to clearing for the Project.

Availability of terrestrial habitat for species designated as Threatened or Endangered on Schedule 1 of SARA will also be reduced by 164 ha during clearing for the PDA. Marbled murrelet and northern goshawk both require mature to old forest stands for reproduction, while olive-sided flycatcher breed in mature to old growth coniferous forests and treed swamps. The amount of preferred (i.e., moderate and highly suitable) habitat removed due to clearing of the PDA is summarized in Table 11-9.

Table 11-9: Total Habitat and Preferred Habitat Removed by Vegetation Clearing within the Project Development Area

Species	Season and Life Requisite	Total Terrestrial Habitat Removed by PDA (ha)	Preferred Habitat Removed[1]	
			Area (ha)	% of Habitat Modelling Limit
Marbled Murrelet	Spring – breeding	164	85	3
Northern Goshawk *laingi* subspecies	Spring – breeding	164	54	2
Olive-sided Flycatcher	Spring – breeding	164	104	4

NOTE:
[1] The amount of baseline habitat (ha) for each habitat suitability rating class is provided for each species in Table 11-6.

Construction and operation of the Project will also alter the suitability of habitat adjacent to the PDA for wildlife that exhibit avoidance behaviour in proximity to anthropogenic features. These features can reduce habitat function, present a barrier to migration, or increase mortality through predation, vehicle collisions, or human conflicts (Bayne et al. 2008; Laurian, et al. 2008; Herrero et al. 2005; Archibald et al. 1987).

Wildlife will also avoid noisy areas, although the response varies by species (Habib et al. 2007; Bayne et al. 2008; Schaub et al. 2008). Songbirds, for example, avoid breeding in noisy habitats because their ability to communicate by song to attract a mate is limited (Habib et al. 2007). Results of the acoustic assessment (see Section 8) indicate sound levels (i.e., the Project and ambient sounds) will be lower during operation of the Project than during construction. After mitigation measures are applied, noise will average 65 dBA (units of sound levels in A-weighted decibels) at the PDA boundary, and 30-35 dBA at a distance of 2 km from the Project (see Section 8). A review of scientific literature suggests that operational noise levels at or below 30 dBA, or beyond 2 km from the point source of noise, will not influence wildlife species presence and habitat use (e.g., Bayne et al. 2008; Habib et al. 2007).

The habitat suitability models predict habitat alteration by downgrading habitat suitability through applying a disturbance coefficient within ZOIs for each disturbance feature (see Section 11.3.2.1 for a full description) and are summarized for marbled murrelet, northern goshawk, and olive-sided flycatcher in Table 11-5. The extent of habitat alteration due to disturbance from the Project, including the amount of preferred habitat that is affected, is summarized for each species in Table 11-10.

Table 11-10: Total Habitat and Preferred Habitat Alteration by Disturbance from the Project in the Local Assessment Area

Species	Season and Life Requisite	Terrestrial Habitat Altered from Disturbance (ha)	Preferred Habitat Altered from Disturbance	
			ha	% Habitat Modelling Limit
Marbled Murrelet	Spring – reproduction	6	6	< 1%
Northern Goshawk *laingi* subspecies	Spring – reproduction	163	31	3
Olive-sided Flycatcher	Spring – reproduction	162	29	3

NOTE:
The ZOI from the Project differs for each species and is provided in Table 11-5.

This summary shows that the Project will reduce habitat for each species; this effect is greatest for northern goshawk and olive-sided flycatcher, where preferred breeding habitat is located within the PDA.

Marine Birds

Construction of the marine terminal, MOF, and the bridge will result in the direct loss of 92 ha of ocean and 5 ha of estuarine tidal flat habitat due to project infrastructure (Table 11-8; Figure 11-11). During construction; blasting, dredging, drilling, and sediment disposal-at-sea activities will occur in marine portions of the PDA. Activities required to support underwater infrastructure (e.g., marine

trestle pilings) can affect marine invertebrates and fish directly through loss of individuals and habitat, while activities that cause a change in habitat created during blasting, dredging, and construction (i.e., a change in physical, chemical, or acoustic conditions) can indirectly affect marine invertebrates and fish. This will result in a reduction in foraging opportunities during construction and operations for marine bird species that feed in intertidal and subtidal habitats, including bald eagle, diving ducks, dabbling ducks, wading birds, shorebirds, and gulls. Results of baseline studies indicate this effect will be greater along tidal flats in Lelu Slough, where seasonally high densities or large concentrations of waterfowl and shorebirds have been recorded (Appendix H: Terrestrial Wildlife and Marine Birds TDR).

Fish habitat removed during project construction will be recovered through implementation of the Conceptual Fish Habitat Offsetting Strategy. Marine bird species will benefit from the Strategy through the recovery of foraging habitat and increased availability of prey species over time. Moreover, the marine terminal and bridge will create intertidal and subtidal habitat (see Section 13). During early operations, marine invertebrates and fish are expected to re-establish in these areas of the PDA and restore previous foraging opportunities to marine bird species. The marine terminal will also provide perching and loafing opportunities for marine bird species that spend a portion of time on land (e.g., bald eagles, cormorants, gulls, and great blue heron). Pigeon guillemot, bald eagle, and pelagic cormorant have been regularly detected on marine infrastructure during marine bird surveys on Ridley and Kaien islands.

As with terrestrial wildlife, sensory disturbances during construction and operation of the Project can alter the suitability of marine habitats adjacent to the marine terminal, the MOF, bridge, vessel berthing areas, and shipping lanes. The frequency, intensity, and duration of acoustic emissions (in-air and underwater) might influence marine bird foraging patterns, predator avoidance, communication, or result in displacement from suitable habitats (Chan and Blumstein 2011, Velando and Munilla 2011, Bellefleur et al. 2009, Ronconi and St. Clair, 2002, EC 2014). The production and propagation of under-water noise is influenced by the size, speed, and design of construction equipment or transportation vessels as well as oceanographic conditions (e.g., topography, depth, temperature, salinity, and surface conditions; Ronconi and St. Clair 2002). Under baseline conditions, marine birds are exposed to sensory disturbance through commercial and recreational vessel traffic within the RAA along existing shipping corridors, and locally, through Porpoise Channel and Lelu Slough as boats access Port Edward. The increase in marine activity during project construction, operations, and decommissioning phases will increase exposure to physical or sensory disturbance of marine birds within the LAA.

11.5.2.2 Mitigation

To reduce the change in habitat availability for terrestrial wildlife and marine birds, the following mitigation measures will be employed:

- Boundaries of the PDA will be clearly marked and clearing, grading or dredging, construction, and temporary storage of materials of terrestrial and marine habitat will be limited to within the PDA boundaries.
- If temporary workspace or storage areas are required beyond the extent of the PDA, they will be located in existing cleared areas to the extent possible.
- A 30 m vegetation buffer will be retained around the perimeter of Lelu Island, except at access points (e.g., at the bridge, pioneer dock, MOF, trestle, and pipeline interconnection).

- Wetland habitat compensation will include restoration and compensatory activities to recover the loss of wetland habitat function to terrestrial mammals, amphibians, and birds.
- Fish habitat offsetting will include restoration and compensatory activities to recover the net loss of marine fish habitat used for foraging by marine birds.
- LNG carriers, tugs, and barges will not exceed a speed of 16 knots within the LAA.
- Mitigations for the acoustic environment will reduce noise disturbance to adjacent terrestrial and marine habitats.
- A Blasting Management Plan will be implemented.

11.5.2.3 Characterization of Residual Effects

Terrestrial Wildlife

The residual effects of the Project on terrestrial wildlife habitat (predicted based on results of ecological community modelling and habitat suitability models) indicate there is a low probability that the change in availability of preferred habitat will affect the sustainability of regional wildlife populations.

Change in the availability of terrestrial ecological communities is negligible to moderate and restricted to the terrestrial portion of the PDA (164 ha) (Table 11-8). Vegetation clearing for the PDA will have the greatest effect on shrub-dominated bogs, treed swamp or bog, and old coniferous forest. The greatest effect will be on wildlife species that use these habitats for foraging, breeding, staging during migration, and/or overwintering. Baseline survey results indicate black-tailed deer, northwestern salamander, songbirds, and shorebirds were commonly observed in these habitat types (Appendix H: Terrestrial Wildlife and Marine Birds TDR). The Project will not result in the loss or alteration of critical habitat for species listed as Threatened or Endangered on Schedule 1 of SARA. Change in preferred habitat availability is moderate in magnitude and will result in the loss or alteration of 91 ha of preferred habitat for marbled murrelet (Table 11-9 and Table 11-10; Figure 11-12), 85 ha of preferred habitat for northern goshawk (Figure 11-13), and 133 ha of preferred habitat for olive-sided flycatcher (Figure 11-14).

Direct habitat removal will occur once during vegetation clearing and will persist unless the PDA is reclaimed following decommissioning of the Project. BMPs to avoid destruction or disturbance of active nests during the breeding period (i.e., BC MOE 2012, 2013) will be applied to comply with SARA and the *Wildlife Act*, where applicable. The Wetland Habitat Compensation Plan will be implemented during project operations and offset the net loss of wetland habitat removed during clearing.

Noise during construction and operation will cause additional disturbance of terrestrial habitats and extend locally to the LAA. Disturbance will be long-term and occur continuously through the life of the Project. Noise production will be lower during project operations than during construction but will still be concentrated around the PDA. Effects of sensory disturbance are expected to decrease along peripheral edges of the LAA, where noise returns to ambient levels and becomes predictable, allowing wildlife to habituate to project activities (Stankowich 2008, Herrero et al. 2005, Klopper et al. 2005, Archibald et al. 1987). Habitat alteration from sensory disturbances is considered reversible following decommissioning of the Project.

Habitat loss and alteration will occur in an area that is subject to existing land-based anthropogenic disturbance due to the proximity and frequency of Port Edward and Prince Rupert, Skeena Drive, the CN railway, and industrial activity on Kaien and Ridley islands (Erbe et al. 2012). Terrestrial wildlife inhabiting these areas have secure populations and access to other suitable habitat in the LAA and RAA. Consequently, populations are expected to demonstrate moderate or high resilience to changes in habitat availability caused by the Project.

Marine Birds

Results of the ecological community modelling indicate the change in marine habitats (i.e., ocean and estuarine tidal flats; Table 11-8) will be low in magnitude and occur locally, within the LAA. Removal of marine habitat will occur once to construct the marine terminal, MOF, and bridge and will last for the lifetime of the Project. The Conceptual Fish Habitat Offsetting Strategy (Appendix K) will offset the net loss of marine communities, and subsequent marine bird foraging habitat, removed during construction. Marine invertebrates and fish are also expected to occupy intertidal and subtidal habitats created by project infrastructure.

Loss or alteration of marine bird habitat occurs in an area that is subject to existing commercial and recreation marine activities (Erbe et al. 2012). The Project will contribute to an increase in vessel traffic that will be highest in the LAA and RAA during the construction phase as personnel and materials are transported to Lelu Island from Prince Rupert and Port Edward. During operations, vessel transits will be limited to shipping vessels and escort tugs calling at the marine terminal. Approximately 550 vessels per year currently call on the Port of Prince Rupert. The Project will increase vessel transportation in the RAA by 350 carriers per year.

An increase in vessel traffic is expected to result in multiple, regular displacement of marine birds within the LAA. Displacement will vary by species, age, or seasonal sensitivities to vessel traffic (Schwemmer et al. 2011). Limited research has been conducted on changes in habitat use by marine birds from acute and chronic noise. Lacroix et al. (2003) detected no significant change in diving patterns of molting long-tailed ducks resulting from underwater seismic exploration in the Beaufort Sea, Alaska. Melvin et al. (1999) found a 50% reduction in common murre bycatch in gillnets outfitted with acoustic devices emitting a 1.5 kHz signal at 120 dB re 1 µPa, although there was no significant decline in rhinoceros auklet bycatch. In-air acoustic emissions are estimated to be 20-25 dBA within 500 m from the primary and alternate shipping lanes (Section 8). Available literature suggests that the duration of this effect will be short-term and reversible as species that use habitats in the LAA consistently may habituate to project activities (Schwemmer et al. 2011, Bellefleur et al. 2009, Ronconi and St. Clair 2002).

Most regional marine bird species have secure populations and access to other suitable habitats within the LAA and RAA. As such, regional populations are expected to demonstrate a moderate or high degree of resilience to changes in marine habitat availability caused by the Project.

11.5.2.4 Likelihood

The likelihood of a residual effect occurring is high. If approved, vegetation clearing and construction project components will change habitat for terrestrial wildlife and marine birds.

11.5.2.5 Determination of Significance of Residual Effects

The mitigation measures proposed to reduce effects from change in habitat availability adhere to BMPs to limit destruction and disturbance of terrestrial wildlife and marine bird habitat. With mitigation measures applied (including wetland compensation and fish habitat offsetting), residual effects from the change in habitat availability will not affect the sustainability of regional terrestrial wildlife and marine bird populations. Consequently, change in habitat availability from the Project is predicted to be not significant.

11.5.2.6 Confidence and Risk

The confidence in this prediction is moderate to high based on the effectiveness of mitigation, and the quality and quantity of baseline data used to support the assessment.

Since the confidence in this prediction is not low, no additional risk analysis has been conducted.

11.5.3 Change in Mortality Risk

11.5.3.1 Potential Effects

Terrestrial Wildlife

The Project is most likely to result in direct mortality to terrestrial wildlife during vegetation clearing in the PDA. Mortality caused by vehicle collisions and human-wildlife interactions have been previously assessed and will be managed to acceptable levels through standard procedures and practices described in Section 11.4.

Mortality of large and medium sized mammals (e.g., bears, wolves, coyotes, and mustelids) and adult birds is unlikely because these species are highly mobile and therefore able to disperse from the PDA during vegetation clearing. Direct mortality from clearing activities would be highest for wildlife with a limited means of dispersal or those that exhibit strong site fidelity or specialized habitat requirements. These include small mammals, amphibians, and species that occupy nests, dens, or burrows during breeding periods.

The *Migratory Birds Regulations* of the MBCA (Section 6) and the *Wildlife Act* (Section 34) prohibit the destruction of birds, their nests or eggs. Vegetation clearing during construction presents the greatest risk of mortality to birds. Destruction of active nests could result in direct mortality of young. Adult birds will temporarily or permanently abandon nests that are exposed to disturbances either close in proximity or long in duration (Carney and Sydeman 1999). Indirect mortality can result if adult birds fail to incubate eggs, feed young, or expose the nest to predation during prolonged absences (Malt and Lank 2009). Construction of the Project can also cause indirect mortality through the creation of edge habitats along the perimeter of the PDA. Forest edges that are created during construction will increase access to interior forest areas by potential predators (e.g., ravens, crows, squirrels, and coyotes) and parasitism species (e.g., cowbirds). Increased edge habitat can result in reduced nest success in these areas (Paton 1994, Malt and Lank 2009, EC 2014).

Small mammals typically construct natal dens in logs, rocky outcrops, or underground. Mouse, vole, and shrew species with potential to occur in the PDA are at greatest risk of mortality if clearing and construction occurs during spring and summer months, when these species are occupying dens.

The onset of breeding for amphibians potentially inhabiting Lelu Island begins in late winter or early spring and continues until mid to late summer, when juveniles emerge from breeding ponds (Corkran and Thoms 2006). Amphibians are at greatest risk of direct mortality if wetland habitat is drained or filled during construction activities that overlap with the breeding period for amphibians.

Marine Birds

Nests and offspring of marine bird species are also protected under the *Migratory Birds Regulations* of the MBCA (Section 6) and the *Wildlife Act* (Section 34). As with terrestrial bird species, vegetation clearing can result in direct and indirect mortality of nesting marine birds using terrestrial habitats to breed in the LAA.

Birds, particularly marine species, are also highly susceptible to mortality events caused by sources of artificial lighting at the LNG facility (including the pilot flare), marine terminal, and berthed or anchored vessels. Many marine bird species forage nocturnally as a means to avoid diurnal predators or to optimize foraging on vertically migrating or bioluminescent prey (Rich and Longcore 2006). Many marine bird species are also nocturnal migrants, suspected of orienting migration routes on star patterns. Artificial lighting interrupts natural behavioural patterns of birds by replicating environmental sources of nocturnal light (Rich and Longcore 2006).

Birds are attracted to artificial lighting and can suffer mortality through direct collision with lighting structures. They may also deplete energy reserves by circling lit structures, eventually grounding themselves from exhaustion or injury and becoming vulnerable to predation (Longcore et al. 2013, BirdLife International 2012). Attraction to and mortality from illuminated structures is amplified during precipitation or fog when birds are more likely to adjust flight patterns (e.g., reduce flight altitude, fly along coastlines) and because suspended moisture refracts more light (Longcore et al. 2013, Black 2005, Merkel and Johansen 2011). Literature suggests this effect might be greatest during seasonal migration or amongst juveniles and species that optimize foraging efficiency in illuminated waters (Rich and Longcore 2006). Threatened or Endangered species with small population sizes are especially vulnerable to increased mortality (Longcore et al. 2013, Le Corre et al. 2002). The recent event of 7,500 bird mortalities recorded at the Canaport facility in New Brunswick provides an example of the potential extent effects from lighting may have. Researchers, cited in an interview by Canadian Broadcasting Corporation (2013), indicated that design of the flare tower may have contributed to birds adjusting flight patterns to become oriented towards the light at the flare tower. Conditions at the project site, such as the 30 m riparian buffer around the PDA, are expected to vary from those at the Canaport facility and will decrease the potential for a similar mortality event to occur (see Section 11.5.3.2 below).

11.5.3.3 Mitigation

To reduce mortality for terrestrial wildlife and marine birds, the following mitigation measures will be employed:

- A 30 m vegetation buffer will be retained around the perimeter of Lelu Island, except at access points (e.g., at the bridge, pioneer dock, MOF, trestle, and pipeline interconnection).
- Boundaries of the PDA will be clearly marked and clearing, grading or dredging, construction, and temporary storage of materials of terrestrial and marine habitat will be limited to within the PDA boundaries.
- Guidelines for restricted activity periods to protect wildlife and marine birds will be followed. Clearing activities will occur outside of the breeding season for terrestrial birds, amphibians, and bats (April 15 through July 31), and will avoid the breeding period for raptors (January 5 through September 6).
- If clearing is required during these breeding periods, bird surveys will be conducted in advance of vegetation clearing by a BC-certified Registered Professional Biologist to comply with the Migratory Birds Regulations of the *Migratory Birds Convention Act* and the BC *Wildlife Act*. Buffers will be established around active nests and clearly marked to show the extent of clearing (BC MOE 2013).
- If raptor nests are identified within the clearing limits of the PDA and require removal, this would be subject to permit approval under Section 34 of the BC *Wildlife Act*, where the Act applies.
- Permanent fencing will be erected around the Project.
- Feeding and harassment of wildlife will be prohibited.
- Wildlife education and awareness training will be provided.
- Traffic between Prince Rupert, Port Edward, and the project site will be reduced through the use of buses, crew cab trucks, water taxis, and other group transportation options when practical. This will primarily apply to travel required for shift changes.
- Operators of project-related ground and marine transportation will adhere to posted speed limits.
- A Project Waste Management Plan will be implemented and ensure that wastes and recycling materials will be temporarily stored on site in wildlife-proof containers and regularly transferred to an approved disposal or sorting facility.
- To mitigate potential light-induced mortality, lighting mitigations will follow objectives contained within the Canada Green Building Council LEED guidelines and the International Commission on Illumination (LEED 2004; CIE 2003; Section 9). The use of exterior lighting (including portable lighting structures) at the LNG facility, the MOF, marine terminal, trestle, berth, and on berthed vessels will be limited where practical and permissible under federal safety and navigation regulations.
- A Blasting Management Plan will be implemented.

11.5.3.4 Characterization of Residual Effects

Terrestrial Wildlife

Mortality for terrestrial wildlife will be substantially reduced by adhering to applicable legislation (e.g., the MBCA) and regulations and through the implementation of mitigation activities. Mortality of birds, amphibians, and small mammals will be low in magnitude (i.e., limited to a small number of individuals) since vegetation clearing will be completed outside of breeding periods when wildlife are more likely to be occupying nests, dens, or breeding ponds. Mortality from clearing will be a single event occurring during initial clearing within the PDA. Effects of mortality will be short-term (i.e., vegetation clearing will occur over a period of a few months); and while mortality is permanent, natural recruitment (i.e., individuals recovered through reproduction and migration) is expected to potentially offset the loss of a few individuals within a regional population.

Reducing mortality for species of management concern is especially important. Clearing outside of restricted activity periods or applying no-disturbance buffers to active breeding sites within restricted activity periods will effectively reduce mortality of federally listed species with potential to breed in the PDA (e.g., western screech-owl *kennicottii* subspecies, marbled murrelet, and olive-sided flycatcher). Mortality of grizzly bear and wolverine *luscus* subspecies caused by vehicle collisions and human-wildlife interactions is expected to be negligible because these species are unlikely to occur in the LAA; however potential for mortality will be managed to acceptable levels through standard procedures and practices described in Section 11.4 and 11.5.3.2.

Marine Birds

Potential for marine bird mortality will be low to moderate in magnitude when facility structures are regularly lit during operations. Mortality events are expected to occur irregularly and might increase under certain weather conditions (i.e., fog or precipitation) or during seasonal migratory periods when increased numbers of marine birds pass through the LAA. For secure populations (i.e., those designated Not-at-Risk under SARA or on the BC Yellow List), natural recruitment is expected to offset the loss of a few individuals within a regional population. Effects of artificial lighting would occur for the lifetime of the Project but are reversible following project decommissioning.

Mortality of marine bird species of management concern might have medium or long-term effects on regional populations if light-induced mortality exceeds the rate at which natural recruitment could replace individuals within a species (Longcore et al. 2013; Le Corre et al. 2002). Collision rates are reportedly higher for juvenile birds and could result a delayed onset of population-level effects as fewer individuals reach breeding maturity (Rich and Longcore 2006). Literature suggests species within taxonomic orders of *Procellariiformes* (petrels, storm-petrels, and shearwaters), *Charadriiformes* (auks, murres, and puffins) are more susceptible to light-induced mortality (BirdLife International 2012; Rich and Longcore 2006; Black 2005). Historical data and baseline survey information indicate these species are uncommon along nearshore coastal habitats within the LAA and are unlikely to interact with sources of artificial light in the PDA. Accordingly, marine birds will have a moderate to high degree of resilience to potential effects of mortality; effects are reversible following decommissioning of the Project. Implementation of lighting mitigation is expected to substantially reduce temporal and spatial effects of lighting.

11.5.3.5 Likelihood

The likelihood of a residual effect occurring is moderate. There is potential for mortality of birds and small mammals during project construction and operation.

11.5.3.6 Determination of Significance of Residual Effects

With mitigation measures applied, residual effects from the change in mortality risk will not affect the sustainability of regional terrestrial wildlife and marine bird populations and is predicted to be not significant.

11.5.3.7 Confidence and Risk

Given the effectiveness of proposed mitigation and the quality of data available, the confidence in the prediction for the determination of significance for change in mortality risk for terrestrial wildlife is high. Lighting mitigation will reduce potential effects from artificial lighting on marine birds. There is limited research to document the extent of light-induced mortality on the north coast of BC and the effectiveness of lighting mitigation. Consequently, the confidence in the significance prediction for marine birds is moderate.

Since the confidence in this prediction is not low, no additional risk analysis has been conducted.

11.5.4 Alteration of Movement

11.5.4.1 Potential Effects

Terrestrial Wildlife

Effects of alteration of movement will be restricted to terrestrial wildlife inhabiting the LAA. Project construction activities, such as tree felling, can impede movement by blocking potential corridors with organic debris or equipment. Similarly, terrestrial components of project infrastructure can alter wildlife movement in the PDA by imposing physical barriers along movement corridors used to access important resources (e.g., breeding and foraging habitat). The PDA will overlap with black-tailed deer migration corridors recorded on Lelu Island during baseline studies (Appendix H: Terrestrial Wildlife and Marine Birds TDR). Small groups or individual deer are expected to adjust movement patterns to navigate around the LNG facility or avoid Lelu Island completely. Wildlife will expend additional energy to adjust their movement patterns around the PDA and consequently decrease the amount of time spent feeding in preferred habitats. Species with more restricted ranges (e.g., medium and small mammals and amphibians) will be less able to navigate away from features causing disturbance.

Species that migrate between Lelu Island and the mainland (e.g., black-tailed deer, river otter, grey wolf, bald eagle, barred owl) are less likely to rely exclusively on habitat on Lelu Island and movement patterns will be affected to a lower degree. The PDA is not located within regional migration corridors for grizzly bear and wolverine (BC CDC 2013, BC MSRM 2005, PRPA 2002). As construction activities on the mainland are limited to the access road, the Project will have a negligible effect on movement patterns of other terrestrial species occupying habitats on the mainland portion of the RAA.

Noise created by vegetation clearing, construction, and operation activities can result in avoidance behaviour. Although the response varies by species, wildlife tends to avoid noisy areas (Habib et al. 2007, Bayne et al. 2008, Schaub et al. 2008). This effect has been taken into account in assessing the change in habitat availability (see Section 11.5.2), and specifically within the habitat suitability models developed for species designated as Endangered and Threatened on Schedule 1 of SARA. Wildlife can habituate to predictable exposure to sensory disturbances over time and will reduce the extent to which they exhibit avoidance behaviour (Stankowich 2008, Herrero et al. 2005, Klopper et al. 2005, Archibald, et al. 1987).

Marine Birds

Marine components of the PDA (i.e., the marine terminal, MOF, and bridge) and marine shipping have potential to alter seasonal migration and local dispersal patterns of marine birds. Project infrastructure will impose physical or perceived barriers to important habitats if marine birds exhibit avoidance behaviour. This effect can be further complicated if birds are excluded from portions of the LAA or RAA that support locally or seasonally important foraging (e.g., eelgrass beds, salmon spawning areas) or habitat (e.g., staging) resources. Construction, operation, and decommissioning of the Project are also expected to result in in-air and underwater acoustic emissions that can influence marine bird use of the LAA and is described in Section 11.5.2.

Under baseline conditions, marine bird movements are expected to be influenced by existing infrastructure like the marina in Port Edward and the shipping terminals on Ridley and Kaien islands. Commercial and recreational vessel traffic within the RAA is expected to create localized displacement of marine birds along shipping routes. The increase in vessel traffic during project construction and operations will cause additional displacement within the LAA.

The energetic costs associated with marine birds avoiding project infrastructure and transiting vessels can also negatively affect marine bird fitness (EC 2014, Velando and Munilla 2011, Bellefleur et al. 2009, Kaiser et al. 2006, Ronconi and St. Clair, 2002). Although the degree of sensitivity varies by species, multiple studies have found that marine bird flushing behaviour in response to boat traffic decreases the time and efficiency of foraging (Schwemmer et al. 2011, Bellefleur et al. 2009, Speckman et al. 2004). The increased energetic cost and decreased foraging effort associated with flushing behaviour can, in turn, result in decreased survival rates of juvenile birds (Bellefleur et al. 2009, Speckman et al. 2004).

11.5.4.2 Mitigation

To limit alteration of movement for terrestrial wildlife and marine birds, the following mitigation measures will be employed:

- Boundaries of the PDA will be clearly marked and clearing, grading or dredging, construction, and temporary storage of materials of terrestrial and marine habitat will be limited to within the PDA boundaries.
- LNG carriers, tugs, and barges will not exceed a speed of 16 knots within the LAA.
- Mitigation for the acoustic environment will reduce noise disturbance to adjacent terrestrial and marine habitats.
- Equipment will be properly maintained.

11.5.4.3 Characterization of Residual Effects

Terrestrial Wildlife

Project-related effects on wildlife movement from site preparation and construction of the LNG facility, operation of construction equipment, and installation of bridge and access road, will be low to moderate in magnitude and short in duration. Changes to movement patterns will generally affect species whose range is restricted to the LAA. Larger ranging species in the RAA, including those capable of moving back and forth between Lelu Island and the mainland, will experience negligible effects. The effects on movement will occur continuously throughout construction and operation phases of the Project, but are reversible following reclamation. Terrestrial wildlife are currently exposed to a low to moderate degree of disturbance and displacement from existing projects and activities; species are expected to exhibit a moderate degree of resilience to the incremental contribution created by the Project.

Marine Birds

Project-related effects on marine bird movement from the marine terminal, MOF, and bridge are expected to be negligible. Project infrastructure is unlikely to limit access to key foraging and staging habitats (e.g., Lelu Slough and Flora Bank). The bridge and trestle will reduce vessel density and speed within these areas, effectively decreasing the level of disturbance imposed by current marine activities.

Alteration of marine bird movement will be restricted to the LAA and will be a multiple-regularly occurring event as individuals adjust daily or seasonal movement patterns in response to marine infrastructure and transiting vessels. There will be a low degree of marine bird displacement along vessel transit routes between Prince Rupert or Port Edward and Lelu Island and along the shipping route during operations. Consistent with guidance from Environment Canada (2013b), the proposed routes for the primary and alternate shipping lanes will be located greater than 500 m from marine bird colonies and transiting vessels will travel at steady speeds parallel to colonies. Displacement of marine birds along the shipping route will be further moderated by implementing a vessel speed of 5 knots in Porpoise Channel and Harbour which will further decrease as vessels approach the berth. Consequently, disturbance from infrastructure and transiting vessels will be short-term. Although the degree of sensitivity varies by species, marine birds are generally expected to recover quickly as the distance from the disturbance increases (Schwemmer et al. 2011).The extent of disturbance may decrease or reverse over time as individuals habituate to the regular presence of infrastructure and vessels (Kaiser et al. 2006). Declines in the sustainability of marine bird populations have not been directly associated with effects from alteration of movement. In the RAA, marine birds are exposed to disturbance and displacement from existing projects and activities. There is reasonable expectation that marine birds will exhibit a moderate degree of resilience to the incremental contribution created by the Project.

11.5.4.4 Likelihood

The likelihood of a residual effect occurring is high. Construction and operation of the project components will cause terrestrial wildlife and marine birds to alter their movement patterns to avoid the infrastructure.

11.5.4.5 Determination of Significance of Residual Effects

With the implementation of mitigation measures, the residual effect of the Project on terrestrial wildlife and marine bird movement is expected to be not significant.

11.5.4.6 Confidence and Risk

Based on the quality of available literature and professional opinion, the confidence in this prediction is high. Since the confidence in this prediction is not low, no additional risk analysis has been conducted.

11.5.5 Summary of Residual Effects

Table 11-11, summarizes the effects of change in habitat availability, change in mortality, and alteration of movement on terrestrial wildlife and marine birds. Overall, the individual project effects will be local and affect only a small proportion of regional wildlife populations (estimated to be a few individuals).

Table 11-11: Summary of Residual Effects for Terrestrial Wildlife and Marine Bird Species

Project Phase	Mitigation Measures	Residual Effects Characterization						Likelihood	Significance	Confidence	Follow-up and Monitoring
		Context	Magnitude	Extent	Duration	Reversibility	Frequency				
Change in Wildlife Habitat Availability											
Construction	▪ Maintain a 30 m vegetation buffer. ▪ Limit clearing limits of the PDA and temporary work space. ▪ Apply mitigation measures for acoustic environment. ▪ Implement Wetland Habitat Compensation Plan and Fish Habitat Offsetting Plan. ▪ Vessels will not exceed a speed of 16 knots within the LAA. ▪ Implement a Blasting Management Plan.	M	M	LAA	LT	R	S	H	N	M	None
Operation		M	M	LAA	LT	R	C				
Decommissioning		M	M	LAA	LT	R	C				
Residual effects for all phases		M	M	LAA	LT	R	S				

Project Phase	Mitigation Measures	Residual Effects Characterization						Likelihood	Significance	Confidence	Follow-up and Monitoring
		Context	Magnitude	Extent	Duration	Reversibility	Frequency				
Change in Mortality Risk											
Construction	▪ Maintain 30 m vegetation buffer. ▪ Limit clearing to the PDA and temporary work space. ▪ Clearing activities will occur outside of the breeding season for terrestrial birds, amphibians, and bats. If clearing is required during these breeding periods, bird surveys will be conducted in advance. ▪ Removal of raptor nests within the clearing limits of the PDA will be subject to permit approval. ▪ Erect permanent fencing around the Project. ▪ Store waste and recycling materials on-site in wildlife-proof containers for permanent disposal at an approved facility. ▪ Prohibit feeding and harassment of wildlife. ▪ Provide wildlife education and awareness training. ▪ Reduce traffic between Prince Rupert, Port Edward, and the project site through the use of buses, crew cab trucks, water taxis, and other group transportation options when practical. ▪ Adhere to posted speed limits on road and vessel transportation routes. ▪ Apply lighting mitigations. ▪ Implement Management Plans (e.g., Blasting Management Plan).	M	M	LAA	ST	R	S	M	N	M	Monitoring effects of acidification or eutrophication of freshwater systems on amphibians, if there is potential acidification or eutrophication
Operation		M	M	LAA	LT	R	MI				
Decommissioning		M	L	LAA	ST	R	MI				
Residual effects for all phases		M	M	LAA	LT	R	MI				

Project Phase	Mitigation Measures	Residual Effects Characterization						Likelihood	Significance	Confidence	Follow-up and Monitoring
		Context	Magnitude	Extent	Duration	Reversibility	Frequency				
Alteration of Movement											
Construction	▪ Limit clearing limits of the PDA and temporary work space. ▪ Vessels will not exceed a speed of 16 knots within the LAA. ▪ Apply mitigation measures for acoustic environment. ▪ Equipment will be properly maintained. ▪ Implement Management Plans (e.g., Blasting Management Plan).	M	L	LAA	ST	R	MI	H	N	H	None
Operation		M	L	LAA	ST	R	MR				
Decommissioning		M	L	LAA	ST	R	MI				
Residual effects for all phases		M	L	LAA	ST	R	MI/MR				

Project Phase	Mitigation Measures	Residual Effects Characterization						Likelihood	Significance	Confidence	Follow-up and Monitoring
		Context	Magnitude	Extent	Duration	Reversibility	Frequency				
KEY **CONTEXT:** **L** = Low resilience: occurs in a fragile ecosystem and/or highly disturbed environment **M** = Moderate resilience: occurs in a stable ecosystem and/or moderately disturbed environment **H**= High resilience: occurs in viable ecosystem and/or undisturbed environment	**MAGNITUDE:** **N** = Negligible: no detectable change on individuals of a regional wildlife population or hectares of habitat **L** = Low: change detectable on a few individuals or hectares of habitat (i.e., < 10 ha) in a regional population **M** = detectable change on many individuals or hectares of habitat (i.e., 10 to 250 ha) in a regional population **H** = High: detectable change on the majority of individuals or hectares of habitat (> 250 ha) in a the regional population **EXTENT:** **PDA** = project development area **LAA** = local assessment area **RAA** = regional assessment area	**DURATION:** **ST =** Short-term: effect less than one breeding season/generation **MT =** Medium-term: effect occurs for several breeding seasons/generations or a project phase **LT =** Effect occurs across multiple breeding seasons/generations or project phases **P =** Permanent: Effect permanent and unlikely to recover following project decommissioning and reclamation **REVERSIBILITY:** **R** = Reversible: will recover during lifetime of the Project or after project decommissioning and reclamation **I** = Irreversible: effects will persist after project decommissioning and reclamation **FREQUENCY:** **S** = Single event **MI** = Multiple, irregular event **MR** = Multiple, regular event **C** = Continuous							**LIKELIHOOD:** *Based on professional judgment.* **L** = Low probability of occurrence **M** = Medium probability of occurrence **H** = High probability of occurrence **SIGNIFICANCE:** **S** = Significant **N** = Not significant **CONFIDENCE:** *Based on scientific information and statistical analysis, professional judgment and effectiveness of mitigation, and assumptions made.* **L** = Low level of confidence **M** = Moderate level of confidence **H** = High level of confidence			

11.6 Cumulative Effects

11.6.1 Context for Cumulative Effects

A detailed description of terrestrial wildlife and marine birds within the RAA is included in Section 11.3.

Past and present projects and activities have affected terrestrial wildlife and marine bird resources in the RAA due to vegetation clearing and disturbance associated with industrial, commercial, and recreational activities. Project effects have the potential to act cumulatively with those from past, present, and reasonably foreseeable future projects and activities to have a cumulatively adverse effect on terrestrial wildlife and marine birds.

A GIS analysis of spatial data was used to predict the potential cumulative effects of development on terrestrial wildlife and marine bird resources within the RAA. The footprint of existing development features was measured by combining provincial TEM datasets for the Kaien Landscape Unit (1:20,000 scale) with Terrestrial Resource Information data (1:20,000 scale) and spatial data from Natural Resources Canada and Government of BC datasets (BC MFLNRO 2013b, NRCan 2013). Past, present, and reasonably foreseeable future projects and activities considered in combination with predicted project-related effects in this cumulative effects assessment are provided in Section 11.6. Reasonably foreseeable future projects and activities include those that have been publicly announced and where detailed project information was publicly available (AECOM 2013, TransCanada 2013, City of Prince Rupert 2012, Golder Associates 2012, Ecosystems Consulting 2009, PGEC 2007).

The total area of disturbance is provided by ecological community within the RAA for past, present, and reasonably foreseeable future development in Table 11-12. Existing development features occupy 1,944 ha within the RAA (1% of the RAA). An additional 478 ha of development is planned in the reasonably foreseeable future (0.3% of the RAA). The Project's contribution to overall development within the RAA is 261 ha (or 0.2%).

Table 11-12: Total Area of each Ecological Community Removed by Vegetation Clearing within the Regional Assessment Area

Ecological Community[1]	Baseline Area of each Ecological Community in the RAA (ha)	Past and Present Disturbance in the RAA (ha)	Pacific NorthWest LNG Project	Foreseeable Future Development[2]	Change in each Ecological Community (%)
Anthropogenic	1,591	1,591	0	0	100
Beach	4	0	0	0	0
Forest – Old Coniferous	20,969	71	44	111	1
Forest – Seral Coniferous	5,597	123	0	57	3
Forest – Seral Deciduous	546	1	0	0	< 1
Marine – Ocean	106,232	41	97	40	< 1
River	21	0	0	0	0

Ecological Community[1]	Baseline Area of each Ecological Community in the RAA (ha)	Past and Present Disturbance in the RAA (ha)	Pacific NorthWest LNG Project	Foreseeable Future Development[2]	Change in each Ecological Community (%)
Rock – Cliff, Outcrop, or Talus	1,009	0	0	0	0
Shrub – Subalpine	1,736	0	0	1	< 1
Wetland – Aquatic	1,784	8	1	3	1
Wetland – Shrub Dominated Bog	8,536	26	76	134	3
Wetland – Treed Swamp or Bog	8,186	83	43	132	3
Unknown	19	0	0	0	0
Total	**156,230**	**1,944**	**261**	**478**	**-**

NOTES:
[1] The extent of ecological communities for the cumulative effects analysis was determined through analysis of TEM data from the Government of BC (2013) and may deviate slightly from the detailed modelling completed for the Project, presented in Section 11.5.2
[2] Reasonably foreseeable future projects and activities include those that have been publicly announced (AECOM 2013; TransCanada 2013; City of Prince Rupert 2012; Golder Associates 2012; Ecosystems Consulting 2009; PGEC 2007)

11.6.2 Cumulative Effects Assessment

The cumulative effects assessment proceeds on an effect by effect basis, with a two-step process to determine the potential for cumulative effects on Terrestrial Wildlife and Marine Birds. In conducting the cumulative effects assessment, the residual effects arising from interactions that were ranked as 1 or 2 in Table 11-7 are considered. The first step consists of two questions:

- Is there a project residual effect?
- Does the project residual effect overlap spatially and temporally with those of other past, present or reasonably foreseeable future projects?

Where the answers to both of these two questions are affirmative, a check in Table 11-13 indicates that there is potential for the Project to contribute to cumulative effects on Terrestrial Wildlife and Marine Birds. Potential contribution of these project effects to cumulative effects is assessed below. The second step consists of one question:

- Is there a reasonable expectation that the contribution (i.e., addition) of the Project's residual effects would cause a change in cumulative effects that could affect the quality or sustainability of the VC?

Where the answer to this question is affirmative, additional assessment of the potential cumulative effects is described below.

Table 11-13: Potential Cumulative Effects on Terrestrial Wildlife and Marine Birds

Other Projects and Activities with Potential for Cumulative Effects	Potential Cumulative Effects		
	Change in Habitat	Change in Mortality Risk	Alteration of Movement
Atlin Terminal	✓	✓	✓
Canpotex Potash Export Terminal	✓	✓	✓
CN Rail Line	✓	✓	✓
Douglas Channel LNG	✓	✓	✓
Enbridge Northern Gateway Project	✓	✓	✓
Fairview Container Terminal Phase I	✓	✓	✓
Fairview Container Terminal Phase II	✓	✓	✓
Kitimat LNG Terminal Project	✓	✓	✓
LNG Canada Project	✓	✓	✓
Mount McDonald Wind Power Project	✓	✓	✓
NaiKun Wind Energy Project	✓	✓	✓
Northland Cruise Terminal	✓	✓	✓
Odin Seafood	✓	✓	✓
Pinnacle Pellet Inc.	✓	✓	✓
Prince Rupert LNG Facility	✓	✓	✓
Prince Rupert Gas Transmission Project	✓	✓	✓
Prince Rupert Ferry Terminal	✓	✓	✓
Prince Rupert Industrial Park	✓	✓	✓
Prince Rupert Grain Limited	✓	✓	✓
Ridley Island Log Sort	✓	✓	✓
Ridley Terminals Inc.	✓	✓	✓
Rio Tinto Alcan Aluminum Smelter and Modernization Project	✓	✓	✓
WatCo Pulp Mill	✓	✓	✓
Westcoast Connector Gas Transmission Project	✓	✓	✓

NOTES:
✓ **=** Those 'other projects and activities' whose effects are likely to interact cumulatively with the Project's residual effects.

The Project is predicted to result in measurable and demonstrable residual effects on terrestrial wildlife and marine birds. These residual project effects are likely to act cumulatively with other projects and activities in the RAA, described in Section 11.6.1. However, given the proposed project mitigation measures, it is unlikely that the Project's contribution to cumulative effects on change in habitat

availability, mortality, and movement will influence the sustainability or viability of regional terrestrial wildlife and marine bird populations.

11.6.2.1 Change in Habitat

A total of 1,944 ha (or 1%) of habitat in the RAA has been removed or altered due to past and present projects and activities (Table 11-12). The cumulative change in ecological communities from past, present, and reasonably foreseeable future activities combined with the Project will result in a 3% decrease in seral coniferous forest, shrub-dominated bog, and treed wetland or swamp relative to baseline availability of each community (Table 11-12). Construction of the Project will account for the loss of 164 ha of terrestrial habitat and 97 ha of marine habitat in the RAA and will primarily result in localized loss of shrub-dominated bog, treed swamps and bogs, and old coniferous forest (Table 11-12). Reasonably foreseeable future development (see Section 11.6.1) will contribute an additional 478 ha of habitat loss. Clearing for future development will occur in areas that are predominately shrub-dominated bog, treed swamps and bogs, old coniferous forest, and seral coniferous forest.

The cumulative change in habitat availability can result in a significant effect if it is anticipated to affect the long-term sustainability of a regional terrestrial wildlife or marine bird population. Potential for a significant cumulative effect is greatest for species whose populations are declining from existing disturbance features or have specific habitat requirements provided by ecological communities within the RAA.

Species that are designated of management concern (e.g., those listed as Threatened or Endangered under Schedule 1 of SARA) due to loss in availability of suitable habitat provide a useful example of the cumulative effects of change in habitat availability. Measuring the cumulative change in habitat in the RAA is also consistent with provincial management plans, federal recovery strategies, and with the Government of Canada's mandate to prevent extirpation or extinction of Threatened and Endangered species through management of federal lands (Environment Canada 2014; COSEWIC 2012; BC MSRM 2005).

Marbled murrelet is a species whose national and provincial populations are declining in part, due to rates of habitat loss or alteration, and provides a meaningful illustration of cumulative effects on change in habitat from development within the RAA. Loss and fragmentation of suitable nesting habitat have been identified as primary threats to the decline of marbled murrelet populations (Environment Canada 2014; Environment Canada 2013a; COSEWIC 2012; Burger 2004). Suitable nesting habitat is characterized as low elevation (≥600 m) old growth coniferous forest (≥250 years) that extends 0.5 to 30 km from the coast and is dominated by cedar, hemlock, or spruce (Burger 2002, 2004). Research on marbled murrelet populations indicate that forestry and road construction have had the greatest effect on reducing suitable nesting habitat (COSEWIC 2012). Direct loss of nesting opportunities results from the targeted harvest of old-growth coniferous forest while road construction increases the density of linear features on the landscape thereby fragmenting suitable nesting habitat (COSEWIC 2012; Malt and Lank 2009). Reproductive success for marbled murrelets decreases along forest edges in fragmented habitats as nests and young have higher exposure to predators (COSEWIC 2012; Malt and Lank 2009; Burger 2004).

Habitat suitability models completed for this assessment used a conservative approach by including habitats with suitable nesting characteristics within 500 m of shore in determining availability of preferred habitat. Consistent with Burger (2002, 2004) and Mather et al. (2010), these habitats were assigned a maximum habitat value of moderate. Results of habitat suitability modelling indicate that 91 ha of preferred marbled murrelet nesting habitat will be removed or altered by the Project; the majority of this is located less than 500 m from coastal shoreline (see Section 11.5.2; Figure 11-12). A spatial analysis

conducted by Long et al. (2011) indicates that loss of available nesting habitat between 1978 and 2008 was lowest in the North Coast Conservation Region, where the RAA is situated. Using a conservative modelling scenario (i.e., Model 1), Long et al. 2011 measured an overall net increase of 14,724 ha of nesting habitat from the recruitment of old-growth coniferous forest classes exceeding the rate of harvest. Ecological modelling conducted in the RAA indicates 111 ha of old coniferous forest will be removed by reasonably foreseeable future developments (Table 11-12). Results of this assessment, in consideration with recent habitat modelling completed in the North Coast Conservation Region, suggest that the Project's residual effect and its contribution to cumulative change in habitat availability will not influence the long-term sustainability of the regional population. This is consistent with habitat management directives outlines in the proposed *Recovery Strategy for Marbled Murrelet (Brachyramphus marmoratus) in Canada* (Environment Canada 2014). The Project's contribution to cumulative effects on habitat is determined to be not significant.

11.6.2.2 Change in Mortality Risk

Project-related effects to the risk of mortality on terrestrial wildlife will be highest during clearing for construction of the PDA, but substantially reduced through adherence to applicable legislation and regulations (e.g., MBCA and the *Wildlife Act*), avoiding sensitive breeding periods, and reducing speed limits. Potential for marine bird mortality will be highest during operations, when facility structures will be regularly lit. Lighting from the Project may, in combination with other existing and proposed coastal developments in Prince Rupert, result in mortality events. Literature suggests collision rates are reportedly higher for juvenile birds and species within taxonomic orders of *Procellariiformes* (petrels, storm petrels, and shearwaters) and *Charadriiformes* (auks, murres, and puffins). Data from baseline surveys and regional datasets indicate these species are relatively uncommon within the LAA and unlikely to interact with sources of artificial light in the PDA (Appendix H: Terrestrial Wildlife and Marine Birds TDR). Lighting mitigation is expected to greatly reduce the potential for mortality from project lighting. As a component of this mitigation, mortality will be monitored on an on-going basis to provide greater certainty on the effectiveness of proposed lighting mitigation.

The Project is likely to result in a residual effect contributing to potential increased mortality to terrestrial wildlife and marine birds. Mortality events will have spatial and temporal overlap with past, present, and reasonably foreseeable future projects and activities in the RAA. However, following the application of appropriate mitigation, the Project's contribution to cumulative risk of mortality is not expected to reduce the sustainability of regional populations. Consequently the Project's contribution to cumulative effects on mortality is predicted to be not significant.

A dispersion model was completed to evaluate potential effects of the air emissions on ambient air quality from cumulative air emission. Modelling results were compared to the BC MOE empirical critical loads for sulfate and nitrogen deposition. The model identified two areas that may exceed the BC MOE critical load for sulfate and nitrogen deposition (Appendix C). These areas, located on Kaien and Ridley islands, respectively, have potential for acidification or eutrophication of freshwater systems (Appendix J). Acidification or eutrophication of freshwater systems would have the greatest effect on amphibian species with potential to breed in freshwater habitats in these areas, including coastal tailed frog (BC Blue List; SARA Special Concern) and western toad (BC Blue List; SARA Special Concern) (BC CDC 2013; Stantec 2011). Changes to water quality in freshwater systems could reduce survival and reproductive success of amphibian species. Local populations of species of management concern are expected to have low to moderate resilience in recovering from acidification or eutrophication of freshwater systems.

Further studies should be completed to determine the accuracy of the dispersion modelling and potential for the acidification and/or eutrophication of amphibian habitat. Results of the acidification assessment will be used to evaluate the need for additional amphibian monitoring and mitigation.

11.6.2.3 Alteration of Movement

Alteration of movement will generally be restricted to wildlife inhabiting Lelu Island as vegetation clearing, construction of project infrastructure, and noise caused by construction and operations of the Project can cause physical or perceived barriers to movement. Construction activities on the mainland and in the marine environment are limited to the access road, marine terminal, MOF, and bridge. These features do not overlap with regional migration corridors for terrestrial wildlife and marine birds and will have a negligible effect on movement patterns (BC CDC 2013; BC MSRM 2005; PRPA 2002). The Project is likely to result in a residual effect on movement for terrestrial wildlife on Lelu Island, however the project-specific residual effect is unlikely to act cumulatively with past, present, and reasonably foreseeable future projects and activities.

There will be a low to moderate degree of alteration to marine bird movement as individuals adjust daily or seasonal movement patterns in response to transiting vessels along the shipping route. Approximately 550 vessels currently call on Port of Prince Rupert; PRPA plans to increase shipping activity to approximately 2,000 calls per year by 2025. The Project will increase vessel transportation in the RAA by 350 carriers per year (a 64% increase from current traffic levels). The residual effect on movement will act cumulatively with displacement caused by present and reasonably foreseeable future marine traffic. However, marine birds are expected to recover quickly as the distance from disturbance (i.e., transiting vessels) increases (Schwemmer et al. 2011). The extent of disturbance may also decrease over time as individuals habituate to the regular presence of vessels along the shipping route (Kaiser et al. 2006). Project-related vessel traffic will have a residual effect on marine bird movement that will interact spatially and temporally with present and reasonably foreseeable future marine activities. However, declines in the sustainability of marine bird populations have not been directly associated with effects from alteration of movement. Accordingly, the Project's contribution to cumulative effects on marine bird movement is not expected to influence the sustainability of regional populations.

11.6.2.4 Summary of Cumulative Effects

Past and present projects and activities have contributed to the loss or alteration of 1,944 ha of habitat in the RAA (Table 11-12), and have contributed to change in mortality and movement of terrestrial wildlife and marine birds. The Project will result in the removal of 261 ha of terrestrial and marine habitat, which will be offset by through the Wetland Habitat Compensation Plan and the Conceptual Fish Habitat Offsetting Strategy. Through compliance with applicable federal and provincial regulations and through the implementation of mitigation measures, the residual effect of the Project on change in mortality and movement is expected to be low in magnitude.

The Project's contribution to cumulative effects on habitat availability, mortality, and alteration of movement on terrestrial wildlife and marine birds will be local and affect a small portion of the regional population.

Accordingly, cumulative effects will not influence the long-term sustainability of local or regional wildlife populations and are determined to be not significant.

11.7 Follow-up and Monitoring

Details of the follow-up monitoring program will be developed through further consultation with EC and Aboriginal groups and will include:

- Acidification and eutrophication assessment, and if necessary, monitoring of effects of acidification or eutrophication of freshwater systems on amphibians.

11.8 Conclusion

Project effects on change in habitat availability change in mortality, and alteration of movement on terrestrial wildlife and marine birds will, in general, be local in extent. Following mitigation, the Project will potentially affect only a small proportion of regional wildlife and marine bird populations. Based on this assessment, the Project will be in compliance with applicable federal and provincial regulations. Considered in combination with the Wetland Habitat Compensation Plan and Conceptual Fish Habitat Offsetting Strategy, this Project will not have a significant effect on the sustainability of any terrestrial wildlife or marine bird species.

The combined project effects on terrestrial wildlife and marine birds, and their contribution to cumulative effects within the RAA are determined to be not significant. Based on the quality of habitat modelling, baseline data, and previously published information for the Prince Rupert region, the level of confidence in this prediction is high. Cumualtive effects are also expected to be not significant.

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11.10 Figures

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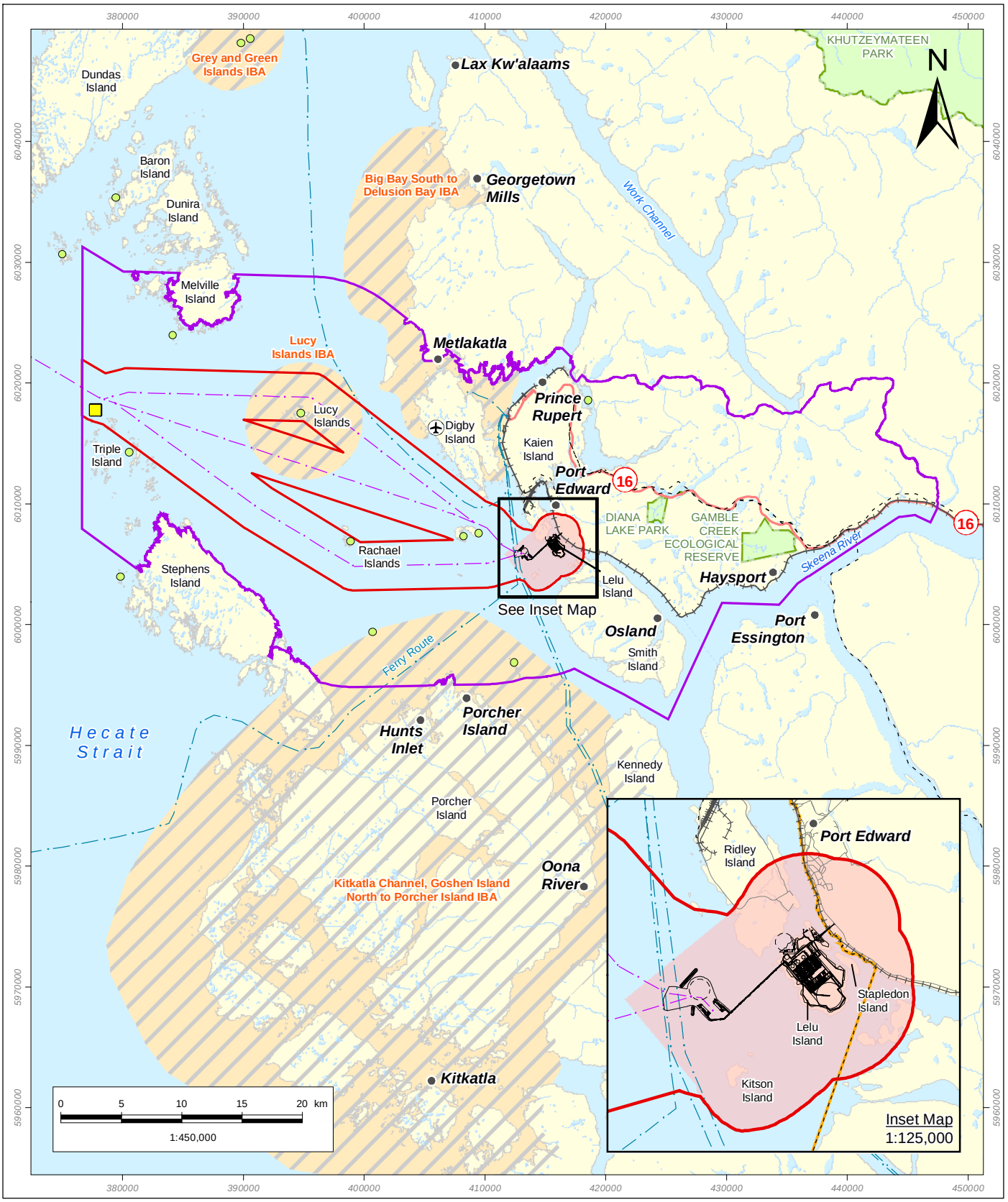

Marine Bird Colony
Important Bird Area (IBA)

Terrestrial Wildlife and Marine Birds Assessment Areas

Habitat Modelling Limits
Local Assessment Area
Regional Assessment Area

Project Component
Turning Basin
Potential Shipping Route
Airport
Pilotage Station
Electrical Power Transmission Line
Ferry Route
Highway
Railway
Watercourse
Protected Area
Waterbody

Pacific NorthWest LNG

Terrestrial Wildlife and Marine Birds Assessment Areas

Sources: Government of British Columbia; Prince Rupert Port Authority; Government of Canada, Natural Resources Canada, Centre for Topographic Information; Progress Energy Canada Ltd; IBA Canada - Important Bird Areas, 2013; Canadian Wildlife Service, 2013.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

DATE: 11-FEB-14
FIGURE ID: 123110537-237
DRAWN BY: K. POLL
PROJECTION: UTM - ZONE 9
DATUM: NAD 83
CHECKED BY: M. WILLIE

PREPARED BY: Stantec
PREPARED FOR: Pacific NorthWest LNG
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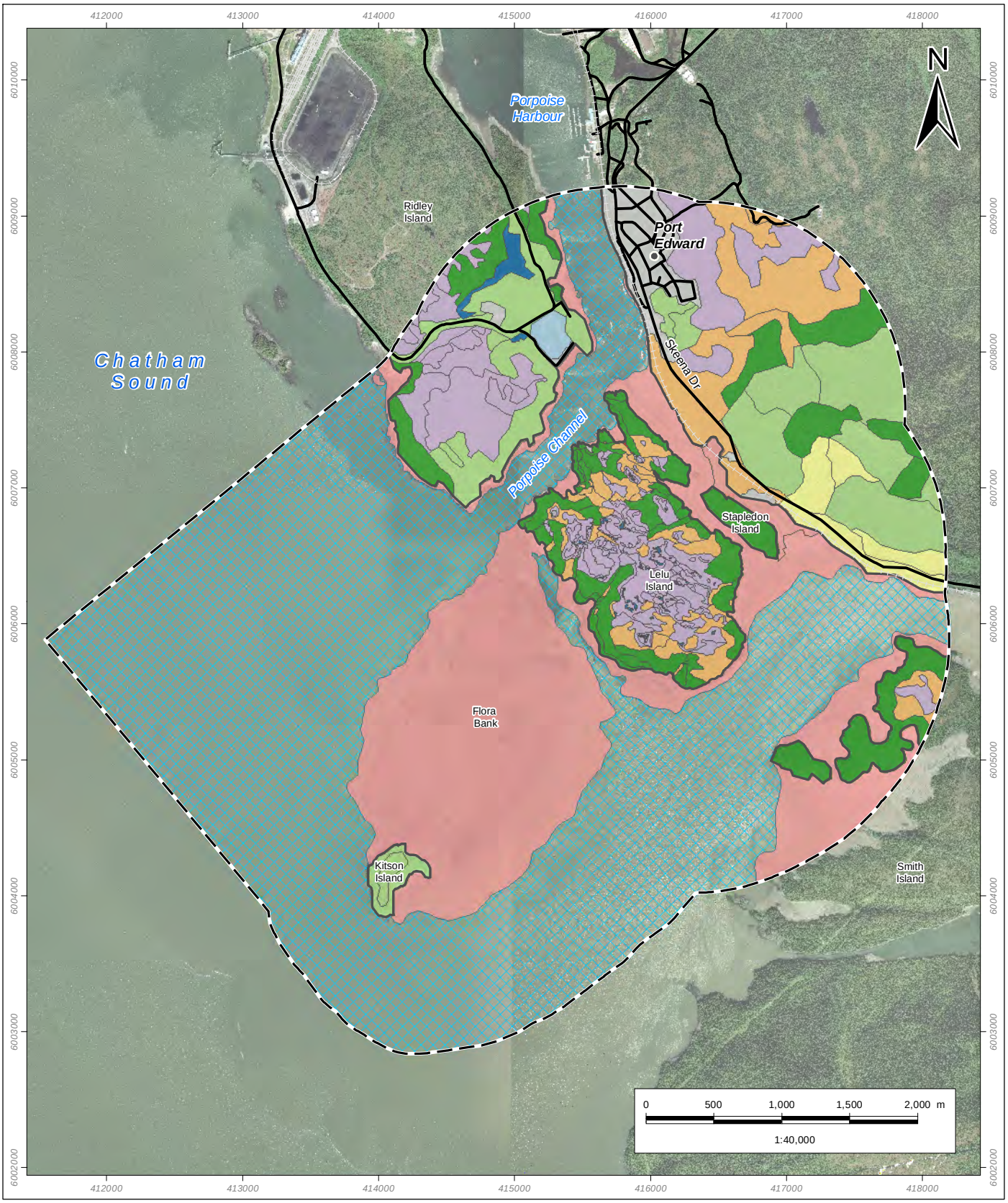

Ecological Communities

- Anthropogenic
- Forest - Old Coniferous Forest
- Forest - Seral Coniferous Forest
- Forest - Seral Deciduous Forest
- Marine - Estuarine Tidal Flat
- Marine - Ocean
- Wetland - Aquatic
- Wetland - Estuarine Marsh
- Wetland - Estuarine Meadow
- Wetland - Shrub-dominated Bog
- Wetland - Treed Swamp or Bog

- Habitat Modelling Limits
- City or Town
- Railway
- Road
- Shoreline

Please refer to the Vegetation and Wetlands TDR for detailed descriptions of vegetation communities.

Pacific NorthWest LNG

Ecological Communities at Baseline

Sources: Government of British Columbia; Government of Canada, Natural Resources Canada, Centre for Topographic Information; Progress Energy Canada Ltd. WorldView-2 Imagery. Imagery date: 2011.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

DATE: 11-FEB-14	PROJECTION: UTM - ZONE 9
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PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **11-2**

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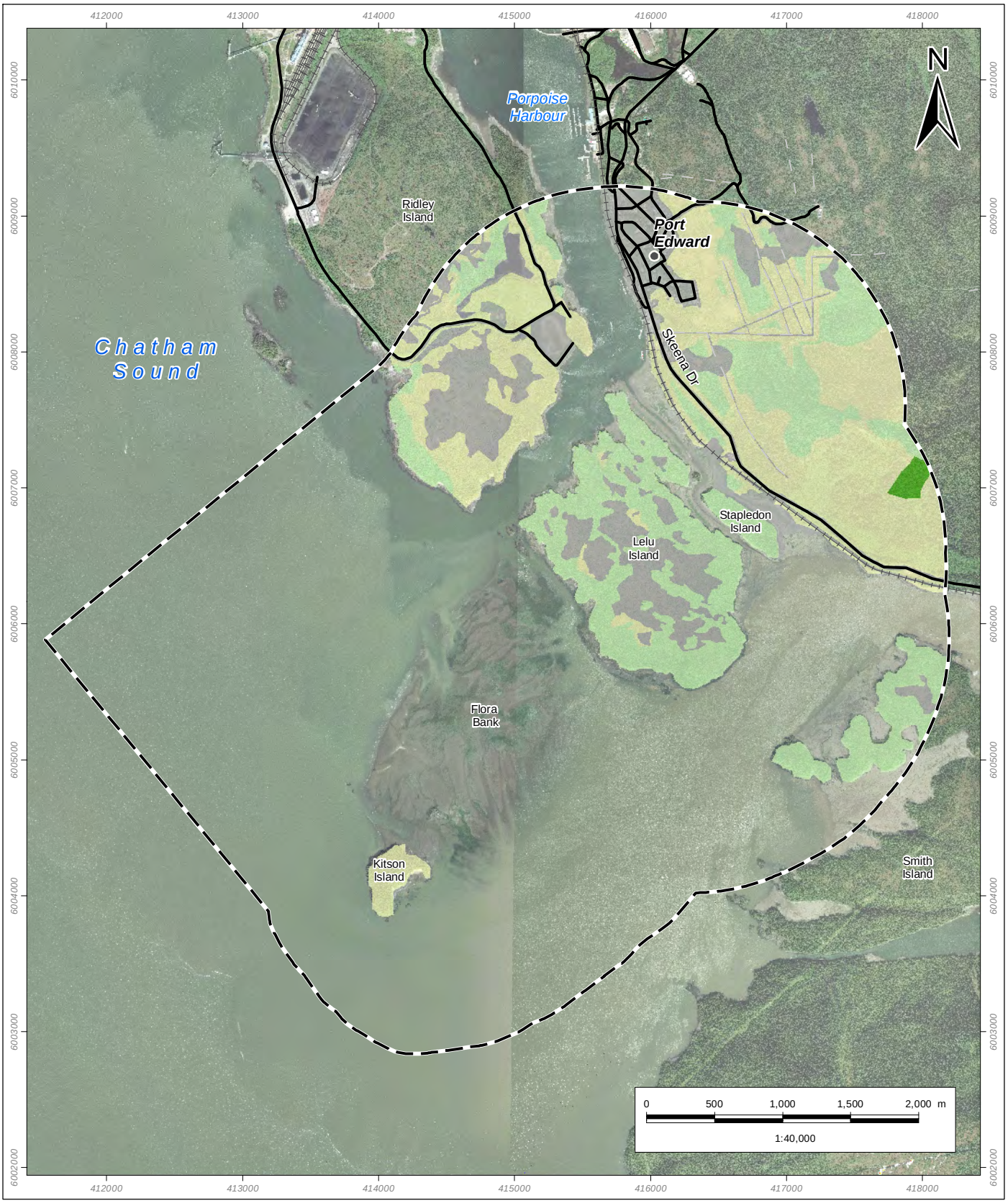

Habitat Suitability Class

- High
- Moderate
- Low
- Nil
- Habitat Modelling Limits
- City or Town
- Cutline or Seismic Line
- Railway
- Road

Pacific NorthWest LNG

Baseline Breeding Habitat Suitability of Marbled Murrelet

Sources: Government of British Columbia; Government of Canada, Natural Resources Canada, Centre for Topographic Information; Progress Energy Canada Ltd. WorldView-2 Imagery. Imagery date: 2011.

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DATE: 11-FEB-14	PROJECTION: UTM - ZONE 9
FIGURE ID: 123110537-242	DATUM: NAD 83
DRAWN BY: K. POLL	CHECKED BY: M. WILLIE

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **11-3**

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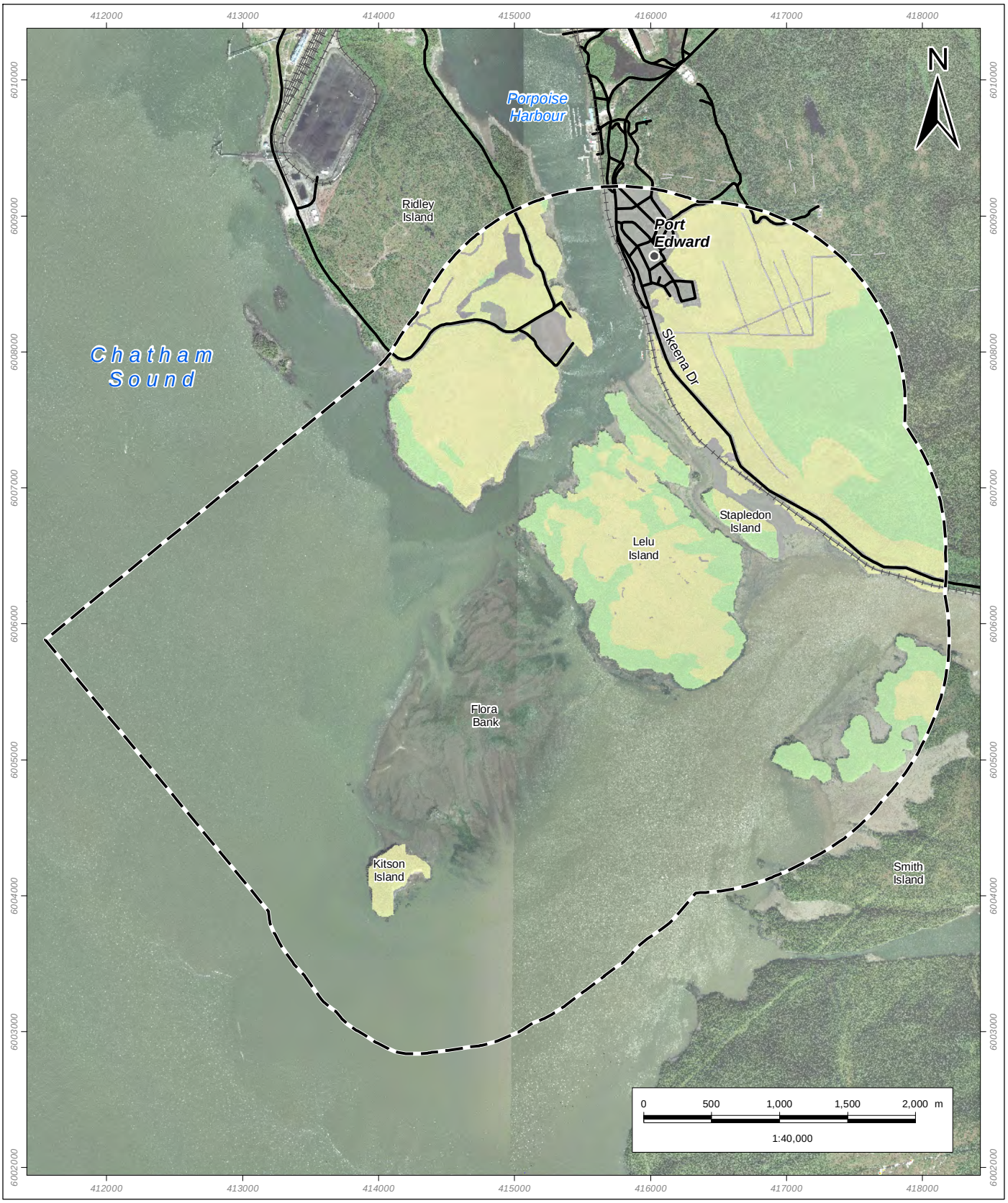

Habitat Suitability Class

- High
- Moderate
- Low
- Nil
- Habitat Modelling Limits

- City or Town
- Cutline or Seismic Line
- Railway
- Road

Pacific NorthWest LNG

Baseline Breeding Habitat Suitability of Northern Goshawk, *laingi* subspecies

Sources: Government of British Columbia; Government of Canada, Natural Resources Canada, Centre for Topographic Information; Progress Energy Canada Ltd. WorldView-2 Imagery. Imagery date: 2011.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

DATE: 11-FEB-14	PROJECTION: UTM - ZONE 9
FIGURE ID: 123110537-243	DATUM: NAD 83
DRAWN BY: K. POLL	CHECKED BY: M. WILLIE

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **11-4**

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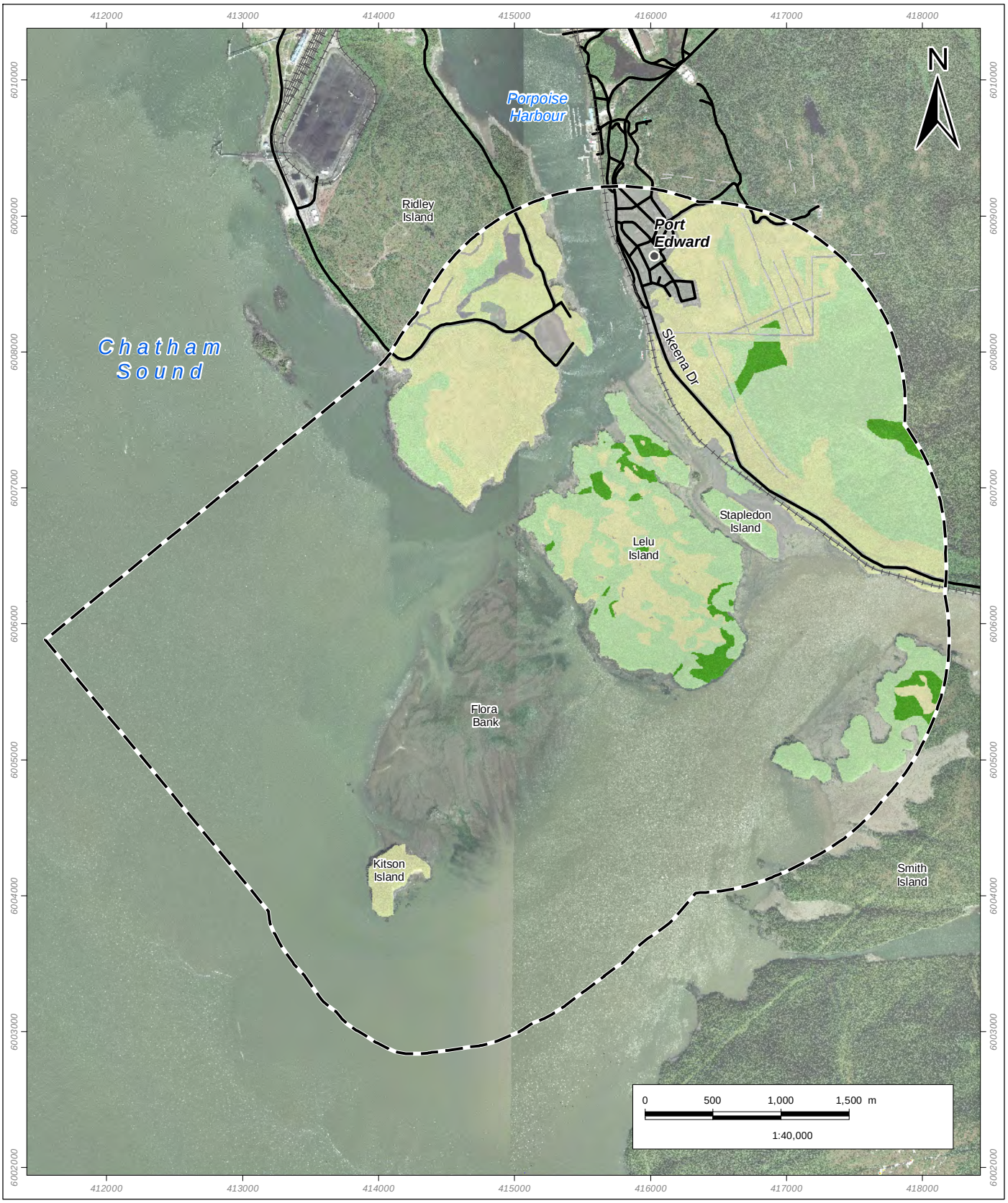

Habitat Suitability Class

- High
- Moderate
- Low
- Nil
- Habitat Modelling Limits

- City or Town
- Cutline or Seismic Line
- Railway
- Road

Pacific NorthWest LNG

Baseline Breeding Habitat Suitability of Olive-sided Flycatcher

Sources: Government of British Columbia; Government of Canada, Natural Resources Canada, Centre for Topographic Information; Progress Energy Canada Ltd. WorldView-2 Imagery. Imagery date: 2011.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

DATE: 11-FEB-14	PROJECTION: UTM - ZONE 9
FIGURE ID: 123110537-244	DATUM: NAD 83
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PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **11-5**

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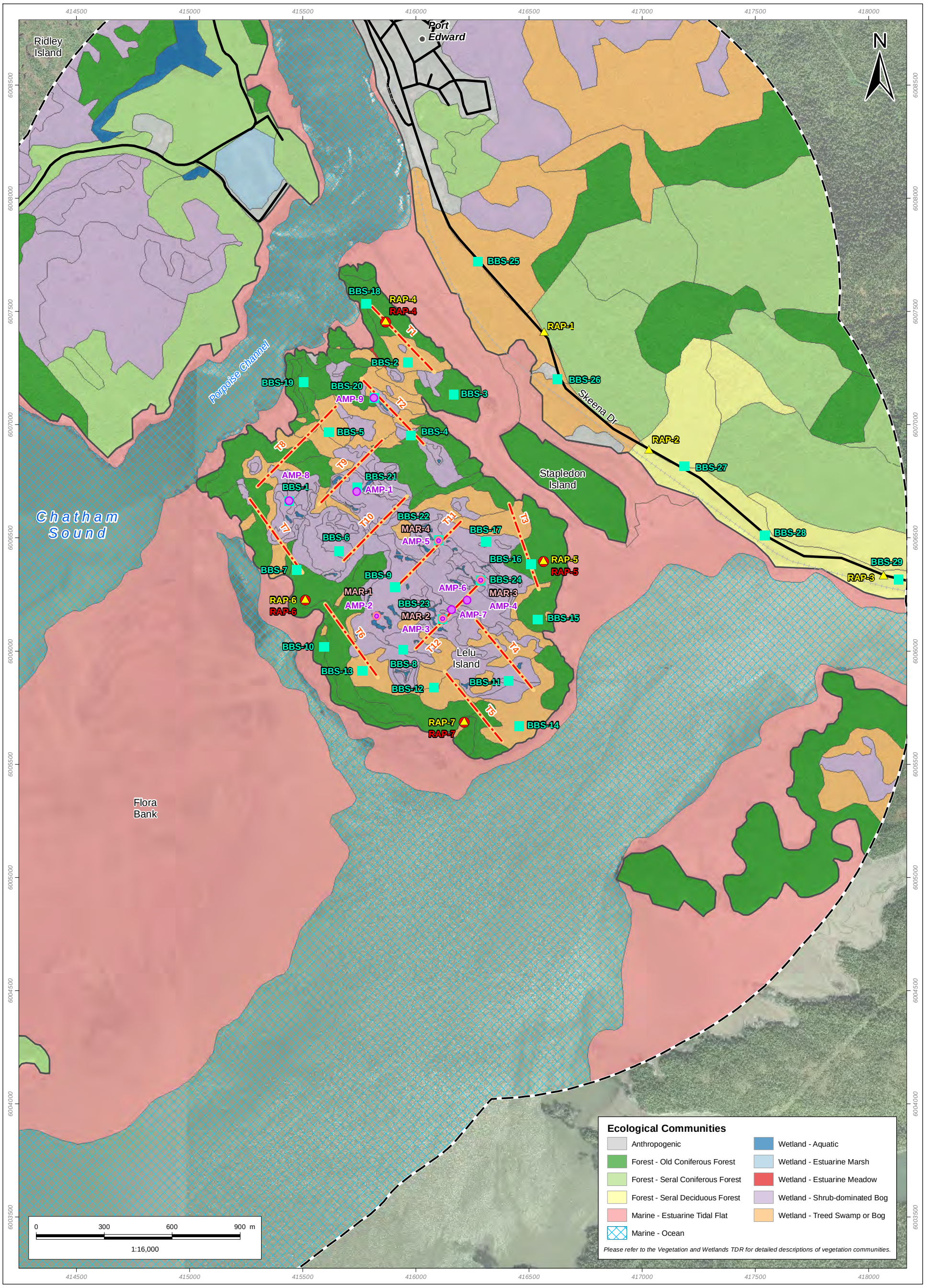


Acoutic Recording Unit Survey
Breeding Bird Survey Location
Diurnal and Nocturnal Raptor Call Playback Survey
Marsh Bird Call Playback Survey
Pond-dwelling Amphibian Survey
Wildlife Encounter Transect
Habitat Modelling Limits
City or Town
Road
Railway
Shoreline

Pacific NorthWest LNG

Terrestrial Wildlife Survey Locations

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

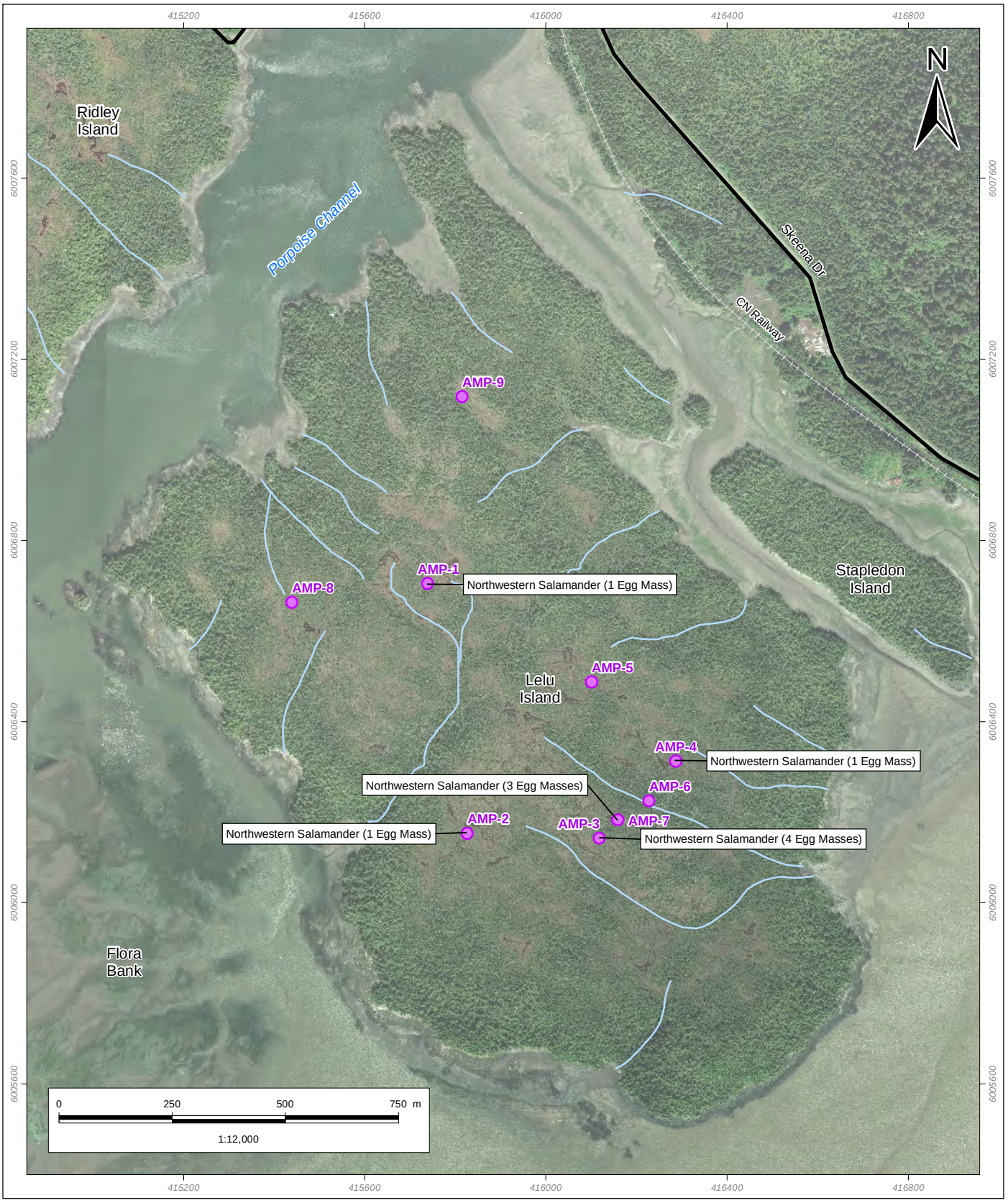
FIGURE NO: **11-6**

Sources: Government of British Columbia; Government of Canada, Natural Resources Canada, Centre for Topographic Information; Canadian Hydrological Service (CHS), 1995; Progress Energy Canada Ltd. WorldView-2 Imagery. Imagery date: 2011.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

DATE: 11-FEB-14	PROJECTION: UTM - ZONE 9	DRAWN BY: K. POLL
FIGURE ID: 123110537-238	DATUM: NAD 83	CHECKED BY: M. WILLIE

2/11/2014 - 10:42:44 AM V:\active\123110537\gis\figures\general\mxds\english\fig_123110537-238_terr_wildlife_survey_locations_ea.mxd



Pond-dwelling Amphibian Survey
Railway
Road
Watercourse

Pacific NorthWest LNG

Amphibian Survey Results

Sources: Government of British Columbia; Government of Canada, Natural Resources Canada, Centre for Topographic Information; WorldView-2 Imagery. Imagery date: 2011.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

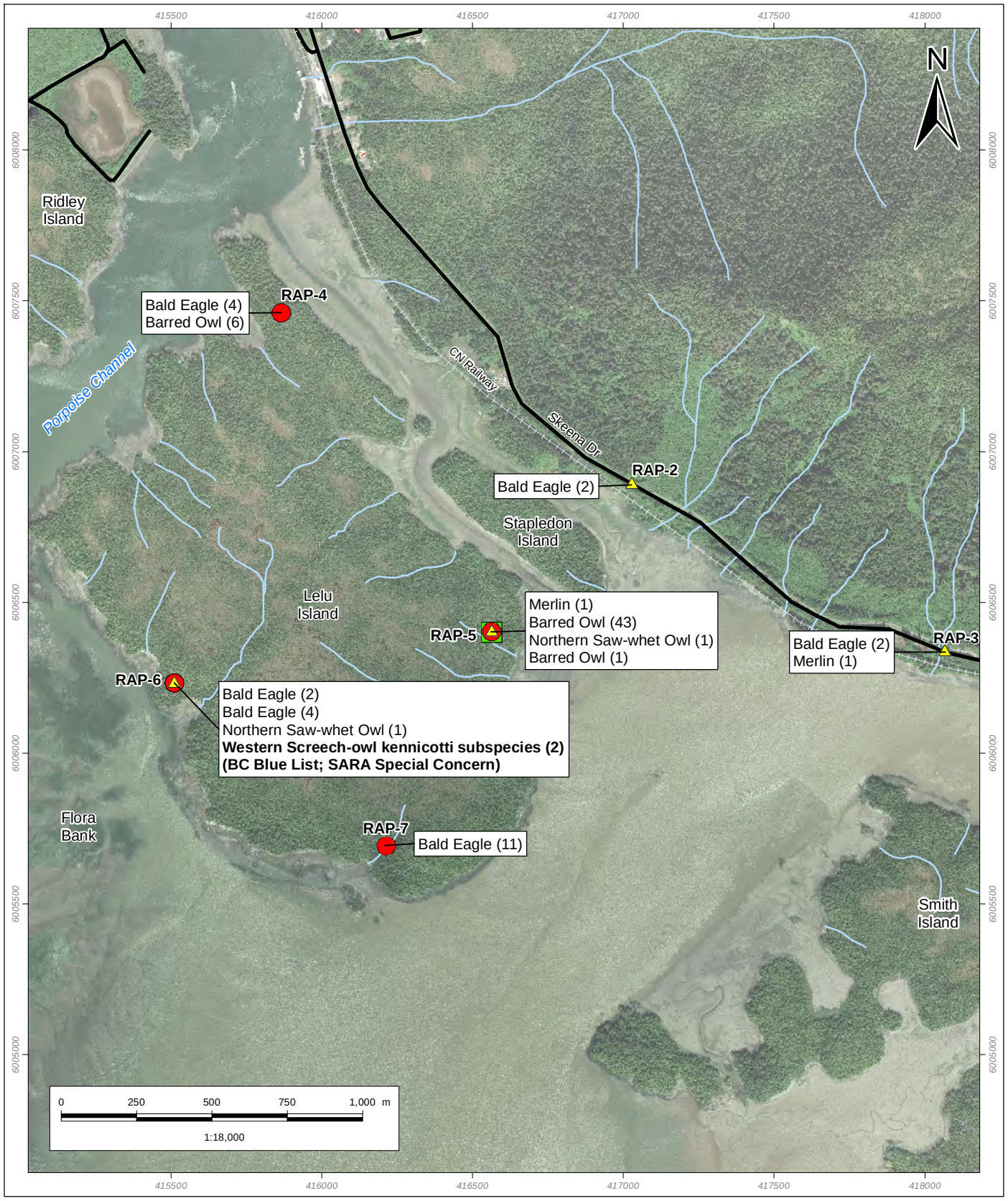
DATE: 11-FEB-14	PROJECTION: UTM - ZONE 9
FIGURE ID: 123110537-346	DATUM: NAD 83
DRAWN BY: K. POLL	CHECKED BY: M. WILLIE

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **11-7**

2/11/2014 - 10:41:49 AM V:\active\123110537\gis\figures\general\mxds\english\fig_123110537-346_amphibian_results_ea.mxd



Acoustic Recording Unit Survey
Diurnal Call-Playback Survey
Nocturnal Call-Playback Survey
Railway
Road
Watercourse

Pacific NorthWest LNG

Raptor Call-Playback and Acoustic Recording Unit Survey Results

Sources: Government of British Columbia; Government of Canada, Natural Resources Canada, Centre for Topographic Information; WorldView-2 Imagery. Imagery date: 2011.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

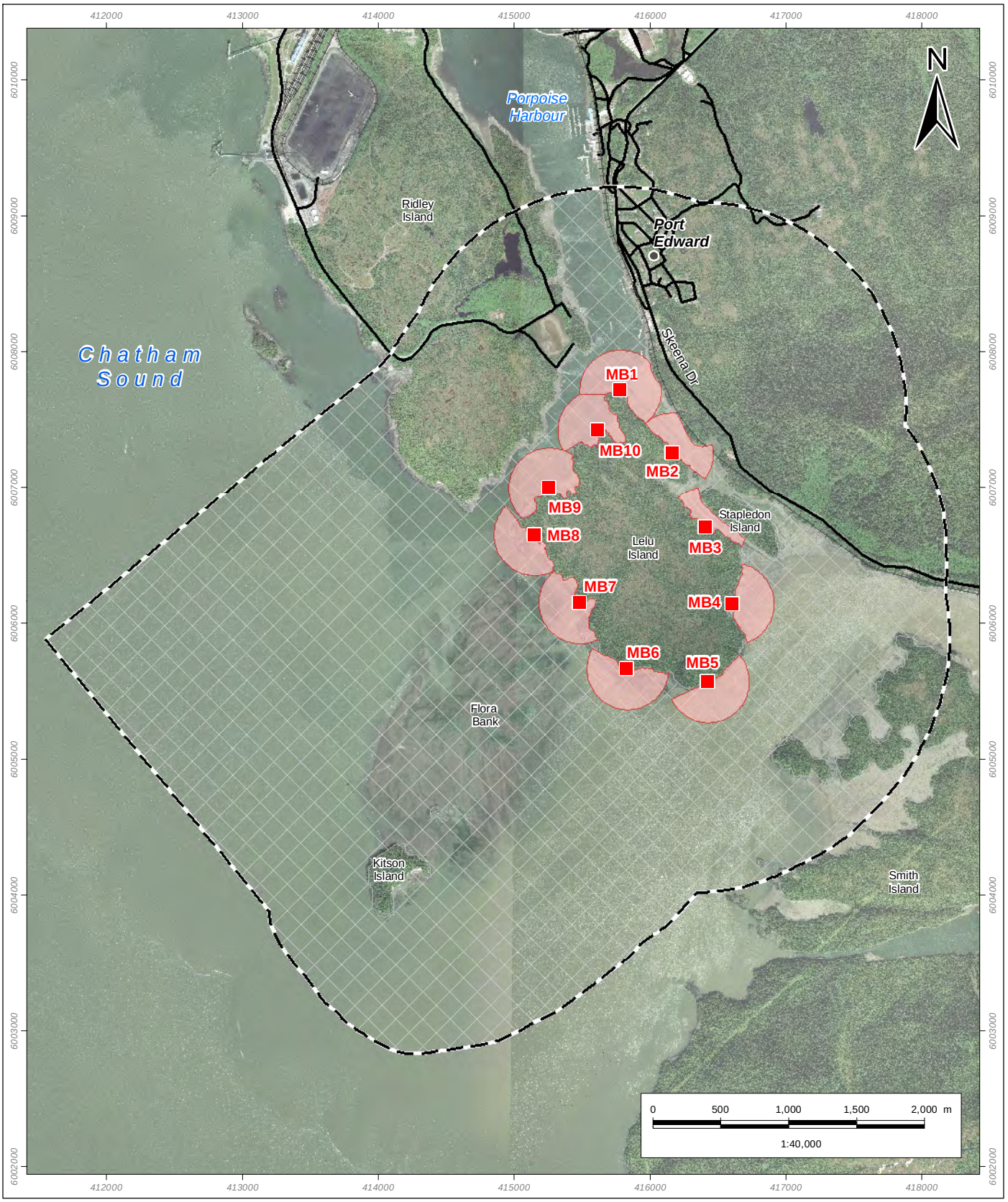
DATE: 11-FEB-14	PROJECTION: UTM - ZONE 9
FIGURE ID: 123110537-347	DATUM: NAD 83
DRAWN BY: K. POLL	CHECKED BY: M. WILLIE

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **11-8**

2/11/2014 - 10:42:10 AM V:\active\123110537\gis\figures\general\mxds\english\fig_123110537-347_raptor_results_ea.mxd



Marine Bird Stationary Count
Habitat Modelling Limits
Marine Bird Station 300 m Radius
Vessel Fixed-width Transect Survey Area
City or Town
Railway
Road

Pacific NorthWest LNG

Marine Bird Stationary Count and Fixed-width Vessel Transect Survey Area

Sources: Government of British Columbia; Government of Canada, Natural Resources Canada, Centre for Topographic Information; Progress Energy Canada Ltd. WorldView-2 Imagery. Imagery date: 2011.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

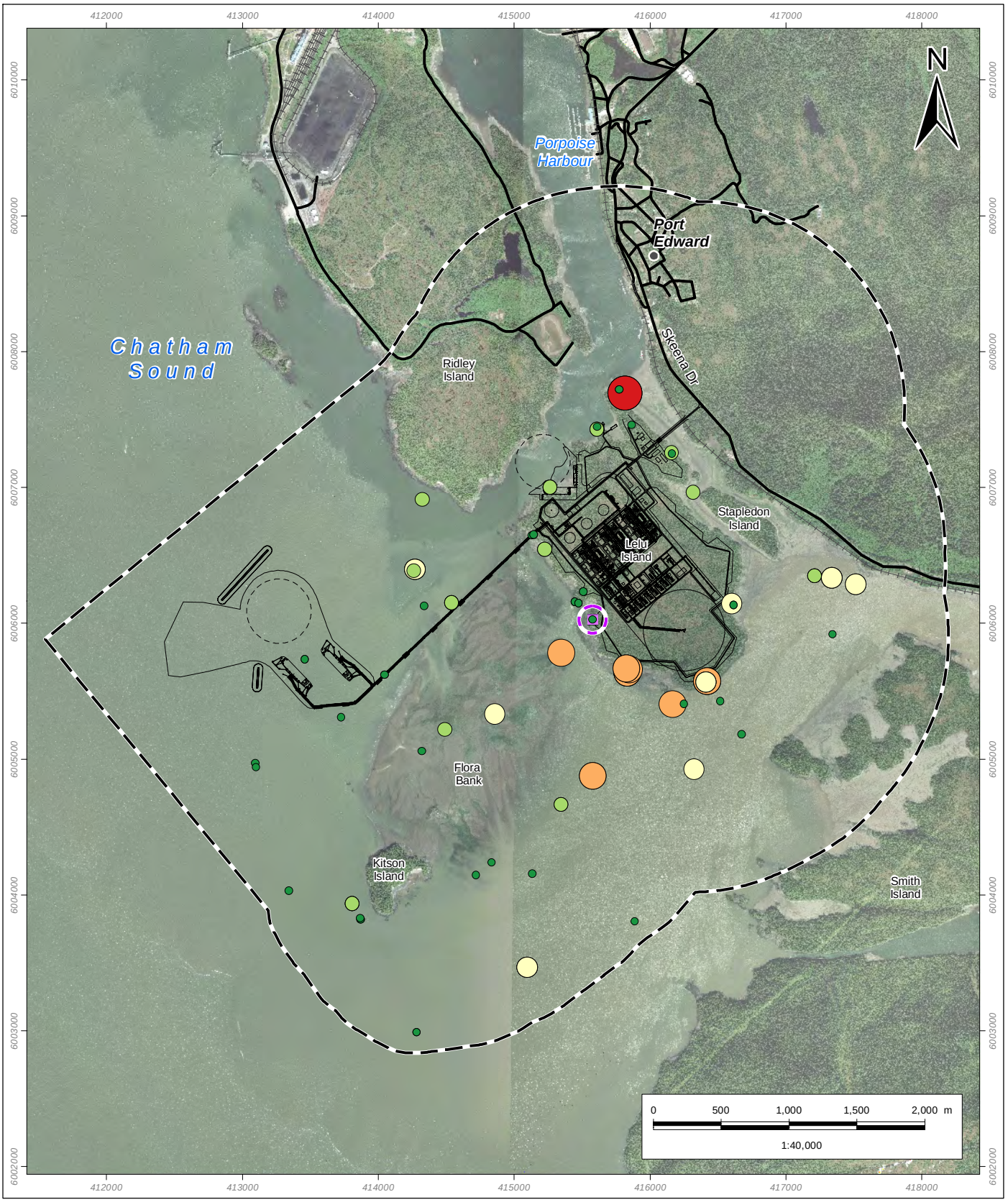
DATE: 11-FEB-14	PROJECTION: UTM - ZONE 9
FIGURE ID: 123110537-239	DATUM: NAD 83
DRAWN BY: K. POLL	CHECKED BY: M. WILLIE

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **11-9**

2/11/2014 - 10:43:02 AM V:\active\123110537\gis\figures\general\mxds\english\fig_123110537-239_marine_bird_stations_e.a.mxd



Bald Eagle Nest

Number of Individuals of Species of Management Concern

- 1 - 3
- 4 - 6
- 7 - 13
- 14 - 20
- 21 - 49

- Project Component
- Turning Basin
- Bald Eagle Nest 100 m Buffer
- Habitat Modelling Limits
- City or Town
- Railway
- Road

Pacific NorthWest LNG

Observations of Important Wildlife Habitat Features and Species of Management Concern

Sources: Government of British Columbia; Government of Canada, Natural Resources Canada, Centre for Topographic Information; Progress Energy Canada Ltd. WorldView-2 Imagery. Imagery date: 2011.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

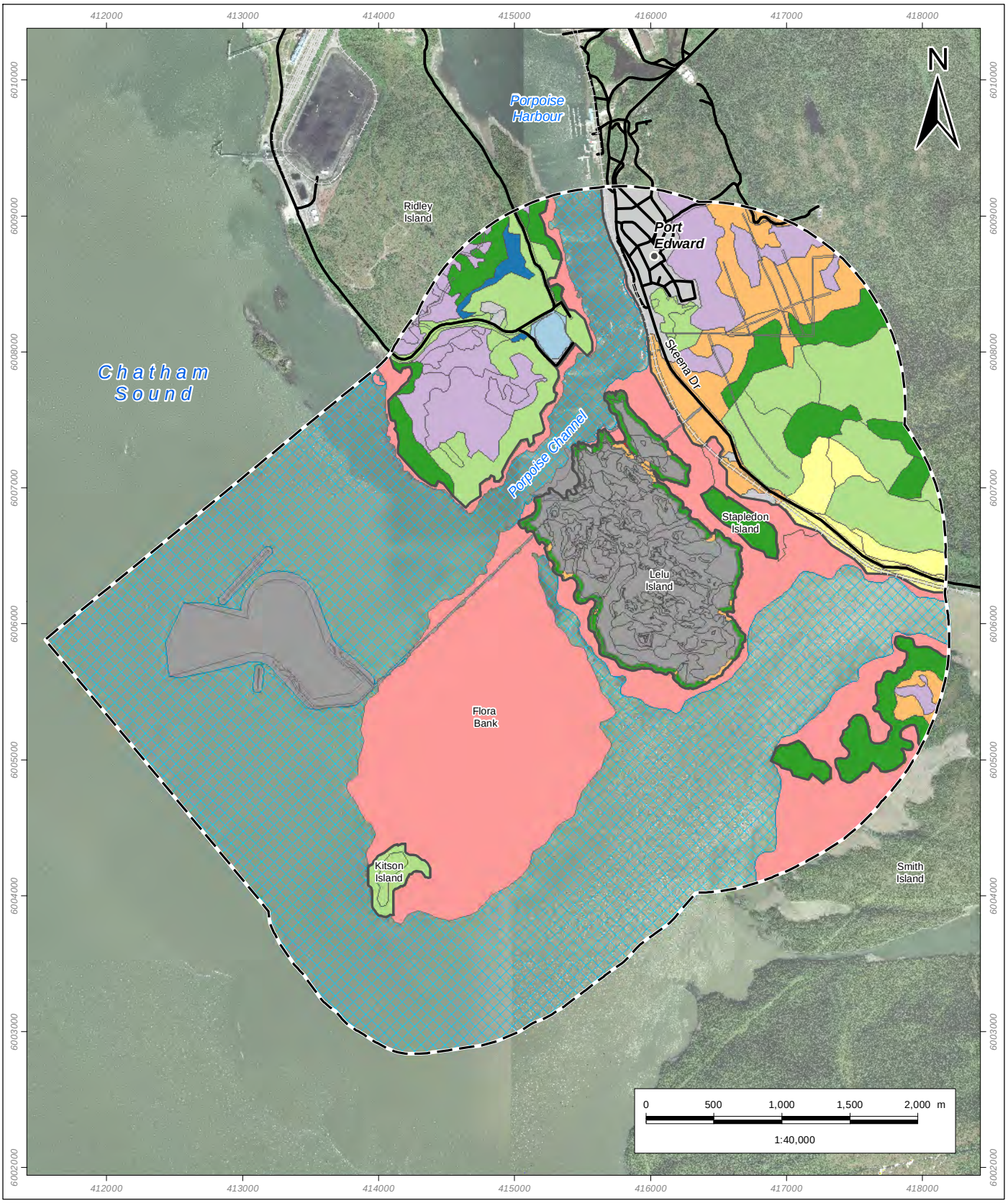
DATE: 11-FEB-14	PROJECTION: UTM - ZONE 9
FIGURE ID: 123110537-240	DATUM: NAD 83
DRAWN BY: K. POLL	CHECKED BY: M. WILLIE

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **11-10**

2/11/2014 - 10:43:36 AM V:\active\123110537\gis\figures\general\mxds\english\fig_123110537-240_obs_important_wildlife_habitat_ea.mxd



Ecological Communities

- Anthropogenic
- Forest - Old Coniferous Forest
- Forest - Seral Coniferous Forest
- Forest - Seral Deciduous Forest
- Marine - Estuarine Tidal Flat
- Marine - Ocean
- Project Development Area
- Wetland - Estuarine Meadow
- Wetland - Shrub-dominated Bog
- Wetland - Aquatic
- Wetland - Treed Swamp or Bog
- Wetland - Estuarine Marsh

- Habitat Modelling Limits
- City or Town
- Railway
- Road
- Shoreline

Please refer to the Vegetation and Wetlands TDR for detailed descriptions of vegetation communities.

Pacific NorthWest LNG

Ecological Communities at Project Build-out

Sources: Government of British Columbia; Government of Canada, Natural Resources Canada, Centre for Topographic Information; Progress Energy Canada Ltd. WorldView-2 Imagery. Imagery date: 2011.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

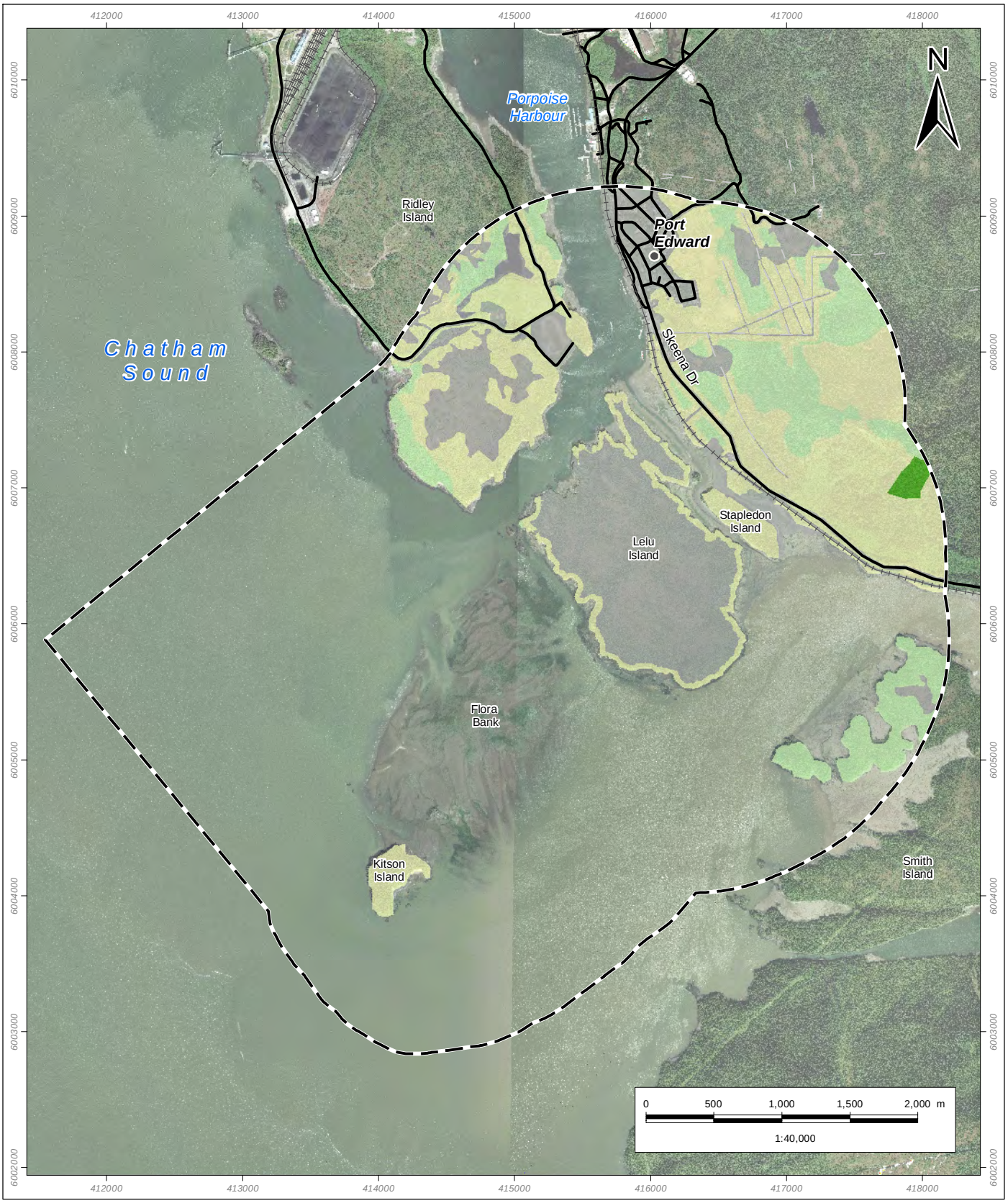
DATE: 11-FEB-14	PROJECTION: UTM - ZONE 9
FIGURE ID: 123110537-245	DATUM: NAD 83
DRAWN BY: K. POLL	CHECKED BY: M. WILLIE

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **11-11**

2/11/2014 - 10:44:40 AM V:\active\123110537\gis\figures\general\mxds\english\fig_123110537-245_wildlife_broad_hab_cats_mbo_ea.mxd



Habitat Suitability Class

- High
- Moderate
- Low
- Nil
- Habitat Modelling Limits

- City or Town
- Cutline or Seismic Line
- Railway
- Road

Pacific NorthWest LNG

Project Build-out Breeding Habitat Suitability of Marbled Murrelet

Sources: Government of British Columbia; Government of Canada, Natural Resources Canada, Centre for Topographic Information; Progress Energy Canada Ltd. WorldView-2 Imagery. Imagery date: 2011.

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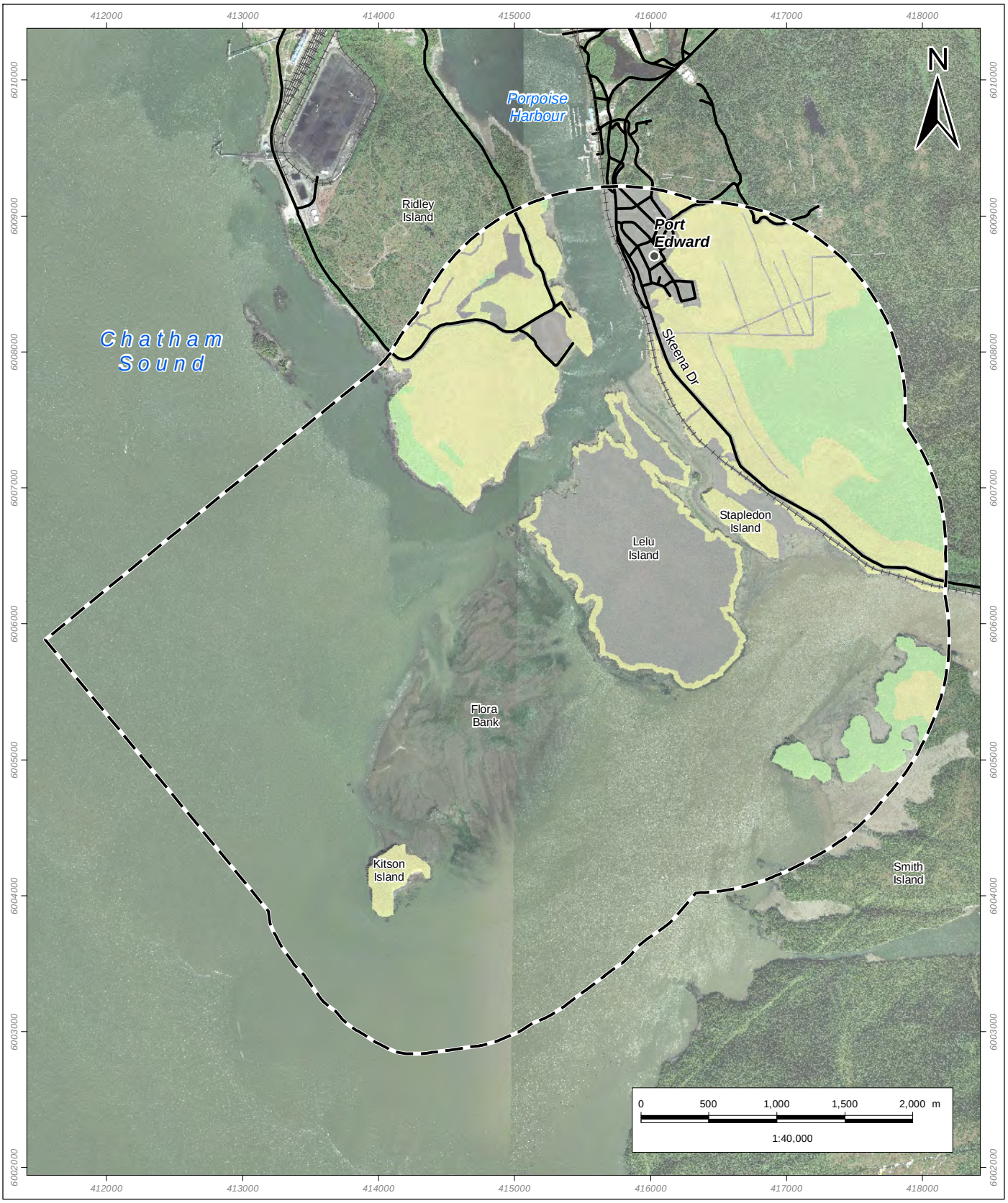
DATE: 11-FEB-14	PROJECTION: UTM - ZONE 9
FIGURE ID: 123110537-246	DATUM: NAD 83
DRAWN BY: K. POLL	CHECKED BY: M. WILLIE

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **11-12**

2/11/2014 - 10:44:23 AM V:\active\123110537\gis\figures\general\mxds\english\fig_123110537-246_marbled_murrelet_nbo_ea.mxd



Habitat Suitability Class

- High
- Moderate
- Low
- Nil
- Habitat Modelling Limits

- City or Town
- Cutline or Seismic Line
- Railway
- Road

Pacific NorthWest LNG

Project Build-out Breeding Habitat Suitability of Northern Goshawk, *laingi* subspecies

Sources: Government of British Columbia; Government of Canada, Natural Resources Canada, Centre for Topographic Information; Progress Energy Canada Ltd. WorldView-2 Imagery. Imagery date: 2011.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

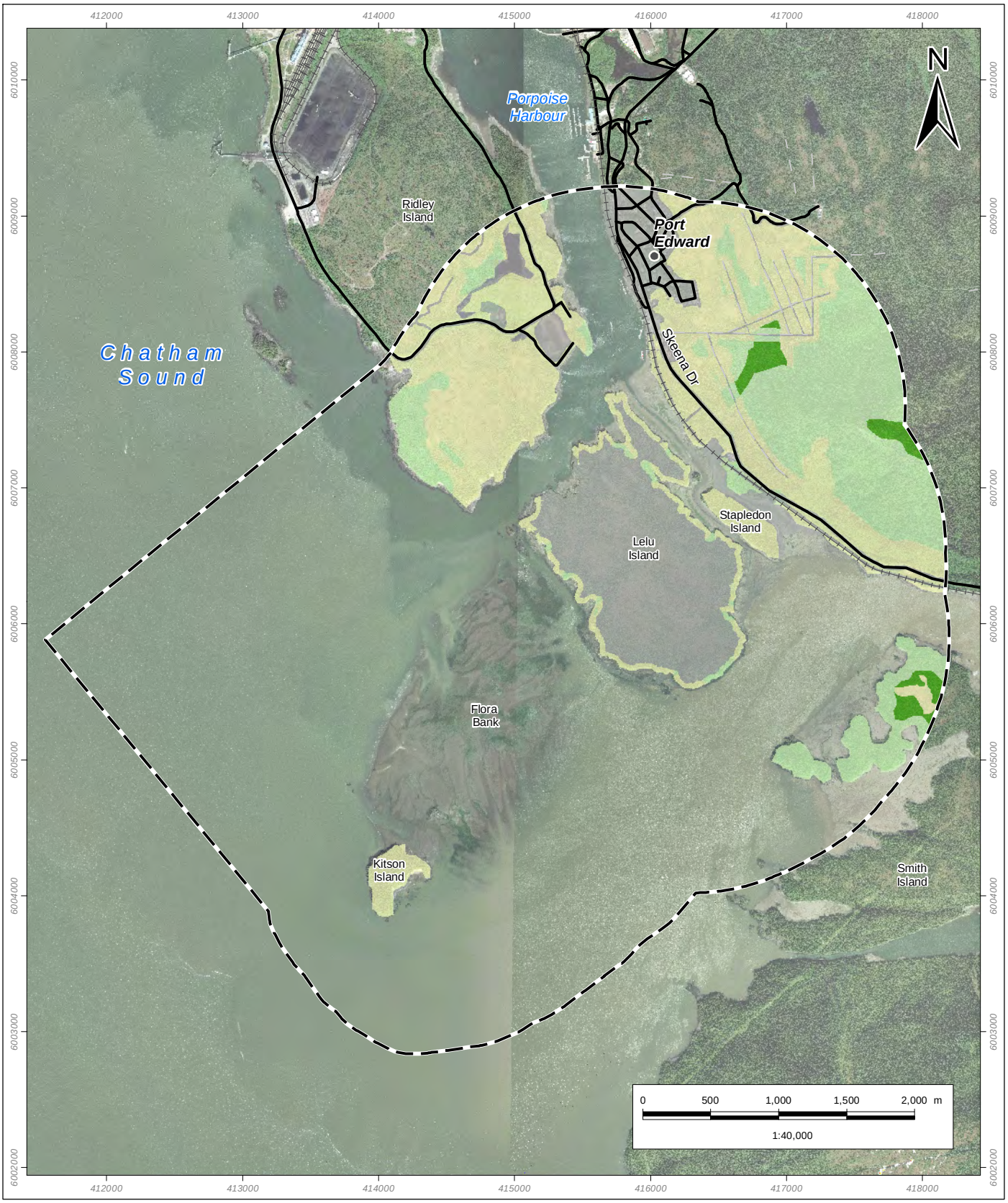
DATE: 11-FEB-14	PROJECTION: UTM - ZONE 9
FIGURE ID: 123110537-247	DATUM: NAD 83
DRAWN BY: K. POLL	CHECKED BY: M. WILLIE

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **11-13**

2/11/2014 - 10:43:51 AM V:\active\123110537\gis\figures\general\mxds\english\fig_123110537-247_northern_gpshawk_mbp_ea.mxd



Habitat Suitability Class

- High
- Moderate
- Low
- Nil
- Habitat Modelling Limits

- City or Town
- Cutline or Seismic Line
- Railway
- Road

Pacific NorthWest LNG

Project Build-out Breeding Habitat Suitability of Olive-sided Flycatcher

Sources: Government of British Columbia; Government of Canada, Natural Resources Canada, Centre for Topographic Information; Progress Energy Canada Ltd. WorldView-2 Imagery. Imagery date: 2011.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

DATE: 11-FEB-14	PROJECTION: UTM - ZONE 9
FIGURE ID: 123110537-248	DATUM: NAD 83
DRAWN BY: K. POLL	CHECKED BY: M. WILLIE

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **11-14**

2/11/2014 - 10:43:18 AM V:\active\123110537\gis\figures\general\mxds\english\fig_123110537-248_olive_sided_flycatcher_mbo_ea.mxd