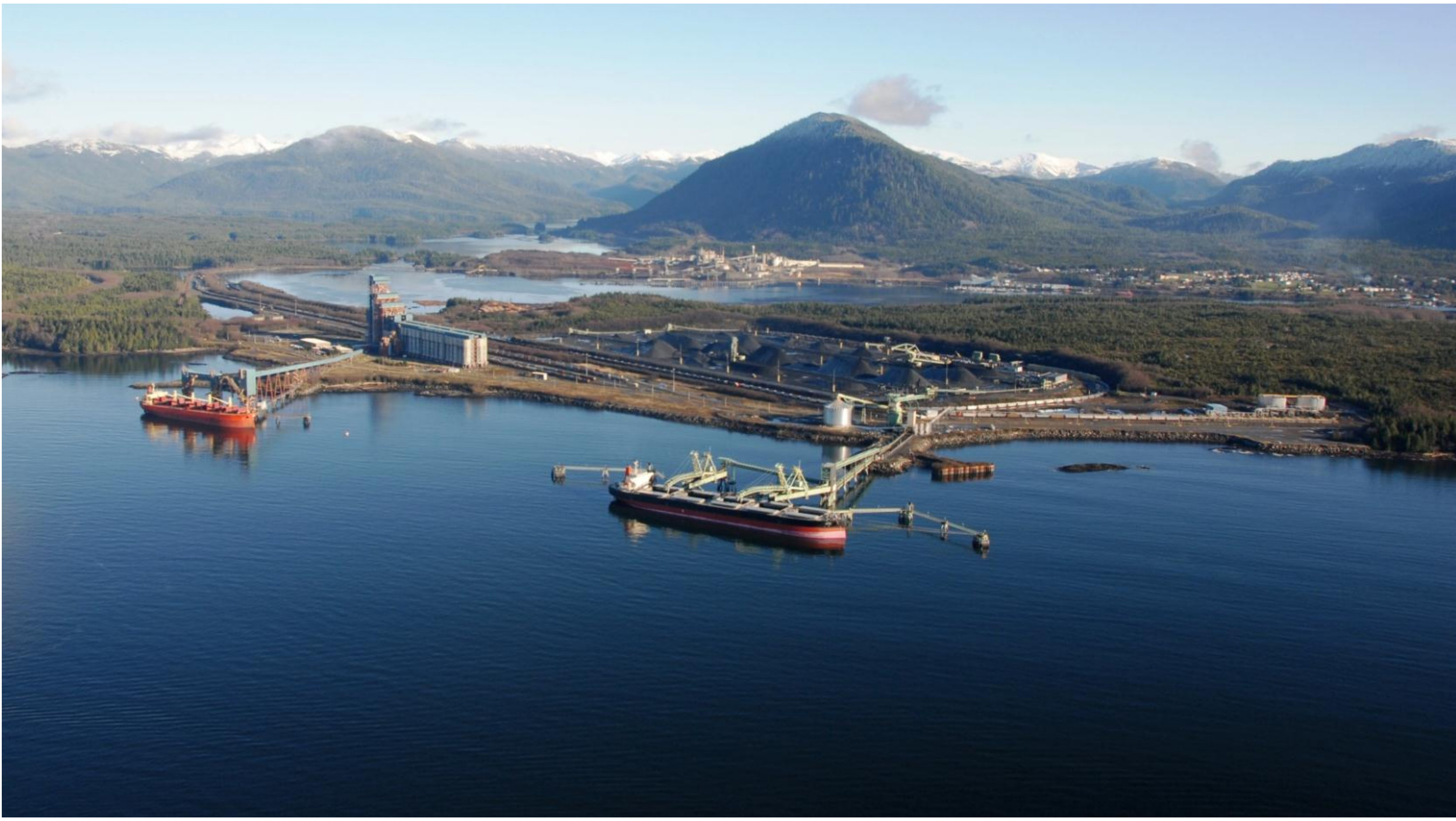

ENVIRONMENTAL IMPACT STATEMENT

Canpotex Potash Export Terminal and Ridley Island Road, Rail, and Utility Corridor

RIDLEY ISLAND, PRINCE RUPERT, BC

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EXECUTIVE SUMMARY

Project Overview

Canpotex Terminals Limited (Canpotex) and the Prince Rupert Port Authority (PRPA) are each proposing to undertake projects on Ridley Island in the Port of Prince Rupert, British Columbia (Port). Canpotex is proposing to construct and operate a potash export terminal (the Canpotex Potash Export Terminal) and the PRPA is proposing to construct enabling transportation and utilities (the Ridley Island Road, Rail and Utility Corridor). The Canpotex Potash Export Terminal will have the capacity to export up to 11.5 million tonnes of potash annually. The Ridley Island Road, Rail and Utility Corridor (RRUC) will service the Canpotex facility as well as other future developments on Ridley Island. A single Environmental Impact Statement (EIS) has been completed for the Canpotex Potash Export Terminal and the Ridley Island Road, Rail and Utility Corridor (referred to jointly as “the Project”) because the two projects are interdependent

The Project requires authorization or approval under section 35(2) of the *Fisheries Act*, section 5(2) of the *Navigable Waters Protection Act*, and section 127(1) of the *Canadian Environmental Protection Act* all of which are triggers under the *Canadian Environmental Assessment Law* List Regulations and therefore require preparation of an environmental assessment. The assessment will be completed at a comprehensive level because the design capacity for the terminal is to accept vessels that exceed the Comprehensive Study List Regulations trigger of 25,000 DWT. As the Project is located on Port property and a Canadian Port Authority is the proponent, completion of an assessment under the Canada Port Authority Environmental Assessment Regulations (CPAEAR) is also required.

Potash is a stable, non-toxic, non-flammable, non-hazardous mineral compound that consists primarily of potassium chloride (KCl). The potassium in potash is a major constituent of fertilizer and is also used in minimal amounts in sports drinks and a number of industrial processes. Recent increases in global food demand have resulted in an increased demand for fertilizer, and therefore potash. It is expected that this demand will continue to increase as pressures on global food supply increase. To meet this demand the proposed export terminal is being designed to export up to 11.5 million tonnes of potash annually. This will include approximately 500,000 tonnes of white potash and the remainder will be red potash.

Scope of the Project

On November 22, 2011 the Canadian Environmental Assessment Agency (CEA Agency) issued the EIS Guidelines that established the scope of the project, scope of the assessment, and consultation requirements. For purposes of the EIS the Canpotex Potash Export Terminal is defined as including:

- An approximately 739 m long marine causeway, access trestle, and berth and all weather ship loading facility capable of receiving vessels of up to 180,000 DWT
- A 180,000 tonne potash storage building with associated conveyor and dust collection systems
- An automated railcar unloading and covered conveyor system

- A settlement pond for storm water and wash down water
- Administrative, personnel, maintenance, and storage buildings
- Site services including water supply, natural gas and sewage.

The Ridley Island road, rail and utility corridor will include the following components:

- An approximately 7 – 8 km long rail loop, consisting of a rail bed for up to 14 inbound and 11 outbound tracks.
- Three inbound tracks and two outbound tracks will be laid exclusively for the Canpotex Terminal
- An approximately 3 – 4 km long 69 V transmission powerline connecting the Canpotex Terminal to the BC Hydro power transmission system.
- An inner paved access road loop with a rail overpass and underpass.

Scope of the Assessment

The EIS Guidelines directed the proponents to consider potential Project-related environmental effects on the following Valued Environmental Components (VECs):

- Air Quality
- Noise and Vibration
- Ambient Light
- Vegetation Resources
- Wildlife and Wildlife Habitat
- Aquatic Environment
- Human Health
- Archaeological and Heritage Resources
- First Nations Current Use
- Navigable Waters.

The environmental effects analyses are based on existing data, field studies conducted between 2009 and 2011, and emissions modeling. The assessment also considers the potential effects of accidents and malfunctions that may occur during construction or operation of the Project including: spills; derailments; vessel collisions or groundings; marine mammal vessel strikes; and train collisions with an ungulate.

Consultation

Canpotex and the PRPA have undertaken a number of consultation activities to inform First Nations, the public, stakeholders and government regulatory agencies about the Project, and to seek input during Project planning. Prior to posting of the Notice of Commencement to initiate the CEAA assessment process, Canpotex carried out a number of early engagement activities with potentially interested First Nations (Metlakatla, Lax Kw'alaams, Gitxaala, Kitselas and Kitsumkalum) and other stakeholders in the region. On April 8, 2009 a preliminary Project Description was sent to First Nations along with an offering to come to the communities to discuss the Project. Meetings with the interested First Nations have been ongoing since this time and Canpotex and the PRPA have provided capacity-funding to support their participation in consultation activities and the Project review process.

On August 29, 2011 the *Background Document: Initial Federal Public Comment Period* was posted for a 30 day public comment period. On the same day the draft EIS Guidelines were submitted to the CEA Agency for distribution to the working group and interested First Nations. A summary of issues that were raised during the public review of the background document and working group review of the EIS Guidelines is provided in Table ES-1.

Table ES-1: Summary of Issues from Initial First Nations Engagement and Public Consultation

Primary Issue	How the Issue is Addressed in the EIS
The scope of the Project should include marine vessel operation and navigation out to the pilotage station at Triple Islands.	Scope of assessment has been increased out to Triple Islands for the assessment of vessel activity and accidents and malfunctions.
The transportation of dredged materials as well as the effects of disposing those materials should be addressed in the assessment.	A separate report assessing the effects of disposal of dredge material at proposed disposal sites has been completed and summarized in the EIS.
Metlakatla and other potential vessel users in Prince Rupert (i.e., tourism operators) should be consulted with regarding their use of waters in the Prince Rupert Area.	Interviews were conducted as part of the Navigation assessment. Traditional Use Studies that include discussions on water use have been requested from First Nations.
Vibration should be included as a VEC.	EIS expanded to include vibration under the heading "Noise and Vibration".
The scope of the project should include traffic along the rail corridor to Lorne Creek.	The scope of assessment has been increased to include the assessment of air, noise and vibration, and ungulate strikes along the rail line to Lorne Creek.
The list of projects to be included in the Cumulative Effects Assessment should include the Port Land Use Plan.	The cumulative effects Project Inclusion List has been expanded to include land use developments as outlined in the Port Land Use Plan.
The Navigation Assessment should include 'interference with existing use' as a measureable parameter.	"Interference with Existing Use" has been added as a measureable parameter.
Disposal at sea sites other than Brown Passage should be considered.	Two new disposal at sea sites are being proposed. A full effects assessment has been completed for these sites.
Include the effects of the causeway on water movement in the channel.	The aquatics section includes findings from a modeling exercise on changes in water and sediment deposition as a result of construction of the causeway.
Consider maintaining access to the beach on the southeast corner of Ridley Island.	On land access to the beach via the road on Ridley Island cannot be provided due to Port protocol and public safety. This is discussed in the EIS.
Potential for increases in marine traffic accidents as a result of new projects should be assessed.	This issue is included in the accidents and malfunctions section.

Mitigation Measures

Opportunities to reduce or eliminate potential environmental effects of the Project have been incorporated into the overall planning and design of the Project. Key site selection considerations, engineering design features, and operational procedures that have been incorporated into the design and planning process to reduce or eliminate potential adverse environmental effects including:

- The site was selected to avoid any unnecessary new roads, rail lines or infrastructure.
- The length of the causeway has been reduced by 216 m thus reducing the marine footprint.
- There are no streams, ponds or open water within the terminal or road, rail and utility corridor footprint, therefore no freshwater fish or waterfowl are affected.
- At-sea disposal sites located within PRPA boundaries as opposed to at Brown Passage are being proposed therefore reducing the travel time and associated emissions for disposal of dredge material.
- During all phases of the Project, Canpotex and the PRPA will limit traffic between Prince Rupert and Ridley Island through use of buses, crew cab trucks and other group transportation options when practical. This will primarily apply to travel requirements for shift changes.

Summary of Environmental Effects

The following sections summarize the potential Project-related environmental effects addressed in the EIS.

Air Quality

Project air emissions of criteria air contaminants (CAC); sulphur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), inhalable particulate matter (PM_{10}), inhalable particulate matter ($PM_{2.5}$) have been assessed. Predicted dispersion concentrations were made using the US EPA CALPUFF modelling system and results compared with the relevant Canada ambient air quality objectives. The results were also compared with the British Columbia ambient air quality objectives. The dispersion modelling considered four distinct scenarios: the Baseline Case which assessed emissions from the existing facilities; the Project Case that included emissions from the Project alone; the Application Case that included the emissions of the Baseline Case plus emissions of the Project; and the Cumulative Effects Case that is the Application Case plus emissions from foreseeable future projects in the area. The assessment results indicated that the CAC concentrations for all cases are below the most stringent Canada ambient air quality objectives. The most stringent British Columbia air quality objectives for 24-hour averaged PM10 and annual averaged $PM_{2.5}$ may be exceeded, 49% and 19% respectively, but only for a very small area over the water to the northwest of the wharf. There were no exceedances of any relevant regulatory objectives at any of identified sensitive receptor locations. As the effects of all criteria air contaminants are within the Canada and British Columbia objectives for all averaging periods or the British Columbia objectives exceedances are over areas of no concern, the potential effects of the Project on air quality are not significant.

Project air emissions of greenhouse gases (GHG) were also assessed and compared with the Canada and British Columbia year 2020 projected totals. GHG emissions from Operations are very small in comparison with the year 2020 projected Canada (about 0.004%) and British Columbia (about 0.05%) GHG emission totals. The potential effects of the Project on climate change are not significant.

Noise and Vibration

The Canpotex facility is physically separated from the nearest affected residences in Port Edward by distance, the topography of Ridley Island, and the water body separating Ridley Island from the mainland. The impact of the facility in the construction phase and the operation phase is based on providing the sound metrics advocated by Health Canada for use in Environmental Assessments. The noise in the construction of the port facilities and the storage facilities will be attenuated by the distance and topography, and sound levels can be adequately controlled in Port Edward despite the need for nighttime construction at the port facility and the storage area. The rail corridor is closer to the village, but construction will be confined to daytime activity. During operations, the distance provides adequate attenuation of the sound from the activities on Ridley Island and the marine terminal. The increased rail traffic that passes through Port Edward and inland is closer to the potentially affected receptors, but remains within the criterion of Health Canada. The village of Port Edward is situated on a rail line that is being expanded by growth of the freight and materials shipment through Ridley Terminals and Fairview Terminal. The incremental change of noise by adding the traffic of Canpotex to that of the existing plus Fairview plus Ridley Terminals traffic is less than the threshold specified by Health Canada. As a result, effects of the project on noise are expected to be not significant.

Vibration along the route will not change substantially due to the Canpotex operations although train passages will be more frequent and within acceptable limits. Based on this conclusion, effects of the project on vibration are expected to be not significant.

Ambient Light

Light pollution effects were assessed by considering the visibility during the construction and operational phases. During construction, control over lighting by contractors can be limited, but the topography of Ridley Island will shield Port Edward from most of the temporary lighting that may be used in the construction phase. The lighting for the operational phase has been designed to reduce light pollution. The lighting at the terminal will likely not visible from Port Edward, and has also been designed with full horizontal cutoff fixtures so that the sky glow due to the project will be substantially reduced than would be the case with older style light fixtures. The retention of the tree cover wherever possible, but particularly on the highest ground of Ridley Island will further reduce the impact of light at Port Edward. With mitigation measures in place effects of the project on ambient light are expected to be not significant.

Vegetation

During rare plant surveys two provincially listed rare vascular plants were found on Ridley Island, occurring outside of the Project footprint; no SARA listed plants were observed. There will be no direct loss of observed rare plants due to the Project.

A total of 69 ha of wetland occur in the Project footprint and will be lost. These wetlands provide biogeochemical, climate, and habitat functions. Residual effects to wetland function are expected to be neutral as a Wetland Compensation Plan will be developed.

A total of 15.6 ha of ecological communities of conservation concern occur in the Project footprint and will be lost. This includes one Red-listed wetland community, two Blue-listed wetland communities, and two Blue-listed upland communities. This loss represents 28% of ecological communities of conservation concern mapped on Ridley Island. Loss of wetland communities of conservation concern will be mitigated through development of a Wetland Compensation Plan. Loss of upland communities of conservation concern is expected to be far below thresholds outlined by the Central and North Coast Order (CNCO) for the Kaien Landscape Unit.

A total of 36 ha of old forest and 47 ha of riparian area will be lost due to the Project. These losses are well within the recommendations by the CNCO for retention of old forest and riparian areas in the Kaien Landscape Unit.

Traditional use plants will be lost due to vegetation clearing for the Project; these species are very common on Ridley Island, as well as regionally and provincially. Where practical, traditional use plants will be incorporated into the Wetland Compensation Plan.

Based on the findings of this assessment and the commitment to develop a Wetland Compensation Plan, potential effects of the Project on vegetation resources are considered not significant.

Wildlife and Wildlife Habitat

The assessment considered the effects of the Project on SARA listed species, nesting migratory birds and marine birds. To assess effects on species-at-risk, marbled murrelet, northern goshawk and western toad were chosen as indicator species.

The assessment considered Project effects on habitat, animal movement patterns, and mortality. Table ES-2 lists the results of the habitat suitability models for these indicator species.

Table ES-2: Amount of Suitable Habitat on Ridley Island for Indicator Species

Species	Life Requisite and Season	Area of Suitable Habitat at Baseline (ha)	Percent of the LAA[1] (%)
Marbled Murrelet	Breeding requirements in spring and summer	8.1	1.5%
Northern Goshawk	Breeding requirements in spring and summer	49.0	9.1%
Western Toad	Living requirements in all seasons	360.6	67.0%
	Breeding requirements during spring	24.0	4.5%
Total Mapped Area of Ridley Island		**537.9**	

NOTE:
[1] LAA- Local Assessment Area

The most common bird species are winter wren, Swainson's thrush, Townsend's warbler, and dark-eyed junco. Less common species include hermit thrush, northern flicker, Stellar's jay, and yellow warbler. Barn swallow is the only listed-species (COSEWIC Threatened) recorded during breeding bird surveys. In addition to migratory bird nests there are two bald eagle nests on Ridley Island which will be avoided by construction activities.

The most abundant species recorded during the marine bird surveys were unidentified species of gulls, bald eagle, northwestern crow, mew gull, and marbled murrelet. Federally listed species-at-risk observed during marine bird surveys included marbled murrelet and great blue heron.

The number of individuals displaced by habitat alteration for most wildlife species on Ridley Island is very small and will not affect their species population. For western toad, habitat availability on Ridley Island will be reduced; however, it is very small compared to the habitat available along the North Coast of British Columbia and throughout their range in the province. Most importantly, the habitat compensation program will replace and protect terrestrial and breeding habitat for western toads, and will provide habitat for many other species of wildlife. Given the proposed wetland habitat compensation the Project effect of change in habitat availability on wildlife is predicted to be not significant.

Overall, with mitigation measures in place, the risk of mortality for most wildlife is low. Consequently, the risk of mortality on wildlife is considered not significant.

With mitigation measures in place, the effect of alteration of movement on wildlife is anticipated to be not significant.

Aquatic Environment

The Aquatic Environment assessment considers effects of the Project on marine fish and fish habitat. Effects on freshwater fish and fish habitat are not considered, as previous studies conducted on Ridley Island indicate there is no suitable freshwater fish habitat within the Project footprint. Project activities associated with the construction and operation of the marine terminal and the road, rail and utility corridor may result in: loss or alteration of marine fish habitat; direct mortality or physical injury; sensory disturbance (related to underwater noise); and degradation of water and sediment quality. The *Fisheries Act* provides legal protection to fish and their habitats. Section 35 of the Act prohibits harmful alteration, disruption or destruction of fish habitat (HADD) without authorization, and Section 32 prohibits killing of fish without authorization. Where HADD is unavoidable, compensation measures must be undertaken to ensure that there is no net loss of productive capacity of fish habitats.

Project construction activities will result in the loss, alteration, and/or disruption of 265,550 m^2 of marine fish habitat. This includes 66,200 m^2 of intertidal substrate loss/alteration (infilling), 12,720 m^2 of subtidal substrate loss/alteration (infilling), 161,000 m^2 of subtidal substrate disruption (dredging), 25,350 m^2 of backshore vegetation loss (clearing), and small areas of kelp and eelgrass habitat (infilling). All species of fish, invertebrates and algae surveyed are common on the north coast of British Columbia; no rare or endangered species were observed. To ensure that there is not net loss of productive capacity of marine fish habitats, a detailed habitat compensation plan (HCP) is being developed in collaboration with DFO. This plan will include the creation of high-productivity habitats, including a subtidal reef and an eelgrass bed, as well as the restoration of intertidal and subtidal habitats.

Shoreline infilling and dredging activities will result in the direct mortality of some marine invertebrates. Mobile species such as fish and marine mammals are expected to move away from the construction area, and are not likely to be affected. Loud in-water construction activities such as blasting and pile driving may cause some fish and marine mammals to temporarily avoid the ensonified area; however, sound levels will not be of sufficient intensity to cause physical harm. A blasting management plan will be developed to reduce underwater pressure levels and minimize potential effects on marine organisms. Where feasible, piles will be installed using a vibratory driver, which produces significantly less noise than the conventional impact hammer. If an impact hammer is required, bubble curtains will be employed to provide noise attenuation and reduce sound levels emitted in the marine environment.

Dredging of subtidal sediment and the disposal of this material at sea will result in localized increases in total suspended solid (TSS) levels. TSS monitoring will be conducted throughout Project construction to ensure that levels do not exceed the established guidelines. Re-suspension of contaminants is not considered an issue, as sediment sampling within the dredge area revealed no exceedances of regional contaminant guidelines. All stormwater, wastewater and sewage associated with the terminal will be collected and treated prior to being discharged into the marine environment.

Marine fish habitats affected by the Project represent a small fraction of the available habitat in the Prince Rupert region. The creation of compensation habitats will ensure that the productive capacity of the marine environment is not diminished. Throughout all phases of the Project, best management practices will be employed to reduce or eliminate adverse effects on marine fish and fish habitat. With the proposed mitigation, the residual effects of the Project on the Aquatic Environment are predicted to be not significant.

Human Health

The human health assessment evaluated potential human health effects associated with Project-related air emissions, ambient light and noise emissions, changes in local water and sediment quality, and potash exposure. Dredging and construction of marine facilities have the potential to mobilize contaminants into water and sediment which may be transferred up the food chain, and emissions from trains and vessels may adversely affect ambient air quality. Changes in ambient light and noise associated with Project activities may result in disturbances to local people

Accumulation of metals and polycyclic aromatic hydrocarbons (PAHs) in fish as a result of dredging is not anticipated, as suspension of sediments will be short-term and localized. Therefore, no adverse human health effects are anticipated as a result of fish consumption.

Predicted maximum ground level concentrations of criteria air contaminants (SO_2, NO_2, CO, PM_{10}, and $PM_{2.5}$) are below regulatory air quality objectives; therefore, air emissions will not pose a risk to humans near the site.

Modeling of predicted light levels during operations indicates no effects to most local residents. During construction of the plant and marine terminal, use of mobile equipment will not be visible to local residents, other than somewhat greater skyglow. Implementation of mitigation measures will reduce potential increases in ambient light. Predictive noise modeling indicates no exceedance of Health Canada guidance, and therefore, no noise-related human health effects.

Potash (potassium salt) is nontoxic at concentrations that would be encountered near the site and does not pose a risk to local residents. On-site dust control measures and personal protective equipment will minimize exposure of workers, preventing potential health effects such as eye or skin irritation.

The assessment concluded that use of appropriate mitigation practices during construction and operations will ensure that regulatory objectives are met and protect the quality of life and the health of local residents. Project-related effects on human health are predicted to be not significant.

Archaeological and Heritage Resources

Seventeen heritage sites, including 18 culturally modified tree (CMT) sites, are recorded on Ridley Island. However, a 2011 archaeological impact assessment conducted on the Canpotex Terminal footprint, including offshore components on and east of Coast Island, did not identify any intertidal, terrestrial or CMT sites within the terminal footprint (i.e., low archaeological potential). Previous studies on Ridley Island have concluded that portions of seven CMT sites are located within the Project's road, rail and utility corridor component and could be affected by project development.

In the very unlikely event that unrecorded terrestrial or intertidal sites are encountered during development, every effort will be made to avoid them. Where avoidance is not possible, effects on these sites will be mitigated through a program of detailed data collection, including systematic data recovery. Where CMTs cannot be avoided by development, effects on them will be mitigated through a complete systematic recording and dating program. Therefore, as none of the information regarding traditional aboriginal, terrestrial and intertidal use within the Project footprint will be lost, effects on Archaeological and Heritage Resources are considered to be not significant.

First Nations Current Uses

The Project will occur on Port lands within the claimed traditional territories of Tsimshian Nations. Five Tsimshian First Nation communities claim Aboriginal Rights and/or interests in the Prince Rupert Harbour area and/or up to Kitaelas Canyon: Metlakatla First Nation, Lax Kw'alaams First Nation, Gitxaala Nation, Kitselas Indian Band, and Kitsumkalum Band.

Vegetative resources (e.g., bark, berries) will be affected and will either be removed or inaccessible in the immediate Project area. Marine resources (e.g., fish, shellfish) in the intertidal and subtidal environments directly associated with the Project will also be affected or inaccessible. This includes resources affected during dredging and disposal activities. However, the general availability of First Nations traditional resources in the areas adjacent to the Project footprint are not expected to diminish and alternative locations to carry out traditional activities exist nearby. It is expected that members of nearby First Nations communities will be able to reasonably continue their traditional resource use activities; however, locations of these activities will now be restricted to areas that are outside of the Project footprint.

Navigable Waters

The navigable waters assessment considered the Project's ability to comply with the *Navigable Waters Protection Act* (NWPA), which protects the public's right to navigate, and regulates construction of works that may infringe on this right. The assessment considered the effects of the Project on all navigable waters between the Project site and the pilot station at Triple Islands.

Multiple navigation systems and controls will be in place to guide Project-related vessel movements during terminal construction and operation. Based on the assessment, the potential effects on vessel traffic will be low and not significant.

Effects of the Environment on the Project

The types of environmental factors that have potential to affect the Project include slope instability, extreme weather, seismic activity and tsunamis, and climate change and sea level rise. There are no hills within the property that could lead to a landslide. Due to the exposure of Ridley Island to wave action from Chatham Sound there is the possibility that extreme weather resulting in high winds and waves, dense sea foam and poor visibility could result in temporary closure of the terminal. However, the potential for extreme weather to affect operations is considered low due to the low probability of an extreme weather event and the design criteria followed during project development.

The Project is located in an area of high seismic activity. An earthquake of significant magnitude could lead to permanent lateral ground movement and alter the berth and trestle foundation, potentially leading to settlement and/or damage to the structure. To minimize the potential for these effects, the structure was designed to accommodate the seismic movement in a 1 in 475 year seismic event. Should an earthquake result in a tsunami, the Project is designed to withstand significant waves in 50 year return periods. As a result of Project design measures seismic activity is not expected to have a significant impact on the Project.

Increasing concentrations of greenhouse gases in the atmosphere are believed to be causing global climate change. Increased temperature may contribute to a sea level rise. The Project has been designed to meet extreme weather criteria identified in the National Building Code (2005). In addition, a conservative sea level rise of 1.0 m has been incorporated into the design.

Based on a consideration of the various mitigative strategies applied throughout design criteria and the EMP, it is concluded that significant adverse effects of the environment on the Project are not likely.

Accidents and Malfunctions

Potential accidents and malfunctions that were considered in the EIS are:

- Train derailment along the Skeena River (upstream of the eulachon spawning reach)
- Fuel spill at the terminal refuelling station
- Potash spill to the marine environment
- Marine vessel collision with another vessel or grounding
- Marine vessel collision with a marine mammal
- Train collision with an ungulate.

A train derailment along the Skeena has the potential to result in the release of toxic and non-toxic substances into the Skeena potentially affecting Aquatic Resources, Current Traditional Use and/or Human Health. Depending on the timing and location of the release there is the potential to affect juvenile salmon and/or eulachon and their habitat. However, given the mitigation in place and the Emergency Response Plans the effects of a spill would likely be localized though it may result in temporary disturbance to some freshwater species and habitat during clean up. Such a disturbance is expected to be short term, localized and reversible. Therefore the potential residual effects associated with a train derailment are expected to be not significant. A fuel spill at the terminal is not expected to pose a major risk to the environment as it would occur in a disturbed area where there are no watercourses and all on-site drainage would be collected in an on-site retention pond. As a result, an on-site spill is only expected to affect surface soil.

The release of potash into the marine environment as a result of equipment malfunction or operator error could cause localized increase in salinity in the marine environment, which has the potential to affect marine species intolerant to salinity changes. Marine waters surrounding the terminal exhibit dynamic fluctuations in salinity (as a result of seasonal inputs of freshwater from the Skeena River) and any localized increases in salinity would dissipate rapidly. Species living in environments with dynamic salinity fluctuations have adapted to those conditions and are generally tolerant of changes. If the spill accumulated on intertidal habitat it could result in death of organisms that have low salt tolerance levels. However, because potash is non-toxic, only those organisms directly exposed to it would be affected. The accidental input of potash to the marine environment may have temporary, localized effects on marine biota. However, as potash dissolves rapidly in water and is non-toxic, these effects are expected to be minimal.

Marine vessel collisions and groundings could result in the puncturing of a vessel's fuel tank. In a worst case scenario, this could result in the release of 4,000 m^3 of heavy fuel oil. Given recent records the likelihood of such incidents occurring is considered very low. For the period of 1998 to 2008, there were six reported incidents involving marine vessels in the Prince Rupert area. Of the six reported incidents, three involved bulk cargo vessels. In two cases, the vessel sustained considerable to extensive damage as a result of grounding, but in neither case were fuel tanks punctured. The last recorded incident involving a bulk carrier in the Prince Rupert area occurred in 2001, again with no fuel loss. Considering the number of vessels that call on the Port of Prince Rupert every year (increasing from 215 to 380 between 2006 and 2010) the incidence of vessel collisions and groundings is extremely low.

Vessels strikes with marine mammals can result in injury or death of a whale. Within the assessment area, bulk carrier vessels may encounter several species of large baleen whales, including humpback whales. The probability that a bulk carrier vessel will strike a humpback whale is extremely low. In an extensive worldwide review of vessel collisions with whales only 44 cases of humpback whales being struck by vessels were identified. The maximum speed limit (14 knots) that will be observed by bulk carriers calling on the Canpotex Terminal will reduce the likelihood of a collision with a humpback whale. Current research suggests that the probability and severity of a vessel strike is positively correlated with a vessel's speed. With the proposed mitigation measure to reduce vessel speed, it is considered highly unlikely that a bulk carrier calling on the Canpotex Terminal will strike a marine mammal.

Train collisions with an ungulate could lead to injury and death. Such incidences are known to occur along the rail line between Ridley Island and Lorne Creek. Studies are underway to identify ways to reduce the likelihood of a strike including use of fencing, whistle calls and brush and snow management. The number of trains associated with the Canpotex Project is not expected to result in a significant effect on ungulate population numbers. The cumulative effect of collisions as a result of all projects in the area is a concern for the local population, but not regionally, because populations are relatively strong and can handle hunting pressures that result in the loss of up to 9% of the population annually. As a result the effects on the regional population are considered not significant.

Capacity of Renewable Resources

Renewable resources on Ridley Island and in Prince Rupert Harbour include vegetation, wildlife, and aquatic resources. An adverse effect on these resources could result in a reduced capacity to support sustainable forestry, fishing, hunting and trapping. However, after consideration of Project design and Project—specific mitigation and compensation measures, none of these thresholds or standards were exceeded. Therefore the determination for each of the renewable resources was that the Project would not result in significant adverse residual effects. Due to the lack of residual effects, the effects of the Project on the capacity of renewable resources are predicted to be not significant.

Conclusion

No adverse biological, health or heritage effects are predicted. Residual effects are predicted to be of low magnitude, range in duration from short-term to long-term, localized in geographic extent and reversible at the terminal site following decommissioning.

The environmental effects of the Project, as summarized above, have been determined using assessment methods and analytical tools that reflect current best practices of environmental and socio-economic practitioners. It is the conclusion of the EIS that the Project can be constructed, operated and decommissioned without significant adverse effects, including consideration of cumulative effects and accidents and malfunctions. The Project, as proposed, will benefit the local and regional economy with the addition of new industrial and transportation infrastructure and activities on lands designated for that purpose.

AUTHORSHIP

This Environmental Impact Statement has been prepared by a multi-disciplinary team of professionals. Stantec Consulting Ltd. is the primary author of the document. Project Management was provided by Sandra Webster, Ph.D., R.P.Bio. Senior Review was provided by Robert Federico, B.Sc., and Ward Prystay M.Sc., R.P.Bio. The effects assessments were completed by Stantec team members. The primary authors of this report are:

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TABLE OF CONCORDANCE

Table 1: Table of Concordance – EIS Guidelines

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19 Capacity of Renewable Resources	
19 Capacity of Renewable Resources	19 Capacity of Renewable Resources
20 Summary of Environmental Effects and Mitigation Measures	
20 Summary of Environmental Effects and Mitigation Measures	20 Summary of Environmental Effects and Mitigation Measures
20.1 Summary of Environmental Effects	20.2 Summary of Residual Effects
20.2 Summary of Mitigation Measures	20.1 Summary of Mitigation Measures
20.3 Summary of Residual Effects	20.2 Summary of Residual Effects
20.4 Summary of Cumulative Environmental Effects	20.3 Summary of Cumulative Environmental Effects
20.5 Summary of Significance Determinations	20.4 Summary of Significance Determinations
20.6 Summary of Aboriginal Engagement and Consultation	20.5 Summary of Aboriginal Engagement and Consultation
20.7 Conclusions	20.6 Conclusions
20.8 Summary Table	20.8 Summary Table

EIS Guidelines	Section
21 Environmental Management	
21 Environmental Management	21 Environmental Management
21.1 Planning	21.1. Planning 21.2 Environmental Management Plan 21.2.1.1 Health and Safety Management Plan 21.2.1.2 Air Quality and Dust Control Plan 21.2.1.3 Noise, Vibration, and Ambient Light Management 21.2.1.4 Spill Prevention and Emergency Response Plan 21.2.1.5 Water Management Plan 21.2.1.6 Habitat Mitigation and Compensation Plan 21.2.1.7 Archaeological Resource Monitoring Plan 21.2.1.8 Blast Management Plan 21.2.1.9 Environmental Monitoring Plan 21.2.1.10 Erosion and Sediment Control Plan 21.2.1.11 Weed Control Plan
21.1.1 Decommissioning and Reclamation Plan	21.3 Decommissioning and Reclamation Plan
21.2 Follow-up and Monitoring Program	21.4 Follow-up and Monitoring Program
22 Benefits to Canadians	
22 Benefits to Canadians	22.0 Benefits to Canadians
23 Summary of Commitments	
23 Summary of Commitments	23.0 Summary of Commitments

Table 2: Table of Concordance—Comments of EIS Guidelines

ID #	Comment	Section
21	Advise that information regarding the location of the project and the distance to all potential human receptors for different uses (residential, recreational, etc.) within the area affected by the project be included in the air quality assessment.	7.3.2.1 Potential Effects Air Quality Technical Data Report (Stantec 2011)
22	Advise that ambient air quality monitoring include all CACs (i.e. VOCs, NH3, ozone), and potential contaminants and emissions occurring in the area. For any contaminants and emissions not being considered, a rationale should be included to explain why this is the case.	7.1.2 Key Issues 7.1.3 Selection of Measurable Parameters 7.1.3.1 Criteria Air Contaminants 7.2.2 Air Quality Baseline Air Quality Technical Data Report
23	Advise that more detailed commitments be provided here in place of the last sentence. For example, HC advises that where modelling results predict exceedences (or near exceedences) of applicable air quality standards or guidelines, that a discussion of the potential impacts on human health be included. Also advise that information be included on mitigation measures that will be undertaken to minimize any negative impacts to air quality during all phases of the project.	13.3.3.1 Potential Effects 7.3.2.2 Mitigation
24	Advise that potential noise-related human health endpoints (i.e. sleep disturbance) be considered in addition to percent highly annoyed. Note that the change in % HA, when considered alone, will not necessarily be predictive of all noise-related human health effects when discrete noise events occur in addition to sustained project-related noise. Health Canada advises using additional methodology to evaluate human health impacts related to these discrete noise events.	8.1.2 Key Issues 8.1.3 Selection of Measurable Parameters 8.3.1 Assessment Methods 8.3.2.1 Potential Effects
25	Advise that all noise-sensitive human receptors (e.g. Port Edward residences, daycares, school, hospitals, nursing homes, and First Nations communities) and their locations relative to the project area be identified, and that current and project-related noise levels be mapped at various distances (i.e.. through the use of noise contours) to enable a comparison of baseline noise levels with predicted noise levels at receptors.	8.3.1 Assessment Methods 8.3.2.1 Potential Effects
26	In addition to assessing sustained project noises, it is advised that all intermittent, tonal and impulsive noises (i.e. whistles from train operation) be identified during all project phases.	8.3.2.1 Potential Effects
27	Advise that the local study area (geographic extent) be inclusive of the Village of Port Edward, and that the regional geographic extent be inclusive of Prince Rupert.	3.4.2.1 Local Assessment Area 3.4.2.2. Regional Assessment Area
28	Advise that in addition to outlining a follow-up monitoring program, that possible noise mitigation measures also be identified (i.e. community consultation and complaint resolution mechanisms).	8.3.2.2 Mitigation

ID #	Comment	Section
29	Strongly advise that a tiered approach* be undertaken for the country foods assessment, such that a quantitative assessment be conducted if it is identified that there is a potential for the contamination of country foods (both marine and terrestrial) that are consumed by residents or First Nations. (Note that for a relatively simple HHRA, as few as 5 to 10 tissue samples could be collected for each species and tissue of interest.)	13.3.2.1 Potential Effects
30	Advise that any human health risk assessment undertaken include a full inventory of potential contaminants, human receptor(s), and existing pathway(s) for human exposure. Also discuss whether there are currently any recreational uses of Ridley Island (i.e. swimming at a local beach), and any consumption of water sources (surface or ground) from undeveloped areas of the island. For any contaminants/pathways not being considered, a rationale should be included to clearly explain why this is the case.	13.1.3 Selection of Measurable Parameters 13.3.1 Assessment Methods 13.3.1.1 Risk Assessment Evaluation Process 13.3.1.2 Potential Human Receptors 13.3.1.3 Potential Human Exposure Pathways 13.3.1.4 Potential Chemical Hazards
31	Advise that for the country foods assessment, a local study area be considered that is inclusive of Ridley Island and surrounding waters affected by project activities. Also advise that the regional study areas be inclusive of the Village of Port Edward and any surrounding areas utilized by First Nations communities for traditional purposes (i.e. hunting or harvesting).	3.4.2.1 Local Assessment Area 3.4.2.2. Regional Assessment Area 13.3.1.2 Potential Human Receptors
32	Advise that a description of mitigation and risk management options be included in cases where potential exposure exceeds toxicological reference values, and that there be a discussion of uncertainties in the exposure and risk estimates.	13.3.2.2 Mitigation 13.3.3.2 Mitigation 13.3.1.1 Risk Evaluation Process
34	Add excavated rock and crushing and screening onto the list of key aspects of project construction	2.4.1 Construction
35	The Metlakatla Nation raised several concerns at the working group meeting pertaining to impacts on traditional fishing areas near Stephens Island, marine mammal vessel strikes, and spills from vessels servicing the project. There are sensitive species that could be negatively impacted by the project-related increase in marine transport as well as VEC's that could also be affected by increased marine transport activities. It is also likely that the increase in marine traffic, when combined with other past and reasonably foreseeable projects could result in cumulative environmental effects. Due to the increase in potential for marine vessel accidents and spills, especially surrounding areas used by First Nations for traditional fishing activities, Transport Canada recommends the spatial boundary for the marine assessment to be the Triple Island Pilotage Station including the anchorages near Stephen's Island.	3.4.2.2 Regional Assessment Area 18.7 Marine Vessel Collision or Grounding 18.8 Marine Vessel Collision with a Marine Mammal
37	In the Cumulative Effects Assessment Guidance from the Agency it states that "Reasonably Foreseeable" projects could include those projects identified in a development plan in which approval is imminent. Transport Canada recommends the cumulative effects assessment include other projects identified in the Prince Rupert Port Authority's Land Use Plan.	3.5.4 Project Inclusion List

ID #	Comment	Section
38	Inclusion of the Naikun Wind Development project in the cumulative effects analysis as it would be considered "Reasonably Foreseeable" as defined in the Cumulative Effects Guidance	3.5.4 Project Inclusion List
51	The scope of the Project should include marine vessel operation and navigation beyond the borders of the Prince Rupert Harbour boundaries to include all project-related navigation activities occurring within Metlakatla territory. The increase in shipping as well as navigational and operational considerations resulting from piloting ships and establishing anchorages in Metlakatla territory will impact a number of environmental and socioeconomic factors that should be assessed and considered during the EA process.	3.4.2.2 Regional Assessment Area 18.7 Marine Vessel Collision or Grounding 18.8 Marine Vessel Collision with a Marine Mammal 16.3.2 Physical Interference 16.3.3 Change in Vessel Traffic
52	Under "Marine Facilities", not only "the transportation of dredged materials to the ocean disposal site", should be considered, but the action and results of the disposal of material itself must be included in the assessment and considered when establishing geographic and temporal boundaries to the assessment.	12.3.2 Loss or Alteration of Fish Habitat 12.3.3 Direct Mortality or Physical Injury 12.3.5 Degradation of Sediment and Water Quality
54	Under Effects of the Environment on the Project Include impacts of naturally occurring erosion and sedimentation processes on shoreline, berth area, and permanent structures	17.0 Effects of the Environment on the Project
55	Metlakatla would like to ensure cumulative environmental effects as a result of interactions between the Canpotex project and the other projects listed are assessed during the Canpotex EA process, even if some of the other projects do not have an environmental assessment completed (and therefore do not have 'significant residual environmental effects' identified) at the time of the Canpotex assessment. A process should be clarified for this.	3.5.4 Project Inclusion List
56	Cumulative effects within Metlakatla territory but beyond the borders of Prince Rupert Harbour need to be assessed, even if other projects have limited their spatial scope to the harbour boundaries. For example, other projects listed in 3.5.1 include increased shipping traffic through Metlakatla territory. The assessment should consider the cumulative impacts of the increase of Canpotex ships, as well as those associated with other projects, on ecologically and culturally sensitive areas in Metlakatla territory both inside and outside the harbour boundaries.	16.3.2 Physical Interference 16.3.3 Change in Vessel Traffic 16.5 Cumulative Effects Assessment
57	Cumulative effects of Canpotex and other projects disposing materials at sea needs to be included in the cumulative effects assessment (in addition to assessing alternative methods and locations for disposing project materials).	12.3.2 Loss or Alteration of Fish Habitat 12.3.3 Direct Mortality or Physical Injury 12.3.5 Degradation of Sediment and Water Quality 12.5 Cumulative Effects Assessment
58	Metlakatla notes that under "Human Environment" that "land use" must include all uses of the marine environment as well.	13.1.2 Key Issues
66	The previous Draft Scope of Assessment considered the potential effects of vibration during construction and operations. The Guidelines do not appear to consider these impacts.	8.3.3 Change in Vibration Levels

ID #	Comment	Section
68	The wildlife and wildlife habitat scope of assessment is limited to federally regulated species. While these are important species for Kitselas, the Guideline limitation excludes ungulates and other species that traverse the rail line, have habitat in proximity to the rail corridor and can be expected to be impacted by a significant increase in rail traffic in the corridor. The Guidelines need to be expanded to include species other than those regulated under federal statute and specifically structured to assess the increased mortality of ungulates. Moose travel beyond our boundaries to winter ranges and return. Many of these winter ranges are near the CNR rail line.	18.9 Train Collision with an Ungulate
69	The scope of assessment needs to be expanded to include Brown Passage. This is the area proposed for use as a disposal site for dredged material. This is the same site proposed for dredge material from Fairview Phase 2. Effects on salmon migration routes, bottom fish, benthic organisms (i.e.: sponges, corals, crabs and snails), hydrodynamic flow and the potential smothering of sub-tidal communities (i.e. sea cucumber) need to be assessed.	12.3.2 Loss or Alteration of Fish Habitat 12.3.3 Direct Mortality or Physical Injury 12.3.5 Degradation of Sediment and Water Quality
70	Kitselas remains concerned that the increase in marine traffic related to container traffic, existing bulk commodities handling and the increases that will occur as a result of an approved Canpotex project have not been adequately considered. The potential for a marine traffic accident increases with each new project and has, in our view thus far, eluded a comprehensive analysis. Kitselas urges regulators to come to grips with this issue and make it a considered element of this project review.	16.3.2 Physical Interference 16.3.3 Change in Vessel Traffic 18.7 Marine Vessel Collision or Grounding
76	DFO would like to see depth contours (map.) for the waters where the terminal is planned, a description of present land use of Ridley Island and a map of the land contours.	2.9 Figure 2-6: Bathymetric and Land Contours 6.3.3.3 Ridley Island
77	Add settling pond location.	1.7 Figure 1-2: Canpotex Potash Export Terminal and Ridley Island Road, Rail and Utility Corridor
78	Include information on infilling, especially type of material to be used, timing of activities, information on type of overburden to be disposed of, ballast description, storage facilities	2.3.2.1 Storage Building 2.3.2.3 Administration and Maintenance Buildings 2.3.3.1 Causeway, Trestle and Berth 2.4.1.1 Onshore – Site Preparation 2.4.1.7 Causeway, Trestle and Berth Construction
80	Sources of air emission should be listed. Ballast and Bilge water management are already regulated. Consider documenting last port of call to predict possible hull-fouling organisms can be noted (potential invasive species).	2.5.1 Emissions 7.3.2.1 Potential Effects Air Quality Technical Data Report (Stantec 2011)

ID #	Comment	Section
82	Scope of marine boundaries should be expanded especially dependent on where the disposal at sea site is located. Concerns of First Nations and local population around increased vessel traffic should be included. Choice of Lorne Creek rail boundary needs to be explained especially with respect to First Nations concerns.	3.4.2.1 Local Assessment Area 3.4.2.2. Regional Assessment Area
87	Include alternatives to the specific site location of the jetty and terminal on Ridley Island.	4.2.1.1 Alternative Terminal Locations 4.2.1.2 Alternative Locations within Prince Rupert Harbour 4.2.2 Alternative Layouts and Construction Methods 4.2.2.1 Trestle Support Structure 4.2.2.2 Causeway
89	The wording in the Key Issues section needs to identify/define more clearly the existing freshwater and marine habitats on and around Ridley Island, not just selectively describe portions of it. Further, the assessment needs to identify the potential effects of the project components during construction and operation on: Water quality and quantity, Fish health, Fish habitat (including marine mammals, benthos, marine pelagic, marine subtidal and foreshore vegetation), Species at Risk, adherence to DFO's no net loss policy	12.1.2 Key Issues 12.1.3 Selection of Measurable Parameters 12.2 Baseline Conditions 12.2.1 Baseline Conditions in the Freshwater Component of the Aquatic Environment 12.2.2 Baseline Conditions in the Marine Component of the Aquatic Environment
EC-003	The EIS should include a sign-off page indicating professional responsibility for the EIS and its sections, somewhat similar to the Section 24 Stantec Quality Management Program in dEISG. The Association of Professional Engineers and Geoscientists of BC (APEGBC) can provide guidance for sign-off regarding engineering disciplines.	Authorship
EC-005	Figures to be provided in the EIS should include: ▪ Proposed disposal at sea locations ▪ Location of marine boundaries ▪ Regional map that shows eastern boundary at Lorne Creek and key communities.	2.9 Figure 2-5: Proposed Disposal at Sea Site Locations 2.9 Figure 2-4: Biophysical Environment Assessment Boundaries 1.7 Figure 1-1: Ridley Island Potash Terminal and Road, Rail and Utility Corridor Location Map

ID #	Comment	Section
EC-007	The EISG should confirm that all project components and activities described in the draft Proposed Comprehensive Study Scope of Assessment, dated June 2010 (06-05-10 V3) are to be included in the EIS, or indicate and explain variances. For example, the Scoping Document Section 4.1 Scope of Project includes the following items, not found in the dEISG. Perhaps they are understood to be included other project component headings, but clarification is needed. a) The modification, use and operation of land disposal sites on Ridley Island that are used for the Project or have potential to interact with the Project. b) The operation of vessels while transiting, berthing and berthed at the marine terminal and while within harbour limits of the PRPA. c) The loading, transportation, and disposal of dredged or other materials at an ocean disposal site.	a) 2.4.1.1 Onshore – Site Preparation and 6.1.4 Sediment Quality b) 2.4.2.2 Arrival and Departure of Vessels c) 2.4.1.6 Marine – Dredging, 2.4.1.9 Disposal at Sea 4.2.4 Disposal at Sea Alternatives
EC-008	As Environment Canada demonstrated at the September 2011 Working Group meeting, consideration of disposal at sea issues are a major component of this CEAA review. Furthermore, several First Nations express strong concern that disposal at sea issues receive full assessment. Accordingly, the EISG needs to include a dedicated section devoted to this subject, consistent with the treatment of a number of other subjects in the dEISG. In this regard, Environment Canada has supplied the proponent and their consultants with considerable information on Disposal at Sea requirements which should be reflected in the EISG. The output from such section, would include the Stantec October 11, 2011 Report on Proposed Disposal at Sea sites which EC has received but not yet reviewed in any detail.	12.3.2 Loss or Alteration of Fish Habitat 12.3.3 Direct Mortality or Physical Injury 12.3.5 Degradation of Sediment and Water Quality
EC-009	Add as a specific bullet under Project Description: "The dredging and excavation of material from the marine berth, the loading, transportation of any dredged and any other material to a disposal at sea site, or any to landbased disposal site." Note, that the disposal sites (at sea or land), and alternatives, for such dredging need to be identified as well as ongoing projected volumes.	2.4.1.9 Disposal at Sea 4.2.4 Disposal at Sea Alternatives
EC-011	Under Section 2 – Scope of Project, or other applicable sections, the EIS Guidelines should include text that captures the following issues: For the purposes of disposal at sea issues, the geographic extent should extend beyond 500m from the facility proper. The extent will also need to include the transportation to a disposal site as well as the footprint of the disposal site and any associated movement of material off the disposal site. Thus the marine environment including habitat, sediment grain size, movement characteristic at the disposal site, as well as marine species that use the site or may be affected in transport will all have to be included in the assessment scope. Consideration to First Nations use of the disposal site and the affected area should be addressed.	3.4.2.1 Local Assessment Area 3.4.2.2 Regional Assessment Area 12.3.2 Loss or Alteration of Fish Habitat 12.3.3 Direct Mortality or Physical Injury 12.3.5 Degradation of Sediment and Water Quality
EC-014	The EISG needs a subsection (or section) to include land based waste disposal issues and potentially contaminated soils issues.	2.4.1.1 Onshore – Site Preparation 6.1.4 Sediment Quality

ID #	Comment	Section
EC-017	EC supports TC, DFO, and the Agency, in establishing the marine boundary at the Pacific Pilotage Authority at Station Triple Island. This boundary is felt reasonable given a number of issues, including strong First Nations' concerns and comments on these draft EIS Guidelines.	3.4.2.1 Local Assessment Area 3.4.2.2 Regional Assessment Area
EC-018	The draft EISG does not seem to clearly identify the eastern boundary for the scope of assessment regarding rail traffic to be Lorne Creek, as previously determined by the RAs. First Nations express strong concerns regarding cumulative effects from increased rail traffic including noise, accidents, impacts on wildlife, and First Nations' access to traditional fishing areas along the Skeena River. The EISG should clarify treatment of these issues.	3.4.2.1 Local Assessment Area 3.4.2.2 Regional Assessment Area 18.4 Train Derailment along the Skeena River 18.9 Train Collision with an Ungulate
EC-026	In regards to accidents and malfunctions, the cumulative effects assessment should consider increased rail traffic to the eastern boundary of this review, and increased shipping to the western marine boundary.	18.4 Train Derailment along the Skeena River 18.7 Marine Vessel Collision or Grounding 18.8 Marine Vessel Collision with a Marine Mammal 18.9 Train Collision with an Ungulate
EC-028	First Nations consultation needs to be considered separately from public consultation.	5 Communication and Consultation 5.1 Aboriginal Consultation 5.2 Consultation with Government Agencies
EC-029	The EIS will need to carefully consider and respond to First Nations concerns and review comments in order for the First Nations, RAs and the Agency to help determine whether the concerns were addressed.	5.1 Aboriginal Consultation
EC-032	The proponent needs to ensure that the EIS Guidelines capture the intent of the waste disposal and soil contamination issues described in Environment Canada's September 27, 2011 memorandum prepared by R. Glue. (attached). Environment Canada's - Pacific and Yukon General Guidelines for Contaminated Sites (attached) provides additional assistance. Issues include: ▪ Historic and current (potential) site contamination within and adjacent to the project footprint need to be identified. (including marine sediments where applicable), for areas in which contaminants may be disturbed, mobilized, as related to the project. ▪ The proponent will need to develop appropriate mitigation measures for the proposed project activities.	2.4.1.1 Onshore – Site Preparation 6.1.4 Sediment Quality
EC-034	The EIS will need to demonstrate that the construction and operation of the project, including the operation of waste disposal areas do not adversely impact water quality, and meet the water quality provisions of legislation such as the *Fisheries Act*, and the *Migratory Birds Convention Act*. This issue includes the water quality of "Penguin Pond", and discharges. EC provides its Environment Canada PYR Interim General Water Quality Guidelines for Work in and around Water to assist the proponent in preparing its EIS. (attached)	12.3.5 Degradation of Sediment and Water Quality

ID #	Comment	Section
EC-035	The effects of extreme weather on the project, for example leading to ship grounding, need also to consider factors such as uncertainty, prediction capability, and the effects of the extreme weather in responding to an event.	17.1 Extreme Weather 18.7 Marine Vessel Collision or Grounding
EC-036	The Effects of the Environment on the Project should include consideration of climate change impacts on the project, including adaptation. For example, changing climate may change the frequency and severity of extreme storm events, loadings, and sea level rise. In this regard we understand the proponent is already considering the issue of increased sea level in project design. As the draft EISG in Section 3.3.3 on Greenhouse Gases already proposes, guidance can be found in the CEA Agency's "Incorporating Climate Change Considerations in Environmental Assessments: General Guidance for Practitioners." Additional information might be found in sources like the recent United Nations Conference on Trade and Development “Ad Hoc Expert Meeting on Climate change impacts and adaptation: a challenge for global ports (29–30 September 2011).” http://www.unctad.org/Templates/Page.asp?intItemID=6097&lang=1 In considering the adaptation issue, a balance will need to be struck in considering this as a Project issue and a larger Port issue.	17.3 Climate Change and Sea Level Rise
EC-038	The EA needs to consider potential malfunctions and accidents that may occur in any phase of the Project, the likelihood and circumstances under which these events could occur, and the residual environmental effects that may result from events such as: ▪ Train derailments, including in the vicinity and immediately upstream of the eulachon spawning reach of the Skeena River ▪ Spills of fuels and other contaminants ▪ Spills of potash into the aquatic and/or marine environment ▪ Marine vessel collisions ▪ Marine vessel grounding ▪ Dredging activities. The existing text of the draft EIS Guidelines seems to limit the analysis to only four types of accidents. Instead the EIS needs identify a number of representative types of accidents and malfunctions, justify the choice, and then to analyze them. Some types will be “worst cases” to ensure that the project can prevent and respond to them. Other types will be “routine cases” that require prevention and response plans, or perhaps have minimal and reversible impact to environment. (e.g.. potentially some small potash spills)	18 Effects of Potential Accidents and Malfunctions 18.1.1 Identification of Potential Accidents and Malfunctions Scenarios 18.1.2 Assessment Methods 18.1.3 Identification of Potential Interactions with Valued Environmental Components 18.1.4 Assessment of Potential Environmental Effects

ID #	Comment	Section
EC-039	The spatial boundaries of the assessment of potential malfunctions and accidents will need to include any transportation activities associated with the Project, including the shipping traffic to the disposal at sea site, to the marine boundary at Triple Island, and, the additional railway traffic up to Lorne Creek (the eastern boundary). The assessment of potential malfunctions and accidents needs to include a focus on particularly sensitive environmental areas, periods, or likely extreme events. For example, First Nations have raised particular concern about the potential increased risk of train derailments that may cause potash or other substances to be spilled into the Skeena River during particular sensitive periods, such as during eulachon runs. In another example, accidents and malfunctions are more likely to occur and difficult to respond to during extreme weather events. The EA needs to identify measures, including design strategies and engineering standards, to prevent or minimize the potential for malfunctions and/or accidents. Any residual effects resulting from malfunctions and accidents, such as from ongoing "minor spills" needs to be carried forward into the cumulative effects assessment.	18.4 Train Derailment along the Skeena River
EC-040	EC recommends that the Summary of Mitigation Measures and Summary of Commitments in the EIS be formatted so that it can be a standalone document and eventually to be signed-off by the proponent, similar to the Table of Commitments and Assurances in BC provincial reviews. The resulting Table provides a useful checklist for agencies and proponent to manage agreements and use for project implementation.	20.1 Summary of Mitigation Measures 22 Summary of Commitments
EC-041	The Environmental Management Program, including an Environmental Management System are very important since they help ensure that what is said actually gets done. The EIS Guidelines should ideally provide slightly more detail on what is envisioned in this section. For example, will the EMS commit to follow any recognized environmental management system? Furthermore, the EIS should be careful not to be too conceptual in describing the Environmental Management Program. Instead, the EIS will need to provide a good outline of each component plan, key commitments, and reference any standards or codes to be used.	21.2 Environmental Management Plan

ABBREVIATIONS AND ACRONYMS

AANDC....................................... Aboriginal Affairs and Northern Development Canada
AAQO ....Ambient Air Quality Objectives
AIA.. Archaeological Impact Assessment
ACCIH .... American Conference of Government Industrial Hygienists
ACE.. Air Contaminant Emissions
AD Anno Domini, designation used to label years in the Julian and Gregorian calendars
ANPC ....Alberta Native Plant Council
AOA.. Archaeological Overview Assessment
BATEA ....Best Available Technology Economically Achievable
BBS ....Breeding Bird Survey
BC .... British Columbia
BCAAQO..British Columbia Ambient Air Quality Objectives
BCAS .... British Columbia Ambulance Service
BCEAA ....BC *Environmental Assessment Act*
BCMOE ....BC Ministry of Environment
BC MWLAP ....BC Ministry of Water Land and Air Protection
BGC .... Biogeoclimatic
BOD_5 ....Biological Oxygen Demand in 5 days
BP .. Radiocarbon years Before Present (which, by convention, means before AD 1950)
CACs .... Criteria Air Contaminants
CadnaA ....Computer Aided Noise Abatement
CBC.. Christmas Bird Count
CCME... Canadian Council of Ministers of the Environment
CCG ....Canadian Coast Guard
cd.. candela
CD .... Chart Datum
CDC..Conservation Data Centre
CEAA.. *Canadian Environmental Assessment Act*
CH_4 ....methane
CIE ....Commission Internationale de L'Éclairage
CMT..Culturally Modified Trees

CNCO	Central and North Coast Order
CNR	Canadian National Railway
CO	carbon monoxide
CO_2	carbon dioxide
CONCAWE	Conservation of Clean Air and Water in Europe
COPC	Contaminants of Potential Concern
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CPAEAR	Canada Port Authority Environmental Assessment Regulations
CRIMS	Coastal Resource Information Management System
CWH	Coastal Western Hemlock
CWS	Canadian Wildlife Service
dB	decibel
DC	Disturbance Coefficients
DO	Dissolved Oxygen
DFO	Fisheries and Oceans Canada
EC	Environment Canada
EHS	Environmental Health and Safety
EIS	Environmental Impact Statement
EISG	Environmental Impact Statement Guidelines
EMP	Environmental Management Program
EPRP	Emergency Preparedness and Response Plan
FSC	Food, Social or Ceremonial
FVN	Fairview Terminal North
FVS	Fairview Terminal South
GEM	Gitxaala Environmental Monitoring
GLCs	ground-level Concentrations
GN	Gitxaala Nation
GHGs	greenhouse gases
GSC	Geological Survey of Canada
H_2O	water
ha	hectares
HADD	Harmful Alteration, Disruption or Destruction
HCA	*Heritage Conservation Act*

HCFCs .... halogenated fluorocarbons
HCP .... Habitat Compensation Plan
IPCC .... Intergovernmental Panel on Climate Change
ISO .... International Organization of Standards
ISQGs .... Interim Sediment Quality Guidelines
K^+ .... potassium
KB .... Kitsumkalum Band
KCl .... potassium chloride
KI .... Key Indicator
Km .... kilometer
KIB .... Kitselas Indian Band
L_{eq} .... equivalent sound level
L_{DN} .... day-night averaged sound level
L_d .... day sound level
L_n .... night sound level
LAA .... Local Assessment Area
LEED .... Leadership in Energy and Environmental Design
LFN .... Lax Kw'alaams First Nation
mag/arcsec^2 .... magnitudes per square arcsecond
MBCA .... *Migratory Birds Convention Act*
MFN .... Metlakatla First Nation
MFP .... Metlakatla Fisheries Program
NAAQO .... National Ambient Air Quality Objectives
NFPA .... National Fire Protection Association
N_2O .... nitrous oxide
NO_x .... nitrogen oxides
NO_2 .... nitrogen dioxide
NSAs .... noise sensitive areas
NWPA .... *Navigable Waters Protection Act*
NWWG .... National Wetlands Working Group
% HA .... % Highly Annoyed
PAH .... polycyclic aromatic hydrocarbons
PCB .... polychlorinated biphenyl

PEL .... Probable Effects Level
PFCs .... perfluorinated carbons
PGA .... peak firm-ground acceleration
PM .... particulate matter
$PM_{2.5}$ .... particulate matter <2.5 micrometer diameter
PM_{10} .... particulate matter <10 micrometer diameter
PNCIMA .... Pacific North Coast Integrated Management Area
PPV .... peak particle velocity
PRG .... Prince Rupert Grain
PRPA .... Prince Rupert Port Authority
PTS .... permanent threshold shifts
RA .... responsible authority
RTI .... Ridely Island Terminals
SARA .... *Species at Risk Act*
SDR .... systematic data recovery
SEL .... sound exposure level
SO_x .... sulphur oxides
SO_2 .... sulphur dioxide
SPL .... sound pressure level
STEAM .... Sound from Trains Environmental Analysis Method
TC .... Transport Canada
TDGR .... Transportation of Dangerous Goods Regulation
TEM .... Terrestrial Ecosystem Mapping
TGNTS .... Tsimshian First Nations Treaty Society
THC .... total hydrocarbons
TK .... Traditional Knowledge
TLVs .... threshold limit values
TPM .... total particulate matter
tpy .... tonnes per year
TRIM .... Terrain Resource Information Management
TSP .... total suspended particulate
TTS .... temporary threshold shifts
TUS .... Traditional Use Study

TWA .... time weighted average
UNEP .... United Nations Environment Program
US DOT .... US Department of Transportation
US EPA .... United States Environmental Protection Agency
VEC .... Valued Ecosystem Component
VOCs .... volatile organic compounds
VRI .... Vegetation Resource Inventory
WMO .... World Meteorological Organization
WRC .... western redcedar
ZOI .... zone of influence

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1 INTRODUCTION

Canpotex Terminals Limited (Canpotex) and the Prince Rupert Port Authority (PRPA) are each proposing to undertake projects on Ridley Island in the Port of Prince Rupert, British Columbia (Figure 1-1). Canpotex is proposing to construct and operate a potash export terminal (the Canpotex Potash Export Terminal) and the PRPA is proposing to construct enabling transportation and utilities (the Ridley Island Road, Rail and Utility Corridor Project). The Canpotex Potash Export Terminal will have the capacity to export up to 11.5 million tonnes of potash annually. The Ridley Island Road, Rail and Utility Corridor (RRUC) will service the Canpotex facility as well as other future developments on Ridley Island. A single environmental assessment is being completed for the Canpotex Potash Export Terminal and the Ridley Island Road, Rail and Utility Corridor as the two projects are interdependent and cannot proceed without each other.

This Environmental Impact Statement (EIS) has been prepared as a single streamlined assessment of both the Canpotex and the PRPA projects to simplify the regulatory process and allow for timely construction. The objective of the EIS is to provide the Canadian Environmental Assessment Agency (CEA Agency) with the information necessary to prepare a Comprehensive Study Report in accordance with the requirements of the *Canadian Environmental Assessment Act* (CEAA) and the Canada Port Authority Environmental Assessment Regulations (CPAEAR).

The EIS will also be reviewed by the Working Group which consists of Environment Canada (EC), Fisheries and Oceans Canada (DFO), Transport Canada (TC), Health Canada (HC), Metlakatla, Lax Kwa'laams, Gitxaala, Kitselas and Kitsumkalum. As the two projects are being undertaken in a single environmental assessment, the EIS will refer to the combined Canpotex Potash Export Terminal and the PRPA Ridley Island Road, Rail and Utility Corridor as "the Project".

The EIS provides information about:

- Environmental assessment triggers (Section 1.5.1)
- Physical layout and components of the Project, as well as planned environmental management strategies that will be incorporated into the development plan (Section 2)
- Scope of the environmental assessment and methods (Section 3)
- Description of potential alternatives to the Project (Section 4)
- Summary of communication and consultation activities undertaken and/or planned (Section 5)
- Description of the existing environment at the proposed facility (Section 6)
- Assessment of potential effects on selected valued environmental components (Sections 7 to 16)
- Effects of the environment on the Project (Section 17)
- Effects of potential accidents and malfunctions (Section 18)
- Capacity of renewable resources (Section 19)

- Summary of environmental effects, mitigation measures, residual effects, cumulative effects, significance determinations, Aboriginal engagement and consultation, and conclusions (Section 20)
- Environmental management including planning and follow-up and monitoring programs (Section 21)
- Summary of commitments (Section 22).

1.1 Proponent Information and Contact Person

1.1.1 Canpotex Terminals Limited

Canpotex Terminals Limited, a wholly owned subsidiary of Canpotex Limited, is the world's largest exporter of potash and is wholly owned by the following Saskatchewan potash producers: Agrium Inc., Mosaic Canada Crop Nutrition, LP (a subsidiary of The Mosaic Company), and Potash Corporation of Saskatchewan Inc. Canpotex's potash sales are currently in the range of nine to ten million metric tonnes per year. Major international markets include Australia, Brazil, China, India, Indonesia, Japan, Korea, and Malaysia.

Communications regarding the proposed Canpotex Potash Export Terminal should be sent to:

Proponent address:	Canpotex Terminals Limited 1111 – 100 Park Royal South West Vancouver, BC V7T 1A2
Attention:	Tyler McDougall, Manager, Capital Projects Telephone: (604) 903-7167 E-mail: tyler.mcdougall@canpotex.com
Or:	Damon Jericho, Owner's Engineer Telephone: (604) 903-7140 E-mail: damon.jericho@hatchmott.com

1.1.2 Prince Rupert Port Authority

Prince Rupert was designated a National Harbours Port in 1972. In 1984, the Port became a Federal Crown Corporation. The PRPA is a commercial not-for-profit agency established by the Government of Canada under the *Canada Marine Act* on May 1, 1999. The PRPA is responsible for the overall planning and development of the commercial port facilities within the Prince Rupert Harbour.

Communications regarding the proposed Ridley Island Road, Rail and Utility Corridor should be sent to:

Proponent address:	Prince Rupert Port Authority 200 – 215 Cow Bay Road Prince Rupert, BC V8J 1A2
Attention:	Lorne Keller, Vice-President, Project Development Telephone: (250) 627-2503 E-mail: lkeller@rupertport.com

1.1.3 Environmental Assessment Consultant

Canpotex and the PRPA have retained Stantec Consulting Limited (Stantec) to prepare the integrated EIS for the two projects.

Environmental assessment communications should be sent to:

Consultant Address:	Stantec Consulting Ltd. 4370 Dominion Street, 5th Floor Burnaby, BC V5G 4L7
Attention:	Sandra Webster, Project Manager Telephone: (604) 412-2986 Facsimile: (604) 436-3752 E-mail: sandra.webster@stantec.com

1.2 Project Overview

Ridley Island is owned by the Government of Canada and managed by the PRPA. It is an established port facility with road and rail access to existing coal and grain terminals, and is zoned for heavy and light industrial land uses under the Port of Prince Rupert 2020 Land Use Management Plan (PRPA 2011). The Project will be located on approximately 146 hectares (ha) of land and an approximately 13.5 ha water lot. The Canpotex Potash Export Terminal will require approximately 21 ha of land and the PRPA RRUC will require approximately 125 ha of upland area (Figure 1-2).

The Canpotex Potash Export Terminal will include the following components:

- A marine berth, access trestle, causeway and all weather ship loading facility capable of receiving vessels of up to 180,000 dead weight tonne (DWT)
- A 180,000 tonne potash storage building with associated conveyor and dust collection systems
- An automated railcar unloading and conveyor system
- A settlement pond for storm water and wash down water
- Administration, personnel, maintenance, and storage buildings
- Site services including water supply and sewage.

Once the terminal is fully operational, it will have the capacity to export up to 11.5 million tonnes of potash annually. This throughput will consist of approximately 500,000 tonnes of white potash on a direct hit basis (meaning the potash will move directly between the railcar and the ship), and the remainder will be red potash (either on a direct hit basis or from railcar to storage and storage to ship).

The PRPA Road, Rail and Utility Corridor Project will include the following components:

- An approximately 7.5 to 8.0 km long rail loop, consisting of a railbed for up to 14 inbound and 11 outbound tracks
- Three inbound rail tracks and two outbound tracks laid for the Canpotex Terminal
- An approximately 3 to 4 km long 69 kV transmission powerline connecting Ridley Island and the Canpotex Terminal to the BC Hydro power transmission system
- An access road with a rail overpass and underpass.

The proposed schedule for the Project is summarized in Table 1-1.

Table 1-1: Potash Export Terminal and Road Rail and Utility Corridor Project Schedule

Project Component	Canpotex	PRPA
Site Clearing	Q3 2012	Q3 2012
Start Construction	Q3 2012	Q3 2012
Complete Construction	Q1 2016	Q2 2014
Operation	Q1 2016 – 2066	Q3 2016
Decommissioning	2066	n/a

1.3 Project Location

The Project will be located on Ridley Island, Prince Rupert, BC. Coordinates at the centre of the proposed terminal footprint are 54.21601° latitude and 130.34928° longitude. In UTM coordinates the site is located in zone 9 at 414209 E and 6008987 N.

Ridley Island falls within the land holdings of the PRPA. As stated in the Port of Prince Rupert 2020 Land Use Management Plan, the island is earmarked for major industrial projects requiring large land bases and access to tide water (PRPA 2011). Development plans for the Island have been in the works for the past 40 years. The water around Ridley Island is within the PRPA's boundaries and therefore under the management of the PRPA. The water lot and lands required for the Canpotex Potash Export Terminal will be acquired through a lease agreement between Canpotex and the PRPA.

A rail line and road connects Ridley Island to Kaien Island, on which the City of Prince Rupert is located. There are two existing industrial marine terminals on the north-western side of Ridley Island: Ridley Terminals Inc. and Prince Rupert Grain Limited. Both terminals have rail and road access, as well as jetties for marine shipping traffic. The nearest residential area is the Village of Port Edward, located approximately 1 km east of the Project site, across Porpoise Harbour.

1.4 Participants in the Environmental Assessment Process

In addition to guidance provided by the CEA Agency, the EIS has been developed through the participation of the Working Group, which consists of Environment Canada (EC), Fisheries and Oceans Canada (DFO), Transport Canada (TC), Health Canada (HC), Metlakatla, Lax Kwa'laams, Gitxaala, Kitselas and Kitsumkalum.

1.5 Regulatory Context

1.5.1 Environmental Assessment Triggers

The Project will be subject to an environmental assessment pursuant to CEAA and CPAEAR. The triggers for the assessment are identified in Table 1-2.

Table 1-2: Environmental Assessment Triggers for the Project

Trigger	Responsible Authority	Canpotex Potash Export Terminal	PRPA Road, Rail and Utility Corridor
Canadian Environmental Assessment Act			
Section 5(1)(d) of CEAA for the issuance of: ▪ An authorization under section 35(2) of the *Fisheries Act* for impacts to fish habitat productivity (resulting from dredging and construction of the rail loop, marine wharf, access trestle and marine outfall)	Fisheries and Oceans Canada	✓	✓
▪ An approval under section 5(2)(a) of the *Navigable Waters Protection Act* (NWPA) for construction of the marine wharf and access trestle	Transport Canada	✓	
▪ An approval under section 127(1) (Part 7, Division 3) of the *Canadian Environmental Protection Act* for the disposal of dredged sediment at sea	Environment Canada	✓	
Canada Port Authority Environmental Assessment Regulations			
Section 3(1) of CPAEAR as the PRPA is the proponent of the Road, Rail and Utility Corridor Project (i.e., exercises a power referred to in section 5(1)(a) of CEAA)	PRPA		✓
Section 3(1) of CPAEAR as the PRPA will issue a lease of Port land to Canpotex for the purpose of the Project (i.e., exercises a power referred to in section 5(1)(c) of CEAA)	PRPA	✓	

The CEAA may also be triggered through the potential provision of funding to the PRPA by Transport Canada.

Other possible environmental assessment triggers that have been reviewed and, based on the experience of Stantec's environmental assessment practitioners, are not applicable to the Project include:

- Section 7(1)(a) of the Canada *Explosives Act.* Explosives will not be manufactured on the site nor will any on-site explosives storage shed meet the definition of a magazine under the *Explosives Act* or Explosives Regulation.
- Section 98 of the *Canada Transportation Act.* The connection to the Canadian National Railway Company (CN) will either be located on CN right-of-way or within 100 m of the centre line of the existing railway line and will be less than 3 km in length and the inbound and outbound tracks will be constructed on PRPA land.

1.5.2 Comprehensive Study List Regulations

A review of the Comprehensive Study List Regulations identified one potential trigger for a comprehensive study. Section 28(c) of the regulation states a comprehensive study is required for:

> *"The proposed construction, decommissioning or abandonment of a marine terminal designed to handle vessels larger than 25 000 DWT unless the terminal is located on lands that are routinely and have been historically used as a marine terminal or that are designated for such use in a land-use plan that has been the subject of public consultation."*

Some of the lands proposed for the Project are designated for such use in a land-use plan that was subject to public consultation (PRPA 2000). However, the Responsible Authorities (RAs) are of the opinion that further public consultation is required and, therefore, that the EIS should proceed as a comprehensive study. The Prince Rupert Port Land Use Plan has since been updated and been through public review (PRPA 2011).

1.5.3 BC *Environmental Assessment Act*

The project is considered reviewable under the *British Columbia Environmental Assessment Act* (BCEAA). However, the BC Environmental Assessment Office is considering an agreement with Canada whereby they accept that completing the environmental assessment pursuant to the CEAA and its regulations is equivalent to an environmental assessment under BCEAA.

1.6 References

PRPA. 2011. Port of Prince Rupert 2020 Land Use Management Plan. Prince Rupert, BC. 97 pp

PRPA 2000. Prince Rupert Port Land Use Plan. Prince Rupert, BC. 37 pp

1.7 Figures

Please see the following pages.

REF: Department of Energy, Mines and Resources - Map 103 J

Scale 1:200,000

Client: Canpotex / Prince Rupert Port Authority	Job No.: 123110264	Fig. No.: 1-1
	Scale: 1:200,000	
	Date: 16-Nov-11	
	Dwn. By: NP	
	App'd By: SW	

RIDLEY ISLAND POTASH TERMINAL AND ROAD, RAIL AND UTILITY CORRIDOR LOCATION MAP

ENVIRONMENTAL ASSESSMENT

RIDLEY ISLAND, BRITISH COLUMBIA

Stantec

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Client: Canpotex | PRINCE RUPERT PORT AUTHORITY

CANPOTEX POTASH EXPORT TERMINAL AND ROAD, RAIL AND UTILITY CORRIDOR
ENVIRONMENTAL ASSESSMENT
RIDLEY ISLAND, BRITISH COLUMBIA

Job No.:	123110264
Scale:	1:20,000
Date:	16-Nov-11
Dwn. By:	NP
App'd By:	SW

Fig. No.: 1-2

Stantec

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2 SCOPE OF THE PROJECT

2.1 Need for and Purpose of the Project

Canpotex is proposing to construct the Ridley Island Potash Export Terminal in response to increased demands for Canadian potash. PRPA is proposing to construct a road, rail and utility corridor as necessary supporting works for the Canpotex Potash Export Terminal and future development of Ridley Island. The Project is needed to meet global marketplace demands for potash by efficiently and economically transporting potash from the potash mines in Saskatchewan to global markets via rail and ocean-going vessel.

2.1.1 Canpotex Potash Export Terminal

Canada is one of the world's largest producers of potash, with the deposits located largely in Saskatchewan. Potash is a stable, non-toxic, non-flammable, non-hazardous mineral compound that consists primarily of potassium chloride (KCl). The potassium in potash is a major constituent of fertilizer and is also used in sports drinks and a number of industrial processes. Recent increases in global food demand have resulted in an increased demand for fertilizer, and therefore potash. It is expected that this demand will continue to increase as pressures on global food supply increase.

For Canpotex to meet the needs of the global marketplace, additional potash export terminal capacity is required. Between 2007 and 2008, Canpotex completed pre-feasibility studies assessing the potential for development of potash export terminals in Prince Rupert, Vancouver, Washington State, and Oregon to increase the flow of potash to global markets. Prince Rupert was selected as one of the two terminal development sites based on transportation costs, terminal development costs and operational considerations (see Section 4: Project Alternatives). The Project will have a positive effect in the Prince Rupert region by:

- Boosting local employment during the construction phase of the Project
- Creating permanent jobs in the community when the facility becomes operational
- Expanding the capacity, facilities and reputation of the Port of Prince Rupert
- Creating ancillary benefits to the local and regional economy
- Building positive relationships and business opportunities for collaboration with First Nations.

2.1.2 PRPA Road, Rail and Utility Corridor

The proposed road, rail and utility corridor are necessary supporting works for the Canpotex Potash Export Terminal as well as for any future developments on Ridley Island. To meet long-term requirements on Ridley Island, the Port is anticipating that a fourteen track rail loop will be needed. The full build out of the loop is being assessed because once the Canpotex facility is in place and operational, further construction to widen the rail loop on a project-by-project basis is not deemed feasible. Construction of the rail line will be phased. The first phase will include construction of the rail lines dedicated to the Canpotex Potash Export Terminal, namely three inbound tracks and two outbound, and widening of the rail bed 15 m on either side of Canpotex's tracks to ensure that future additions to the rail line will not impact activity on existing lines. Timing of future phases will be dependent on need by future developments on Ridley Island.

2.2 Project Location and Existing Infrastructure

The Project site is located on Ridley Island within the limits of the City of Prince Rupert and approximately 11 km south of the town centre. The District of Port Edward is 1 km east of Ridley Island on the opposite side of Porpoise Channel. The coordinates for the potash terminal site are approximately:

- Latitude/Longitude (in degrees, minutes, seconds): 54° 13.273' N 130° 18.915' W
- Universal Transverse Mercator (NAD83): 9U 414246 E, 6008934 N.

Access to Ridley Island is by existing roads from the City of Prince Rupert. It is a 15 km drive that follows Highway 16 south of Prince Rupert for 8 km and then west on Ridley Island Road for 7 km. Ridley Island can be accessed by boat along the western shoreline (Chatham Sound) and the eastern shoreline (Porpoise Harbour); however, there are no public wharfs on Ridley Island.

There are two existing industrial marine terminals on the north-western side of Ridley Island: 1) Ridley Terminals Inc. and, 2) Prince Rupert Grain Limited. Both terminals have rail access from the CN mainline, as well as jetties for marine shipping. There are also smaller industrial facilities on the island including a wood-pellet facility and a log-sort that is no longer in operation. Power on the island is provided via a 69 kV line from BC Hydro and gas is provided by Pacific Northern Gas via a 101.6 mm (4-inch) outside diameter pipeline.

Figure 1-1 shows the location of Ridley Island and key regional and local landmarks and features such as parks, First Nations Reserves, roads and pipelines.

2.3 Project Components and Structures

The primary components of the Project include the access road, rail loop, utilities, onshore terminal infrastructure and marine infrastructure. Project location and its key onshore and marine components are shown in Figures 1-1, 1-2, 2-1 and 2-2 and described in the following sections. Together, the upland Project components will occupy approximately 146 hectares (ha) on Ridley Island with an estimated 13.5 ha water lot; the Canpotex Terminal will require approximately 21 ha of land and the PRPA rail/road corridor will require approximately 125 ha of upland area.

2.3.1 Road, Rail and Utility Corridor

The Ridley Island road, rail and utility corridor will occupy approximately 125 ha of land and consist of a rail loop, access road and utility (power transmission) corridor.

2.3.1.1 Rail Loop

The rail loop will be between 7 and 8 km long, have capacity for fourteen inbound tracks and eleven outbound tracks and allow trains to switch from the CN mainline onto the Ridley Island rail loop and return to the mainline in a continuous forward progression. Initially only the three inbound tracks and two outbound tracks dedicated to the Canpotex Potash Export Terminal will be laid. Rail tracks to fill the remaining capacity of the rail corridor will be laid as required for future projects. Each of the Canpotex tracks will be capable of accommodating a unit potash train with between 174 and 210 rail cars and three or four locomotives. The rail loop will be owned by the PRPA; however, the tracks will be laid and maintained by the terminal they are dedicated to.

2.3.1.2 Access Road

To provide access to the Canpotex Potash Export Terminal and other lands within the rail loop, a new access road will be constructed. The road will be gravel surfaced, two lanes wide, and will parallel the rail loop. Access to the road will be provided from the Ridley Island Access Road via an overpass at the northwest corner of the loop. An underpass at the southern end of the loop will provide vehicle access to lands at the south end of the island. The road will be owned and maintained by the PRPA.

2.3.1.3 Utility Corridor

The utility corridor will include a new 69 kV powerline, owned by the PRPA, connecting the Canpotex Terminal to the existing power transmission system. The 69 kV transmission powerline will tap into the existing 69 kV line near BC Hydro's Ridley Island Substation, run overhead across existing rail tracks, and east along the new rail loop. The length of the 69 kV line is 3 to 4 km and will be situated within a dedicated 24 m wide right-of-way (ROW). It will service the Canpotex lease and future developments on Ridley Island.

Under BC Hydro policy, the PRPA will be responsible for constructing and energizing the 69 kV line extension. Upon commissioning, the PRPA can apply to transfer the ownership of the 69 kV line to BC Hydro for operation and maintenance. An ROW, including access road, will be required along the length of the 69 kV line to facilitate the construction and ongoing maintenance of the line.

2.3.2 Onshore Export Terminal Components

The Canpotex Potash Export Terminal will have the capacity to provide an annual throughput of approximately 11 million tonnes of red potash and 500,000 tonnes of white potash (11.5 million tonnes per year in total). Onshore Project components required to provide this throughput are shown on Figure 2-1 and include:

- A potash receiving system, housed within a covered rail car dumper building, capable of unloading two cars simultaneously
- A 180,000 tonne capacity potash storage building
- An automated portal scraper reclaimer

- A covered belt conveyor system
- A dust collection system
- Administration, operations and maintenance buildings
- A storm/washdown water collection and two stage, 1,500 m^3, settling pond treatment system
- Site services including water supply, sewage, sewage treatment, natural gas and electric power.

2.3.2.1 Storage Building

Red potash will be stored in a shingled A-frame storage building. The building will support the overhead stacking, conveyor and automated tripper systems. The storage capacity will be approximately 180,000 tonnes of red potash stored in one continuous pile/row. The potash storage building is classified as F3 – Low Hazard Industrial Occupancy.

2.3.2.2 Potash Handling System

The potash handling system includes potash receiving (unloading and transfer to storage or direct hit) and reclaim (reclaim from stockpile and transfer to berth) capacity for two unit trains simultaneously. The conveyor systems have been designed based on a peak unloading rate of 60 railcars per hour. Based on railcar capacity of 100 tonnes, each receiving and shiploading conveyor system will require a peak discharge rate of 6,000 tonnes per hour (tph). Each railcar unit train will be unloaded within a single eight-hour shift.

The potash handling system has been designed to reduce, contain and recycle fugitive potash dust. Adjustable chutes will be used to minimize drop distances when discharging potash from the conveyor system to storage and vessels. Conveyor galleries will be covered with full width spill trays mounted underneath. The shiploader will have a containment system of catchment pans and spill trays to enclose, collect and contain any product which may escape from the conveying system including spillage and carry-over generated during operation. Dust collection units (baghouses) will be mounted at nine locations from the dump hoppers to the shiploader to gather and filter potash dust that accumulates at key areas. The collected dust will be captured by the dust collection system and bagged.

Potash Receiving System

The potash receiving system will consist of a railcar dumper building that houses a dumper pit, dump hoppers, and an inbound conveying and stacking system. The dumper building will enclose the concrete dumper pit, steel dump hoppers and receiving conveyors and tunnel. The continuous unloading operation will use automated railcar opening and closing devices while locomotives pull the train through at a steady speed of less than 1km/h. All grades of red potash will be reclaimed from the dump hoppers via a series of belt conveyors and elevated to the transfer tower. Elevated conveyor sections will be in open trusses with access walkways provided on both sides of the conveyor. The conveyor will be covered to keep material dry and provide environmental protection. Potash will be conveyed either to the storage shed or diverted to the shiploader for direct hit vessel loading.

Material will be conveyed to the storage shed via the transfer belt conveyor. A stacking belt conveyor will be used to transfer the material to the tipper. The travelling tripper will be equipped with a "soft-drop" cascading chute, 6,000 tph, to reduce the free drop of material, ensure a soft handling and minimize dust generation.

To prevent contamination, all white potash will move through the terminal on a direct hit basis. This means the potash will be unloaded from the trains and loaded directly onto the ships without entering into the potash storage shed.

Offshore Conveyor System

Potash will be transported to the loading berth via a trestle conveyor. The full length of conveyor will be covered to keep material dry and provide environmental protection. A berth conveyor in a fully enclosed elevated gallery will then transfer material to the all-weather shiploader.

2.3.2.3 Administration and Maintenance Facilities

The primary supporting infrastructure on the terminal site will include an administration building, a maintenance building and a refueling station.

The administration building will contain offices, a conference room, a document storage hall, the control room and its associated equipment, service spaces and personnel facilities including lockers, showers, toilets and a lunchroom.

The maintenance building will provide mechanical, control and electrical workshops for maintaining and servicing terminal equipment, offices for maintenance personnel, locker/change facilities for personnel, and a warehouse with a shipping/receiving office area and storage space for spare parts, equipment and maintenance items.

The fuelling station will consist of two 5,000 L capacity double wall horizontal tanks with fuel dispensers. One will contain diesel and the other gasoline. The tanks and re-fuelling area will be situated on a concrete containment slab with oil stop and discharge shut-off valves. A remote emergency stop station will be provided with interlocks into the fire alarm system.

Other facilities required to support terminal operations include parking areas, a gate house, a berth warming room, a sample storage room, a compressor room and a fire water pump house.

2.3.2.4 Site Wide Systems

Incoming services to the terminal will include water and power. Other on-site services include sewage, stormwater and wastewater collection and treatment systems, including waste water settling ponds. Water will be supplied from the existing Ridley Island water tanks located east of the Prince Rupert Grain facility and will supply both potable and fire water to the terminal. The fire water system will be constructed in accordance with the National Building Code, National Fire Code and National Fire Protection Association requirements. Where practical, the inbound water supply line will be buried for protection.

Power

69 kV Feed

The Canpotex Potash Export Terminal will tie into the PRPA's new 69 kV transmission powerline near the northeast corner of the lease area boundary (see Section 2.3.1.3). The transmission line will be extended to the vicinity of the Project high voltage switchyard by the PRPA (Figure 1-2).

Emergency Generator

A mobile 480V, 3 phase, diesel powered generator will be used to provide emergency power. All three electrical substations will be equipped with an emergency power connection outlet that will permit safe but load limited operations of low voltage equipment.

The shiploader will be equipped with its own emergency power connection outlet to direct emergency power to its luffing winch drives. If power is interrupted during loading operations, the drives will lift the shiploader boom out of the ship hold.

Lighting

Lighting sources will include building interior and exterior lighting, lighting for conveyors, streetlights as well as lighting requirements for the marine terminal. Streetlights around the building and parking lot will consist of pole-mounted four 54-watt fluorescent luminaires. Lights used along the conveyors will consist of 175-watt metal halide stanchion-mounted luminaires. All outdoor lighting will be equipped with "dark-sky" shielded fixtures that will greatly reduce light pollution factors. All streetlights that are located along the route of the proposed roadway will have shielded and cut-off design.

The topography of Ridley Island will block Port Edward from any potential light spill from infrastructure associated with the marine terminal.

Sewage Treatment

A packaged sewage treatment facility will be located south of the maintenance Building (Figure 2-1). Sanitary wastewater will be generated at the Administration and the Maintenance buildings. The facility will be a Type II treatment plant and will achieve effluent quality better than 45 mg/L TSS and 45 mg/L BOD_5. The treatment facility will be sized to a capacity of maximum daily flow of 7.8 m^3/day for treatment of 'black water'. Treated waste from the package plant will be discharged into a subtidal outfall (refer to Section 2.3.3.3). A grey water system will also be installed and will consist of a buried tile field on the upstream side of the stormwater wetland (see below). Washroom facilities on the berth will be serviced by incinerator toilets and will not produce any effluent. A local service provider will be contracted to remove ash generated by these toilets.

Stormwater Management

The Prince Rupert area receives approximately 3 m of precipitation annually and therefore a robust stormwater conveyance system and management plan is required. The stormwater conveyance system will be designed for a one-in-50 year 24 hour event. Based on this criterion, the design storm flow from impervious surfaces at the terminal site is 40,350 m^3/day.

Drainage ditches will be constructed to collect and convey stormwater away from major buildings and transfer points to ensure wastewater and stormwater remain segregated. Where needed, ditches will be lined with 150 mm riprap for erosion protection. Culverts designed to pass the one-in-50 year storm flow will be installed under roads and the rail loop to maintain natural drainage patterns. Stormwater will be discharged to Prince Rupert Harbour through a surface outfall located southeast of the marine trestle.

Runoff from parking area, the maintenance building, and gasoline/diesel fuel station parking lots will be collected in catch basins and routed to a below-ground oil/water separator. The oil/water separator will be designed to treat flows for a one-in-10 year storm event; this design flow rate will be 1,670 L/minute. Stormwater from the terminal will be routed through a two-stage settling pond and a constructed wetland before it is discharged to Prince Rupert Harbour through the above-noted outfall.

Wastewater Collection and Treatment

The washdown system will remove potash accumulated in the spill trays and direct it to specific collection areas. It is anticipated that facilities will be washed-down twice a week and generate up to 11.4 m^3 of washwater per day. The system will collect, contain and direct potash-containing water to the settling ponds. Facilities will be designed to handle washdown volume of 11.4 m^3/day.

The conveyors used for direct hit shiploading and the shiploader will be washed before and after white potash shipments to avoid cross-contamination. Washdown water will be collected at primary catchment sumps near the potash storage building transfer towers and on the berth near the trestle. These sumps will direct the washwater to the two-stage settling pond, approximately 1,500 m^3 in volume (50 m x 20 m), at the south end of the site. The settling pond will allow solids to settle out under quiescent conditions. The treated washwater will drain from the settling pond through a constructed wetland that will provide further water quality treatment before it discharges to Prince Rupert Harbour.

Site Security

Access to Ridley Island is controlled by a gatehouse operated by the PRPA and located on the only road entering the island. The potash terminal will also have a galvanized chain link fence to secure the perimeter of two areas of the potash export terminal. The upland area fencing will follow the site lease lines near the administration, maintenance, potash storage and railcar dumper buildings. The lower area fencing follows the lease lines along the foreshore and extends to the water to enclose the trestle entrance.

A second gatehouse, operated by the terminal operator, will control access to the upland terminal site. From the gate house, authorized vehicles will be able to access the office, maintenance and material handling facilities. Access to the marine facilities will be via the existing southern access road which will continue past the overpass. There is no gate house proposed for this access location. Access will be controlled using a card system and monitored by the attendant at the main gate house.

2.3.3 Marine Components

The marine components, which are components of the terminal, include:

- An approximately 554 m long access trestle and 185 m long causeway
- A marine berth, capable of receiving vessels up to 180,000 DWT
- A travelling all-weather shiploader
- Marine outfalls for surface discharge of stormwater and subtidal discharge of treated effluent.

Project marine components are shown in Figure 2-2, and discussed below. The PRPA Harbour boundaries including the shipping lanes are illustrated in Figure 2-3 in reference to the Project. Bathymetric and land contours on and around Ridley Island are shown in Figure 2-6.

2.3.3.1 Causeway, Trestle, and Berth

The berth and access trestle will be conventional pile supported piers constructed using 900 and 1,525 mm diameter steel piles seated a nominal 1 m into bedrock and socketed a further 5 m and partially filled with concrete. The berth and access trestle decks will be constructed of concrete.

Causeway and Trestle

The trestle will extend approximately 760 m from shore to the berth near the north end of Coast Island. The initial 185 m will be a fill causeway with a 20 m wide working surface. The trestle structure will be 554 m long and 10.15 m wide with allowance for future widening to 13.6 m wide. It will consist of approximately 50 piles rock socketed and grouted into bedrock and the top filled with concrete.

Berth

The berth will be approximately 310 m long and 39 m wide with a 40 m extension at the south end to accommodate the feed conveyor take-up and transfer tower. The width will accommodate the conveyor system and allow maintenance vehicle access to conveyors, shiploaders and vessels at both ends of the berth. It will be equipped with mooring bollards and energy absorbing fender units to absorb vessel berthing impacts. The berth will have a storm water collection system, potable water and fire water distribution infrastructure, incinerator toilet, power supply and lighting.

The berth will be supported on approximately 116 steel pipe piles.

2.3.3.2 Shiploader

Shiploading equipment will be designed to operate in both dry and wet conditions. The travelling shiploader will have a design loading capacity of 6,000 tph and will be equipped with a telescoping cascade chute at the bottom of the spout to minimize the freefall of product, provide soft handling for the potash and minimize dust generation.

The full system will be equipped with a washdown system including collection and transfer to shore to prevent potentially contaminated water spilling into the marine environment. The shiploader will have a retractable hatch cover to protect cargo from rain during loading and is expected to be operable in all but the most extreme weather conditions.

2.3.3.3 Marine Wastewater Outfall

Treated sewage from the terminal will be discharged to Prince Rupert Harbour through a 250 mm diameter pipe with 7,800 L/minute capacity. The outfall will exit the head of the trestle causeway at a depth of approximately -4 m CD.

2.3.4 Temporary Work Spaces and Structures

The Project will require temporary structures such as site offices, first aid stations, washrooms and equipment maintenance shops during the construction phase. In most cases these will likely be mobile trailers although some of the structures may be purpose-built. All temporary structures will be located on the Project site and will be removed following construction. Specific needs will be defined by the construction companies contracted to build the terminal.

Temporary laydown areas and barge landing sites will be required during construction of the Project to deliver and store materials and equipment. One temporary laydown area has been identified at the existing dry land log sort area, at the north east corner of Ridley Island. No additional disturbance would be required to use this area as a laydown site. The causeway will be used as a temporary barge landing site during construction. As a result, no additional sites will be required.

Temporary worker accommodations and construction docks will not be required as there are sufficient existing facilities in the area.

2.4 Project Activities

Standard construction, operations and decommissioning activities that will be part of the Project are described below.

2.4.1 Construction

Upon receipt of all regulatory approvals and permits, the construction phase of the onshore and marine facilities will commence. Onshore construction activities will include the following main steps:

- Site preparation, including grubbing, stripping of overburden, blasting, rock crushing and screening, and grading of the Project areas
- Installation of utilities (electrical power, potable water, sewers, sewage treatment, fire protection water, wash-down water, storm-water, settling pond, small vehicle fuelling station, oil-water separator)
- Construction of the terminal
- Construction of the access road, railbed and laying of the rail tracks dedicated to Canpotex
- Installation of the 69 kV transmission line.

Construction of the marine infrastructure will include the following main steps:

- Dredging and blasting at the berth
- Installation of pilings and pile caps
- Construction of access trestle, causeway and berth decks
- Installation of conveyor system, utilities and shiploader on the trestle and berth
- Installation of the effluent disposal pipe and marine outfall.

2.4.1.1 Onshore—Site Preparation

The majority of the Project area is covered by forest and will need to be cleared and stripped to allow grading. The boundaries of the Project footprint, work spaces, and existing utilities will be surveyed and staked prior to land clearing to minimize the extent of disturbance and to prevent potential environmental impacts to adjacent areas. Avoidance areas identified through the environmental assessment process will be fenced or flagged until approved mitigation measures are employed.

Land clearing will entail the removal of vegetation from the road, rail and utility corridor and 10 ha of the 21 ha lease area for the terminal site. There is no merchantable timber on Ridley Island and therefore the vegetative debris will be chipped. Large stumps and rocks will be removed from the cleared site. Organics will be disposed of in the existing on-land disposal area on Ridley Island.

The surface material consists of peat (muskeg) from 0.3 m to more than 3.2 m thick, with an average thickness of approximately 2 m. The peat and organic soils are underlain, in general, by a variable sequence of overburden (sand, gravels, and silts) overlying bedrock. This overburden is not suitable as load bearing material and will need to be stripped down to bedrock prior to placing engineered fill. The intact mica schist bedrock underlying the overall site is suitable to support the rail loop and foundations for the proposed terminal facilities.

Graders, bulldozers, backhoes and other earth moving equipment will be used to strip the overburden. Non-structural overburden (primarily peat) from the PRPA's Road, Rail and Utility Corridor will be disposed of in the existing organic material disposal area on Ridley Island. Overburden from the terminal site will either be stockpiled on-site or disposed of in the existing disposal area. Sand and gravel will be salvaged and incorporated into the cut-fill balance.

Following clearing and stripping, grading will be conducted to level the site, introduce site drainage, and provide a safe and clean work surface. Rock cuts will be necessary to bring the rail corridor and terminal site to design grade. Bedrock will be ripped mechanically or blasted. In areas where the existing elevation of the bedrock is below the final site grade, engineered fill will be used to bring the surface up to finished grade. Where practical mobile crushers will be used to process blasted and mechanically ripped rock for use as backfill.

Estimated quantities of overburden, cut, fill and imported fill materials are identified in Table 2-1.

Table 2-1: Summary of Cut, Fill and Overburden Volumes for the Project

Material	Canpotex Terminal	Road, Rail, and Utility Corridor	Total
Peat and Overburden	420,000 m^3	2,290,000 m^3	2,710,000 m^3
Native Rock Cut/Fill	140,000 m^3	1,881,000 m^3	2,021,000 m^3
Imported Gravel Fill	467,000 m^3	425,300 m^3	892,300 m^3

On-Land Disposal

The disposal area on Ridley Island is shown in Figure 1-2. This area, referred to as the 'muskeg disposal pond', is an approved on-land disposal site managed by the PRPA. All overburden being disposed of at this site will be transported by truck. Due to the high water content of the overburden there will be some spillage from the truck to the road on route to the disposal site. To ensure this spillage is controlled and is not washed into the marine environment silt fences will be installed along ditches that discharge to the marine environment. In addition, spilled material along the road will be graded and collected and then transported to the disposal site on a regular basis.

Prior to construction commencing and organic material being disposed of into the disposal site sediment samples will be collected from overburden following a standard random sampling methodology. These samples will be analyzed for contaminants (e.g., PAHs and metals) to determine if there are any exceedances. No materials exceeding provincial contaminant guidelines for the region will be disposed of in the muskeg disposal pond. This is consistent with the PRPA's management protocol for the disposal site.

Sediment testing conducted in 2010 and 2011 indicated that the disposal site is not contaminated with polycyclic aromatic hydrocarbons (PAHs; see Section 6.1.4). Elevated levels of copper and arsenic were detected; however, these levels were below background levels for the Skeena Region, as determined by the British Columbia Ministry of Environment (see Section 6.1.4).

2.4.1.2 Onshore—Canpotex Potash Export Terminal

Construction of the Potash Export Terminal will include the excavation of building sites, pouring of foundations and construction of facility buildings, construction of drainage systems, and installation of the potash handling infrastructure. Foundation requirements are expected to be reinforced concrete slab-on-grade. A concrete batch facility will likely be established on site to reduce transportation times in and out of Prince Rupert.

2.4.1.3 On-shore—Canpotex Rail Tracks

Once construction of the railway grade is complete, concrete or hardwood ties will be distributed and placed in proper line and spacing. Ballasting, final surfacing with mechanized lifting, tamping and lining equipment, and distressing and thermite welding will complete track construction. Signals and switching equipment will be installed as required.

2.4.1.4 Onshore—69 kV Transmission Line

The 69 kV transmission line will be an overhead system. The poles will be attached to concrete foundations. The conductors, overhead ground wires and counterpoise will be hung from the poles.

2.4.1.5 Onshore—Access Road and Overpass

Construction of the access road will follow the general process of establishing a crown on the road and surfacing the road with approximately 300 mm depth of crushed rock mixed with fines and sand. Drainage ditches will be constructed on either side of the road and culverts will be used to direct runoff and snowmelt to Prince Rupert Harbour. The overpass connecting the access road to the Ridley Island Access Road will be constructed using a combination of pre-cast retaining walls, concrete abutments and steel bridge beams. The overpass will be approximately 10 m wide, designed to BC Ministry of Transportation and Highways standards for roads and bridges, with cantilevered pedestrian walkways.

2.4.1.6 Marine—Dredging

The safe arrival, moorage and departure of cape size vessels (180,000 DWT) will require dredging and blasting to provide the necessary under-keel clearance for safe vessel operation in swells. A low tide water depth of -15 m is required for the approach lane to the berth (the vessel will be empty when it comes to the berth with a maximum ballasted draft of 9.5 m). A depth of -21 m will be required in the berth pocket (when the vessel is loaded). The -21 m of water depth will allow the 18 m of draft from the loaded vessel plus 3 m of under-keel clearance.

The sediment depths and undulations in the bedrock offshore of Ridley Island limit where the berth and access trestle can be constructed. As a result, it is necessary to dredge to create the water depth needed at the berth face. The proposed maximum dredge area is shown in Figure 2-2. There are no known options for avoiding this dredging. Maintenance dredging will not be required.

Dredging will likely be conducted by cutter suction dredging equipment. The estimated dredge volume is approximately 800,000 cubic metres of soft material. Material will be disposed of at an approved at sea disposal site.

Blasting will occur at approximately 17 to 20 m in the berth pocket in front of the berth. The volume of rock expected to be removed is approximately 40,000 cubic meters. Blasted rock will be used as infill where possible. Rock not used as infill will be disposed of at the disposal at sea site.

2.4.1.7 Causeway, Trestle and Berth Construction

The trestle and berth will be supported by approximately 116 and 50 piles respectively. The steel pipe piles will be between 900 mm and 1,525 mm in diameter. To adequately anchor piles into rock, pin anchors will be installed that will tie the pile to the bedrock. The installation process is to seat the piles a nominal 1 m into the bedrock and then to drill a socket hole approximately a further 5 m. Where possible a vibratory hammer will be used to get the piles to the bedrock. The interstice between the shaft wall and the pipe walls would then be filled with high-strength grout to bond the two pipes together.

Both the berth and trestle will consist of cast in place concrete caps, prestressed precast girders and cast in place deck slabs. The deck slabs will be installed using marine equipment.

2.4.1.8 Disposal Pipe and Marine Outfall

The storm sewers and sanitary sewers will be constructed using the typical open trench cut method where the trench depth will be about 1.2 m. Both the storm and sanitary sewers will be constructed based on the following steps:

- "Backcutting" the trench
- Placing, grading and compacting granular bedding
- Installing the pipes
- Placing and compacting the pipe surround granular to 300 mm above the crown of the pipe
- Backfilling the rest of the trench with compacted select granular materials consistent with the causeway material.

The sanitary outfall will be below the low tide level and, therefore, will have to be installed at the same time that the causeway toe-berm is constructed. In contrast, the storm water runoff outfall will be above, though near, the high-tide elevation.

The sewer construction under the railway will be constructed in a similar manner to that described above. Depending upon the overall schedule, portions of the sewer may be constructed in advance of construction of the causeway portion of the sewers. These "advance" sections of sewers would be constructed from the "seaside manholes" south of the tracks to the "landside manholes" on the other (north) side of the tracks. Extra strong pipe has been specified for crossing under the tracks, out along the causeway, and for the sewer outlet pipe that will slope into the sea.

2.4.1.9 Disposal at Sea

Environment Canada's previously approved disposal site in the Prince Rupert area is Brown Passage. However, to accommodate the large amount of dredgate that will result from the current Project, two alternate sites, sites A and B, located within the Prince Rupert Port Authority boundaries are being assessed. Site A is located approximately 1 km west of the dredge site and Site B is located approximately 6 km southwest of the site at Kinahan Islands. The benefit of both sites relative to Brown Passage is their proximity to site, thus reducing the amount of vessel activity required. Site A also has the additional benefit of being sufficiently close (<2 km) to use a pipe network to transport dredgeate to the disposal site. Use of a pipe eliminates the need for vessel transport and almost eliminates the sediment plume because the pipe outfall will be approximately 10 m above the seabed as opposed to upwards of 200 m when dumped from a barge.

Approval for proposed sites A and B is being sought under the *Canadian Environmental Protection Act* (CEPA) (Figure 2-5). If approval cannot be obtained for the proposed sites a request to use Brown Passage will be submitted. Following site approval and prior to disposal at the sites, a Disposal at Sea permit will be obtained from Environment Canada under CEPA.

2.4.1.10 Construction Equipment

A variety of equipment will be used for the onshore and marine components of the Project. The type of equipment, number of units expected, and sound source power levels are summarized in Table 2-2.

Table 2-2: Equipment to be used during Project Construction

Construction Phase	Equipment Type	Maximum Number of Units	At Source Sound Power Levels (dBA)
Site Preparation—Clearing and Hauling	Skidder	1	117
	Dozer	17	117
	Brush Cutter	1	116
	Dump Truck	2	116
	P/U Truck	17	87
	Excavator	28	117
	Haul Trucks	40	116
	Medic Truck	1	100
	Drill Rig	6	112
	Fuel Truck	1	100
	Service Truck	1	100
	Lube Truck	1	100
	Bus	1	100
Site Preparation—Excavating and Hauling	Dozer	20	117
	Excavator	30	117
	Loader	2	112
	Dump Truck (20 m^3)	16	116
	Track Drill	2	117
	P/U Truck	19	87
	Haul Truck	40	116
	Fuel Truck	1	100
	Service Truck	1	100
	Bus	1	100
	Medic Truck	1	100
	Drill Rig	6	112
Site Preparation—Grading	Dozer	19	117
	Grader	2	117
	Dump Truck (10 m^3)	7	116
	Dump Truck (20 m_3)	8	116
	Compactor	2	112
	Water Truck	1	116
	Loader	2	112

Construction Phase	Equipment Type	Maximum Number of Units	At Source Sound Power Levels (dBA)
	Crushing Plant	1	107
	P/U Truck	19	87
	Excavator	28	117
	Haul Truck	40	116
	Drill Rig	6	112
	Fuel Truck	1	100
	Service Truck	1	100
	Lube Truck	1	100
	Bus	1	100
	Medic Unit	1	100
Land-based Construction	Dump Truck (29 tonne)	5	116
	Front End Loader	2	112
	Large Crane (100 tonne)	1	112
	Medium Crane (22 tonne)	2	112
	Rail Alignment Rig	1	116
	Backhoe (8 tonne)	2	112
	Tractor	2	116
	Welding Trucks	4	106
	Garbage Trucks	2	99
	Hydrovac Trucks	1	117
	Drill Rig (12.5 tonne)	7	112
	Grader (25 tonne)	2	117
	Compactor (225 kg)	3	112
	Roller	1	112
	Forklift	6	112
	Aerial Work Platforms	4	112
	Boom Truck	2	112
Marine-based Construction	Large Crane (100 tonne)	1	112
	Medium Crane (22 tonne)	2	112
	Tug Boat (1000 hp)	1	110
	Drill Rig (12.5 tonnes)	1	112
	Dredge (2461 tonne)	1	118
	Vibro-hammer Excavator (17 tonne)	1	133

During construction, equipment will be kept free of excess oil and grease and in good working order. Equipment maintenance and refueling will be conducted in a designated area at 30 m from the ocean or any water body.

2.4.2 Operations Phase

The Canpotex Potash Export Terminal will have the capacity to provide an annual throughput of approximately 11 million tonnes of red potash and 500,000 tonnes of white potash (11.5 million tonnes per year in total). The Project will be designed to allow for continuous operation, 24 hours a day and 365 days a year based on historical wind and rain data for the area (Sandwell, 2009). Key activities during the operations phase of the Project are:

- Receiving and unloading of potash from unit trains to the storage building or for direct hit to the ship
- Arrival and departure of vessels from berth.

Additional operations activities include periodic operation of back-up generation, waste management, vehicle fuelling, and infrastructure maintenance.

2.4.2.1 Receiving and Unloading of Potash

Red and white potash will be delivered to the terminal via unit trains of up to 174 – 210 railcars carrying approximately 17,500 to 21,500 tonnes per unit train. Each train will typically use three to four locomotives. The unit trains will be made up of standard Canpotex potash hopper railcars equipped with three bottom discharge gates. The discharge gates will be opened and closed by an automated system installed in the covered dumper building or manually. Potash trains will be operated by CN up to the Canpotex terminal. At the terminal Canpotex staff will inspect the train and take over operation during dumping. Maintenance of tracks dedicated to the Canpotex's Potash Export Terminal will be the responsibility of Canpotex.

While at the terminal, railcars will be advanced through the unloading system at a peak rate of 60 cars per hour. This will result in a maximum unloading rate of 6,000 tph. Cargo from the railcars will be deposited into the dumper hoppers and conveyed by a wide belt feeder to a transfer conveyor for transport to the storage building, except in the case of white potash which will be conveyed directly to ship.

It is estimated that up to 722 trains of potash will visit the terminal annually. Each train will typically be powered by three to four locomotives. Each train will take up to one hour to approach/depart the terminal and approximately eight hours to unload at the terminal; only two of the three to four locomotives will be operating during unloading.

2.4.2.2 Arrival and Departure of Vessels

The number of vessels calling on the terminal each year is dependent upon the vessel size and the throughput of the facility. Based on the current mix of vessels calling on Canpotex's potash terminal facilities in Vancouver and Portland, Oregon, between 130 and 150 vessels may visit Ridley Island terminal each year. It should be noted that this number of ships represents terminal capacity and may not agree with actual potash supply and demand. Up to four tugboats are expected to assist the vessels in and out of berth.

Canpotex will not own or operate the large vessels or smaller tug and barge vessels coming and going to the terminal; however, any shipping associated with the Project will operate:

- Within existing shipping lanes within the Port of Prince Rupert
- In existing approach lanes to the harbour
- In conformance with all existing port, provincial, federal, and international shipping regulations.

All shipping within the Port of Prince Rupert will be conducted following the rules of shipping established by the Port under the *Canada Marine Act* and in compliance with the requirements of the Canadian Coast Guard (CCG), and with the Port Authority Operations Regulations. Furthermore, all shipping within Canadian waters will be subject to both the *Canada Marine Act* and the *Canada Shipping Act* and its regulations including the *Ballast Water Control and Management Regulations*.

The PRPA has the authority to monitor ships about to enter or within the waters of the Port of Prince Rupert, to establish traffic control zones, request information, and impose conditions under which a traffic clearance is to be granted. All marine vessel traffic entering, within, or leaving the Port is managed by PRPA, CCG Marine Communication and Traffic Services, and the Pacific Pilotage Authority. Any vessels over 350 gross tons will require pilotage, as per Port standard practices and procedures.

Assumptions regarding vessel characteristics and activities, while berthing or at berth, are summarized in Table 2-3.

Table 2-3: Marine-based Vessel Characteristics to be used during Project Operation

Features	Vessel Type	
	Bulk Carrier	Tugboat
Average Vessel Size (DWT)*	68,000	–
Main Engine Power Rating (kW)	16,400	3,700 each
Auxiliary Engine Power Rating (kW)	2,400	
Number of Vessels per Year	130-150	400
Number of Vessels in Port at One Time	1	2 – 4
Total Time Manoeuvring (hrs/yr)	750	3,000
Total Time Hoteling (hrs/yr)	4,500	–
Fuel Type	Residual Oil	Marine Diesel Oil

NOTE:
*Maximum vessel size is 180,000 DWT

2.4.2.3 Infrastructure Maintenance

Project infrastructure will require regular maintenance throughout the life of the Project. This is expected to include tuning and lubrication of conveyor systems on land and along the berth and trestle. Other maintenance activities may include maintenance of the sewage treatment facility, and painting.

2.4.3 Decommissioning Phase

Timing of decommission is a function of the terminal lease agreement, lifespan of the potash mines in Saskatchewan and market demands. The life of the facility is expected to be 50 years with regular and effective maintenance and equipment replacement. All decommissioning activities will be conducted in accordance with the applicable regulations at that time. It is expected that at the end of the Project the potash handling infrastructure will be removed to allow for development of the site for another industrial purpose. For the purposes of the environmental assessment, decommissioning will include removal of the land-based above-ground infrastructure and the conveyor and shiploading equipment from the jetty and berth, the berth and access trestle will remain in place.

The road, rail and utility corridor are considered permanent and decommissioning is not anticipated.

Prior to decommissioning, a decommissioning plan will be developed. At a minimum, the plan will include a schedule for equipment decommissioning and disassembly. The schedule will indicate the approximate time required to remove and dispose all abandoned installations, structures, and buildings for which on-site reuse is not possible, and to reinstate the site to a quality necessary for subsequent industrial land use. Decommissioning planning will be developed in consideration of environmental goals for the area.

Disposal of waste will be conducted in accordance with provincial waste management regulations and guidelines of the time. Removal of buildings or structures is expected to have similar effects and considerations as construction and will be conducted in accordance with regulatory requirements applicable at the time of removal.

2.5 Emissions and Waste Management

2.5.1 Air Emissions

On-shore and marine Project sources used during the construction and operations phase will emit particulate matter (PM_{10}, $PM_{2.5}$), nitrogen oxides (NO_X), sulphur oxides (SO_X), carbon monoxide (CO), and volatile organic compounds (VOCs). The combined total emissions from these sources are summarized in Table 2-4. Additional details on air emissions are provided in Section 7.3.2.1 and the Project Air Quality Technical Data Report (TDR).

Table 2-4: Estimate of Emissions during Construction and Operation Phases

	Contaminant	Construction Emissions (tonne/year)	Operations Emissions (tonne/year)
On-Shore	PM_{10}	9.2	5.5
	$PM_{2.5}$	9.2	3.1
	NO_x	160.2	19.2
	SO_2	0.31	0.4
	CO	160.2	23.0
	VOCs	24.7	0.7
Marine	PM_{10}	0.5	10.8
	$PM_{2.5}$	0.5	8.5
	NO_x	11.4	137.5
	SO_2	0.04	40.7
	CO	11.4	11.6
	VOCs	4.1	5.0

2.5.2 Solid Waste

Solid and liquid wastes will be generated throughout the construction and operations phases of the Project. Solid waste types anticipated during the construction phase include scrap metal, used tires, scrap lumber, wood, concrete, grout waste, rock, steel and formwork waste. General wastes will be disposed of at the Prince Rupert landfill which accepts material from residential, commercial, industrial, institutional, demolition, land clearing, and construction sources. The landfill has approximately 75 years of capacity remaining (pers. Comm. City of Prince Rupert, 2009). Recyclable materials such as steel and corrugated cardboard will be sold or recycled.

Overburden resulting from construction of the road, rail and utility corridor will be disposed of at the approved disposal sites located at the southern tip of Ridley Island (Figure 1-2). This disposal site was established for the disposal of organic overburden taken from Ridley Island Terminals Inc. Overburden from the potash terminal site will be stockpiled onsite or at the Ridley Island disposal site.

Dredged material will be disposed of at sea as discussed in Section 2.4.1.9.

2.5.3 Liquid Waste

Four types of liquid waste will be generated by the Project during operation: sewage, grey water, stormwater and washdown water. As described above, the sewage (up to 7.8 m^3/day) will be treated using a type II treatment facility, and the treated sewage will be discharged via a subtidal outfall. Runoff from the parking lot and gasoline/diesel fuel station parking lots will be collected in catch basins and routed to a below-ground oil/water separator. All other types of waste water will be directed through a pond/wetland complex and ultimately discharge through a surface outfall (approximately 40,000 m^3/day during wet weather).

2.5.4 Ballast and Bilge Water Management

All vessels using the terminal will be required to follow the Ballast Water Control and Management Regulations, pursuant to the *Canada Shipping Act*. The Regulation requires that transoceanic vessels manage their ballast water in one of four ways: exchange, discharge to a reception facility, treatment, or keeping it on board (Transport Canada 2010a). Consistent with international regulations (IMO 1978/2004) ballast water exchange must occur outside of the Exclusive Economic Zone (i.e., at least 200 nautical miles from land) and in water depth of over 200 m. Additionally, ships performing ballast water exchange must do so with an efficiency of at least 95% volumetric exchange of ballast water (Transport Canada 2010b). In addition, ships are required to have a ballast water management plan.

Bilge water is regulated under the Regulations for the Prevention of Pollution from Ships and for Dangerous Chemicals. Under these regulations ocean going ships wishing to discharge bilge water containing oil or grease must be fitted with 15 ppm limit oil filtering equipment and a 15 ppm bilge alarm. Internationally bilge water is regulated under Annex IV of MARPOL (IMO 1978/2004). Under this Annex, the discharge of sewage into the sea is prohibited, except when the ship has in operation an approved sewage treatment plant or is discharging comminuted and disinfected sewage using an approved system at a distance of more than three nautical miles from the nearest land; or is discharging sewage that is not comminuted or disinfected at a distance of more than 12 nautical miles from the nearest land.

2.5.5 Hazardous Materials Storage and Management

All hazardous waste produced during the operation of the facility will be collected, stored and disposed of according to all applicable provincial and federal legislation and Canpotex's best management practices. Relevant federal and provincial legislation, codes and standards include: *Hazardous Products Act*, (Canada) Workplace Hazardous Materials Information Systems (WHMIS), *Workers compensation Act*, Occupational Health and Safety Regulations and Transportation of Dangerous Goods.

Explosives and hydrocarbons (used in equipment and machinery) are the primary hazardous materials that will be used during construction. During operation, hazardous materials will be present at a small vehicle fuelling station and small quantities of general process chemicals, such as paints and solvents, will be stored on site when required. Gasoline, diesel fuel, propane, grease, motor oil, and hydraulic fluids are all required to operate the equipment and machinery. Additional anticipated hazardous materials include small quantities of:

- Acetylene
- Oxygen and other compressed gases
- Form oil
- Epoxies
- Concrete additives
- Glycol/methanol.

All hazardous materials no longer in use will be collected and disposed of at a provincially approved facility; there are no local hazardous waste landfills and therefore it will be removed by a licensed hazardous waste hauling service. The potential environmental effects from accidents involving hazardous materials will be addressed in the environmental assessment.

The Canpotex Environmental Health and Safety (EHS) Management System will have standard operating procedures for all hazardous material handling and storage. Workers in contact with hazardous waste will be appropriately trained in handling procedures. All hazardous waste will be transported according to the Transportation of Dangerous Goods Regulation (TDGR).

2.5.6 Noise

Blasting, pile driving and rock crushing during construction will be the most significant sources of noise on the Project. Another potential source of noise is construction equipment. Noise generated during operations is expected to be much lower than during construction and will result from belt conveyors and road, rail and vessel traffic. Estimated noise levels for various Project activities are provided in Table 2-3.

2.6 Required Permits and Approvals

In addition to the *Fisheries Act*, NWPA, and CEPA authorization and approvals identified in the introduction to this environmental assessment report, the terminal may require a waste discharge permit under the BC *Environmental Management Act* for:

- Discharge of treated wash water to the marine environment
- Discharge of treated sewage (under the Municipal Sewage Regulation)
- Baghouse dust emissions.

These requirements will be confirmed through discussions with the BC Ministry of Environment once the emissions have been characterized. No other environmental permits or approvals are anticipated.

2.7 Project Schedule

The proposed schedule for the Project is summarized in Table 2-5.

Table 2-5: Potash Export Terminal and Road Rail and Utility Corridor Project Schedule

Project Component	Canpotex	PRPA
Site Clearing	Q3 2012	Q3 2012
Start Construction	Q3 2012	Q3 2012
Complete Construction	Q1 2016	Q1 2014
Operation of Terminal*	Q1 2016 – 2066	Q1 2016
Decommissioning of Terminal*	2066	n/a

NOTE:
* The lifetime of the road, rail and utility corridor is indefinite.

Dredging and in-water blasting activities are scheduled to occur between Q4 2012 and Q2 2013 if possible. Pile placement would occur throughout the year, weather permitting.

The proposed schedule is subject to many factors that may affect the anticipated timing. Most notably the EA process and other approval processes. As such, the schedule presented here may change.

2.8 References

Government of British Columbia. 2004. *Environmental Management Act*

Government of Canada. 1999. *Canadian Environmental Protection Act* (CEPA)

Government of Canada. 1998. *Canada Marine Act*

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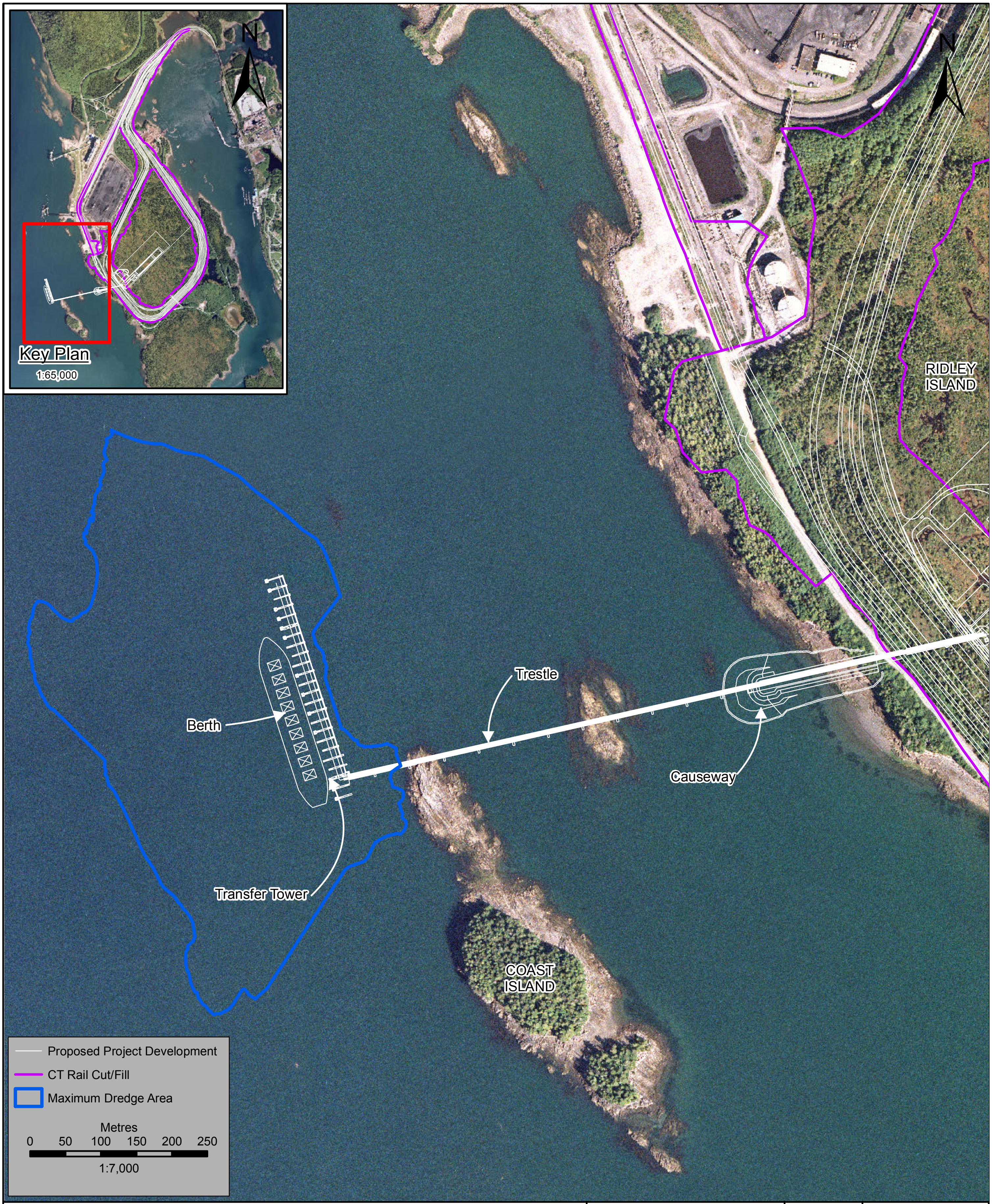
2.9 Figures

Please see the following pages.

Client:		Job No.: 123110264	Fig. No.:
Canpotex	PRINCE RUPERT PORT AUTHORITY	Scale: 1:5,000	2-1
		Date: 16-Nov-11	
PROJECT ONSHORE TERMINAL FEATURES ENVIRONMENTAL ASSESSMENT RIDLEY ISLAND, BRITISH COLUMBIA		Dwn. By: NP	Stantec
		App'd By: SW	

R:\2010Stantec\123110264_Canpotex_Ridley_Island\gis\Figures\EIS\FrontEnd\123110264 Fig 2-3_ProjectOnshoreFeatures.mxd



Client: Canpotex PRINCE RUPERT PORT AUTHORITY	Job No.: 123110264	Fig. No.:	Stantec
	Scale: 1:6,000	2-2	
	Date: 16-Nov-11		
PROJECT MARINE FEATURES ENVIRONMENTAL ASSESSMENT RIDLEY ISLAND, BRITISH COLUMBIA	Dwn. By: NP		
	App'd By: SW		

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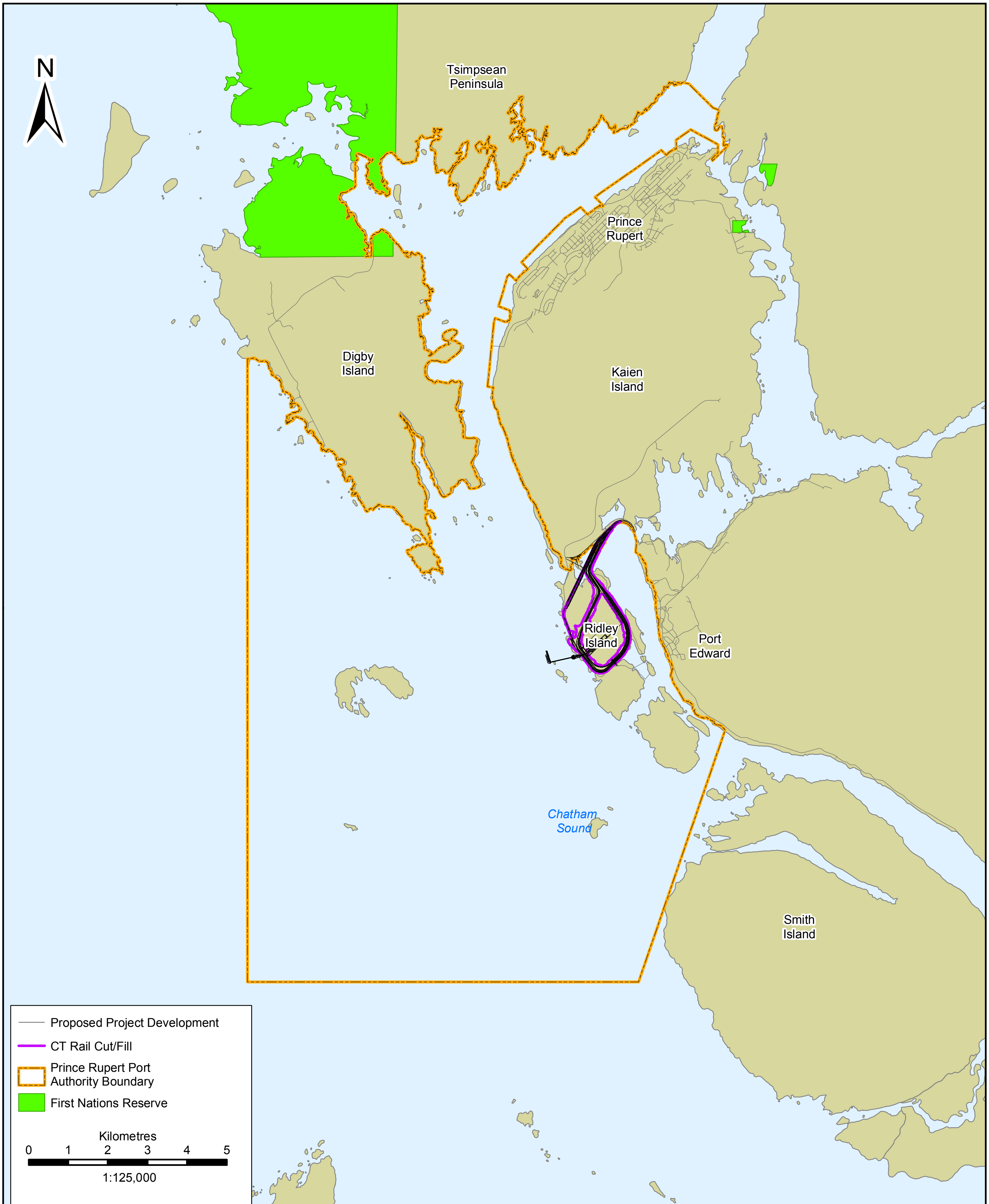
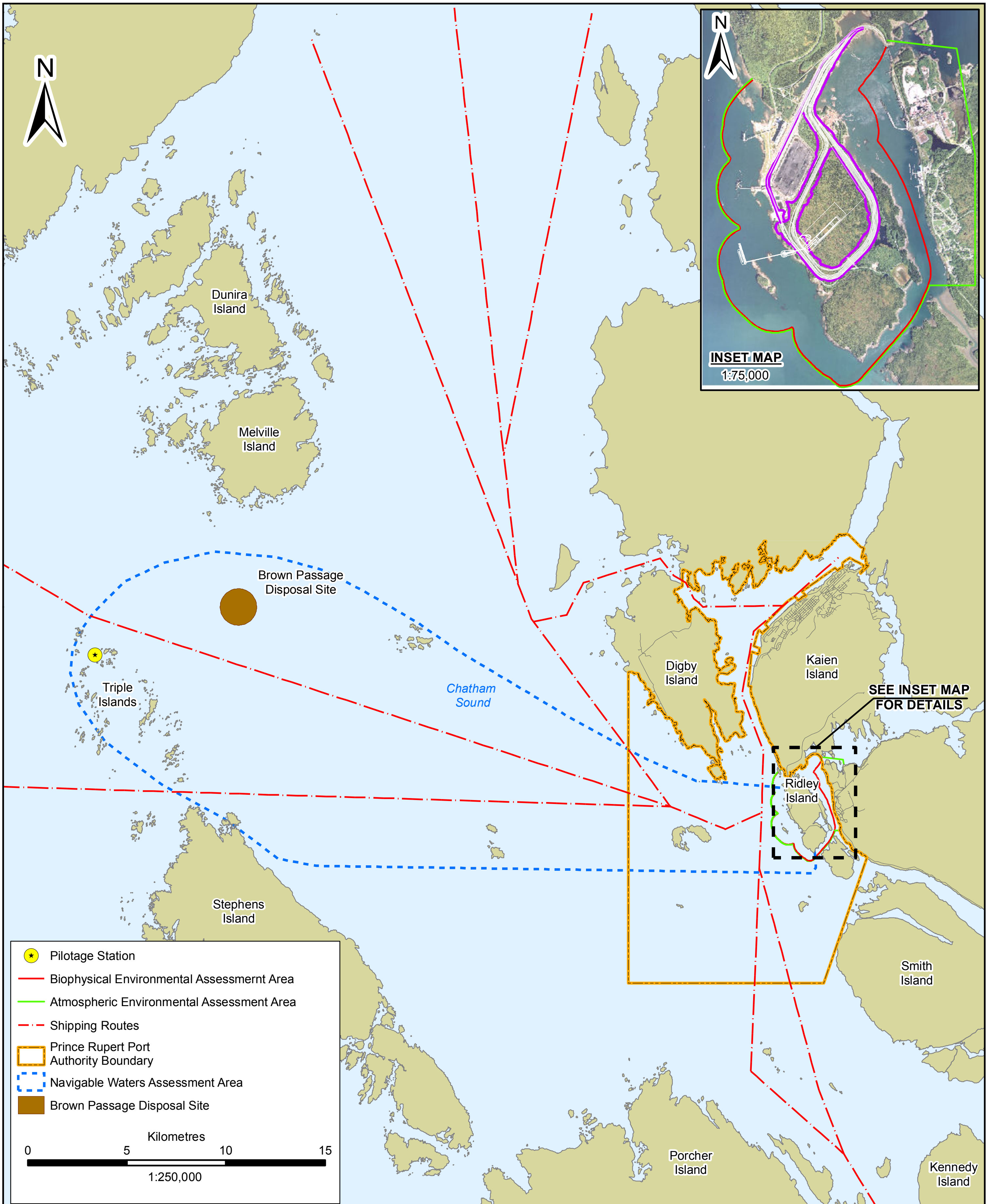


R:\2010Stantec\123110264_Canpotex_Ridley_Island\gis\Figures\EIS\FrontEnd\123110264 Fig 2-3_LocationofCanpotexPotashTerminalWithinPPRBoundaries.mxd

Client: Canpotex; PRINCE RUPERT PORT AUTHORITY	Job No.: 123110264	Fig. No.: 2-3	Stantec
	Scale: 1:125,000		
	Date: 17-Nov-11		
LOCATION OF THE CANPOTEX POTASH TERMINAL WITHIN THE PORT OF PRINCE RUPERT BOUNDARIES ENVIRONMENTAL ASSESSMENT RIDLEY ISLAND, BRITISH COLUMBIA	Dwn. By: NP		
	App'd By: SW		



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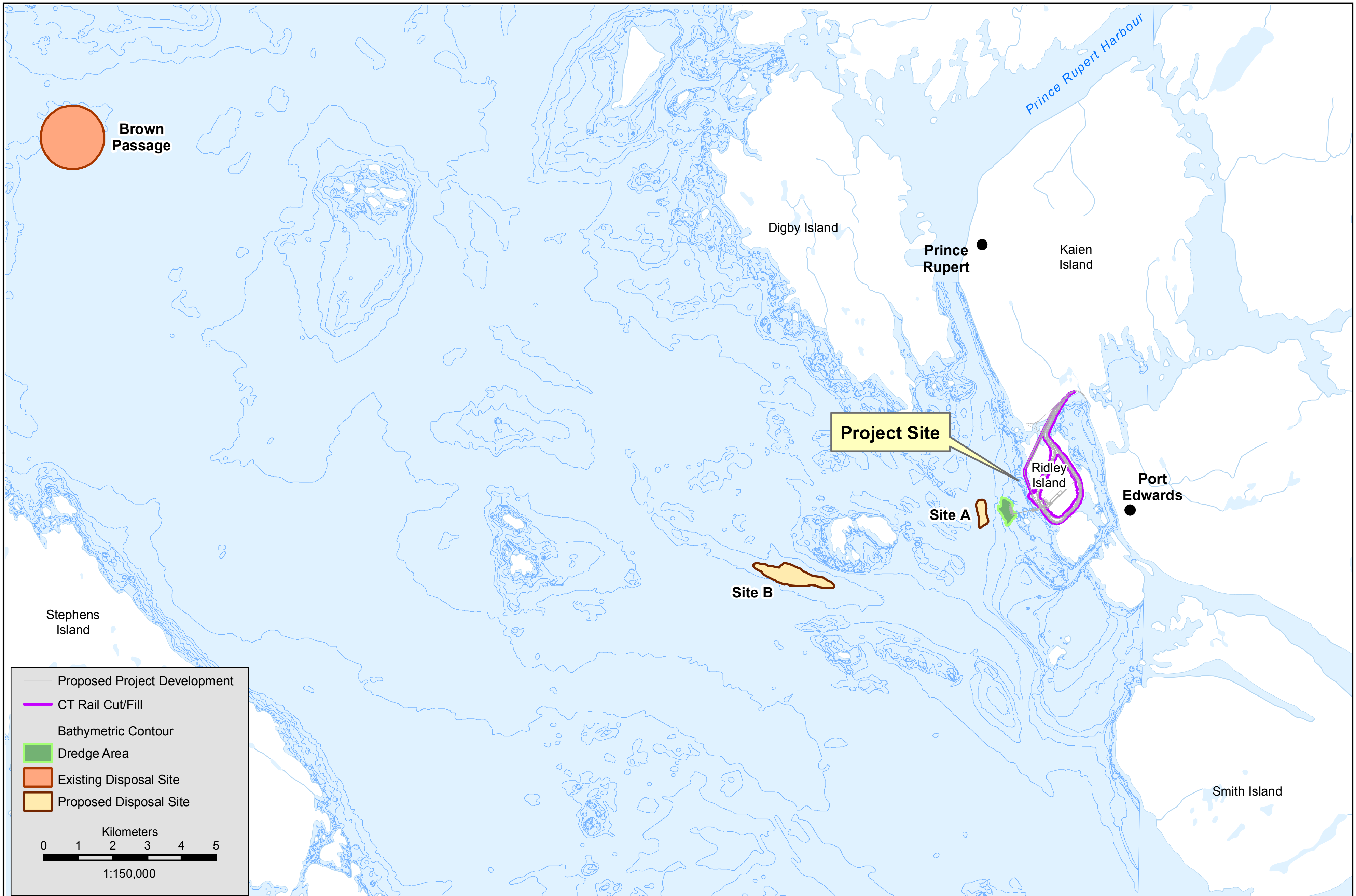
Client: Canpotex — PRINCE RUPERT PORT AUTHORITY

Job No.:	123110264
Scale:	1:250,000
Date:	17-Nov-11
Dwn. By:	NP
App'd By:	SW

Fig. No.: 2-4

BIOPHYSICAL ENVIRONMENTAL ASSESSMENT BOUNDARIES
ENVIRONMENTAL ASSESSMENT
RIDLEY ISLAND, BRITISH COLUMBIA

Stantec



Client: Canpotex | PRINCE RUPERT PORT AUTHORITY

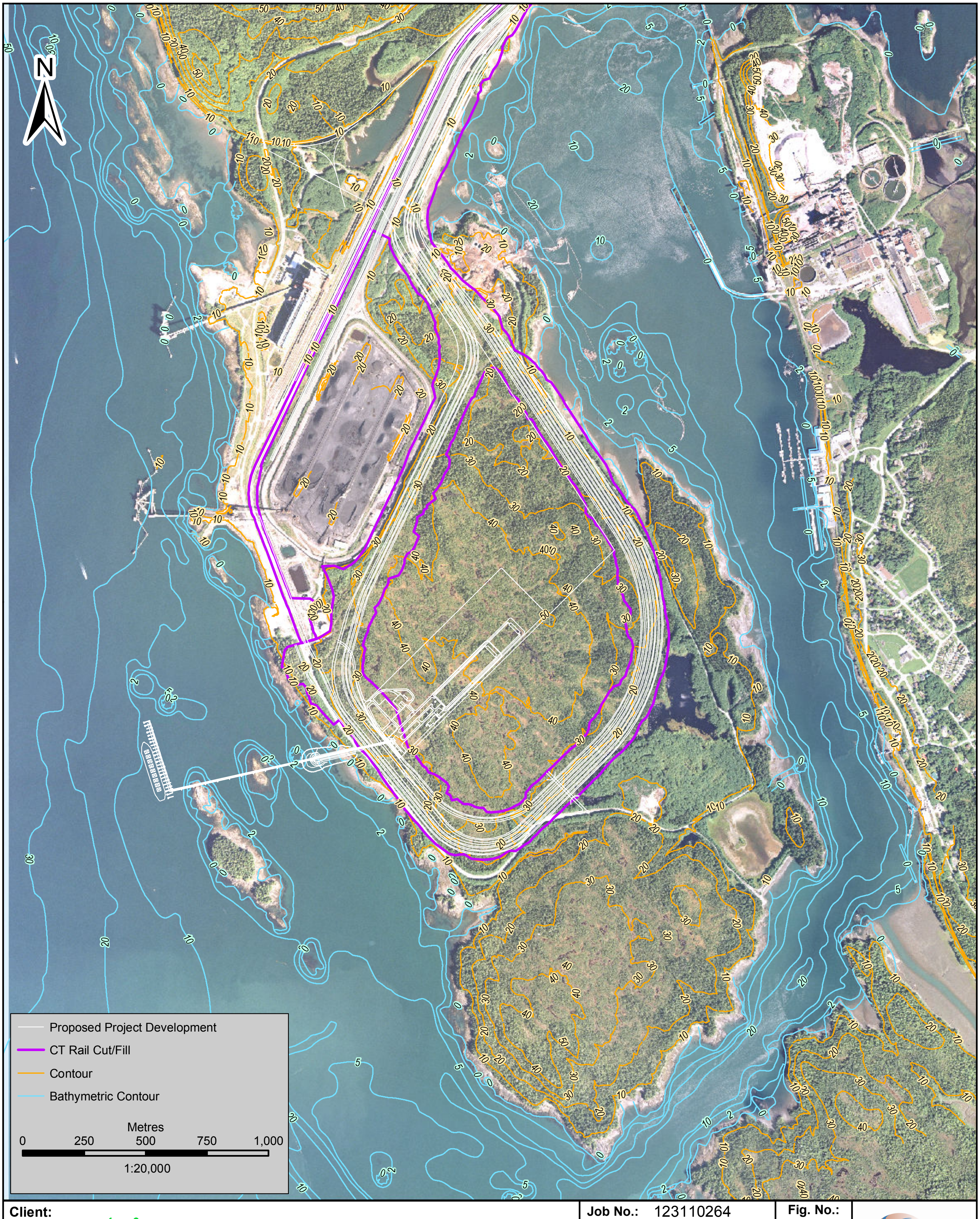
Job No.:	123110264
Scale:	1:150,000
Date:	16-Nov-11
Dwn. By:	NP
App'd By:	SW

Fig. No.: 2-5

Stantec

PROPOSED DISPOSAL AT SEA SITE LOCATIONS
ENVIRONMENT ASSESSMENT
RIDLEY ISLAND, BRITISH COLUMBIA

R:\2010Stantec\123110264_Canpotex_Ridley_Island\gis\Figures\EIS\FrontEnd\123110264 Fig 2-7_ProposedDisposalAtSeaSiteLocations.mxd



R:\2010Stantec\123110264_Canpotex_Ridley_Island\gis\Figures\EIS\FrontEnd\123110264 Fig 2-8_ Land&BathymetricContours.mxd

Client: Canpotex / Prince Rupert Port Authority	Job No.: 123110264	Fig. No.: 2-6
	Scale: 1:20,000	
	Date: 16-Nov-11	
LAND AND BATHYMETRIC CONTOURS ENVIRONMENTAL ASSESSMENT RIDLEY ISLAND, BRITISH COLUMBIA	Dwn. By: NP	Stantec
	App'd By: SW	

3 SCOPE OF THE ASSESSMENT AND METHODS

3.1 Scope of the Assessment

The “scope of the assessment” refers to the physical works and activities that comprise the Project and are subject to consideration in the assessment. For the Project, the scope is proposed to include construction and commissioning, operations, decommissioning and abandonment, and potential accidents and malfunctions. This includes the construction, operation and decommissioning of the following physical components and identified activities.

Onshore Components

- The 7.5 to 8.0 km rail loop/access road located on lands managed by PRPA
- The operation of locomotives servicing the the rail loop from the point of exiting and re-entering the CN mainline
- The 180,000 tonne capacity potash storage building
- The 6,000 tph belt conveyor system
- The dust collection system
- The storm/washdown collection and two stage settling pond treatment system
- The approximately 3 to 4 km 69 kV transmission powerline.

Marine Components

- An approximately 739 m long access trestle and causeway
- Dredging and blasting in front of the proposed pilings and in relation to the new berth structure
- The marine berth
- The marine outfall
- Operation of vessels berthed at marine terminal and out to the pilot station at Triple Islands and the anchorages at Stephen’s Island.
- Transportation to and disposal of dredged materials at the ocean disposal site or use of suction dredge which would not require vessel transport.

Temporary Structures

- On-site assembly/construction sites and temporary on-site service facilities

Other

- The construction related to any fish habitat compensation
- Any other ancillary components and activities associated with the Project and located on PRPA lands and marine areas including administrative, personnel, maintenance and storage building and site services such as water supply and sewage.
- New access roads, new service roads and upgrades to existing roads directly associated with development of the Project

- The removal, transport and disposal of overburden associated with the project
- The resulting increase in rail traffic from the Project footprint to Lorne Creek that is attributable to the Project.

The scope of the Project does not include transport of potash on the existing rail system beyond the Project footprint, except with respect to noise and vibration, air quality and accidents and malfunctions, which are assessed to Lorne Creek. Marine vessel operation is assessed within established shipping routes to Triple Islands Pilotage Station.

3.2 Factors to be Considered

Pursuant to subsections 16(1)(a) to (d) and subsection 16(2) of the CEAA, the following factors are considered in a comprehensive study:

- Purpose of the Project
- Alternative means of carrying out the Project that are technically and economically feasible and the environmental effects of any such alternatives
- Environmental effects (as defined below) of the Project, including the environmental effects of potential accidents and malfunctions that may occur in connection with the Project and any cumulative environmental effects that are likely to result from the Project in combination with other projects or activities that have been or will be carried out
- Measures that are technically and economically feasible and that would mitigate any significant adverse environmental effects of the Project
- Significance of the environmental effects
- The need for, and the requirements of, any follow-up program in respect of the Project
- Comments from the public obtained in accordance with the CEAA
- The capacity of renewable resources that are likely to be significantly affected by the Project to meet the needs of the present and those of the future
- Any other matter relevant to the comprehensive study, such as the need for the Project and alternatives to the Project that the Agency may require to be considered.

For greater clarity, according to the CEAA, “environmental effect” means, in respect of a project:

a) Any change that the project may cause in the environment, including any change it may cause to a listed wildlife species, its critical habitat or the residences of individuals of that species, as those terms are defined in subsection 2(1) of the *Species at Risk Act*

b) Any effect of any change referred to in paragraph (a) on:

   i. health and socio-economic conditions

   ii. physical and cultural heritage

   iii. the current use of lands and resources for traditional purposes by aboriginal persons

iv. any structure, site or thing that is of historical, archaeological, paleontological or architectural significance

v. any change to the project that may be caused by the environment, whether any such change or effect occurs within or outside Canada.

3.3 Scope of the Factors

The proposed scope of factors to be considered in the environmental assessment were defined in a document produced by the CEA Agency that presents background information on the Project (CEAA 2011). The scope of factors to be considered in the environmental assessment is included in Table 3-1.

Table 3-1: Scope of Factors

Environment	Environmental Component
Terrestrial Environment	▪ Air quality ▪ Vegetation and plant communities (includes wetlands) ▪ Wildlife and wildlife habitat (includes avifauna) ▪ Ecologically sensitive or significant areas, species of conservation concern, including species-at-risk and their habitats
Aquatic Environment	▪ Water quality ▪ Fish and fish habitat ▪ Ecologically sensitive or significant areas, species of conservation concern, including species-at-risk and their habitats
Human Environment (i.e., indirect effects resulting from a direct change in the environment)	▪ Current use of lands and resources for traditional purposes by Aboriginal persons ▪ Navigable Waters/Navigation ▪ Human health (e.g., noise, light, country foods) ▪ Structures/sites of historical, archaeological, paleontological, or architectural significance ▪ Social and economic issues

NOTE:
Table based on the CEA Agency's background information document (CEAA 2011)

3.4 Assessment Boundaries

3.4.1 Temporal Boundaries

The assessment's temporal boundaries are defined based on the timing and duration of Project activities that could result in environmental, heritage and human effects. The purpose of the temporal boundaries is to identify when an effect may occur in relation to specific Project phases and activities. Based on the proposed Project schedule, the temporal boundaries for the assessment are:

- **Construction:** Commencing in Q3 2012
- **Operations:** Commencing in Q1 2016
- **Decommissioning:** TBD.

Any decommissioning or abandonment activities are expected to be more than 50 years in the future, and would be subject to future examination under the CEAA and in accordance with the regulations applicable at that time. For the purposes of the environmental assessment, decommissioning will include removal of the land-based, above-ground infrastructure and the conveyor and shiploading equipment from the jetty and berth. The berth and access trestle will remain in place. The road, rail and utility corridor are considered permanent and decommissioning is not anticipated.

3.4.2 Spatial Boundaries

Spatial boundaries for each VEC encompass the geographic extent of where the potential environmental, heritage and human effects of the Project are expected to be measureable. These include the local assessment area (LAA) for consideration of direct effects on the selected VECs, and a regional assessment area (RAA) for consideration of cumulative effects. Spatial boundaries for each VEC are described in Tables 3-2 and 3-3.

3.4.2.1 Local Assessment Area

The LAA boundary consists of the Project footprint plus a buffer zone within which direct and indirect effects of the Project are reasonably expected to occur. LAA boundaries for each VEC are defined in Table 3-2.

Table 3-2: Local Assessment Area Boundaries

Valued Environmental Component	Local Assessment Area Boundary
Air Quality	▪ For the terminal, the LAA included a 30 km by 30 km study area centered on the Canpotex Terminal. For the rail assessment, the LAA extended from Ridley Island to Lorne Creek.
Noise and Vibration	▪ Ridley Island and the Village of Port Edward
Ambient Light	▪ Ridley Island and the Village of Port Edward
Vegetation Resources	▪ Ridley Island
Wildlife and Wildlife Habitat	▪ Ridley Island and a 500 m buffer around the edge of the island
Aquatic Environment	▪ All freshwater habitats on Ridley Island, 500m buffer around Coast and Ridley Islands and proposed disposal at sea sites.
Human Health	▪ Same as Air Quality (in keeping with largest relevant VEC boundary)
Archaeological and Heritage Resources	▪ Project footprint (i.e., area subject to physical ground disturbance)
First Nations Current Use	▪ Ridley Island and along the shipping lane between Ridley Island and the pilotage stations at Triple Islands
Navigable Waters	▪ Project jetty location west along the shipping lane to the pilotage station on Triple Islands

3.4.2.2 Regional Assessment Area

The RAA boundaries for the VECs consist of the areas encompassed within each LAA plus those additional areas that encompass other projects that are anticipated to have residual effects that could interact with residual effects from construction, operation or decommissioning of the Project. RAA boundaries for each VEC are defined in Table 3-3. Where the cumulative impacts screening for an individual effects assessment determines that a cumulative impacts assessment is warranted, the defined RAA is used.

Table 3-3: Regional Assessment Area Boundaries

Valued Environmental Component	Regional Assessment Area Boundary
Air Quality	▪ Same as LAA (only one assessment area for Air Quality)
Noise and Vibration	▪ 5 km buffer from Ridley Island and along rail line to Lorne Creek.
Ambient Light	▪ 5 km buffer from Ridley Island
Vegetation Resources	▪ The Kaien Landscape Unit as identified by Schedule 1 of the Central and North Coast Order (http://ilmbwww.gov.bc.ca/slrp/lrmp/nanaimo/cencoast/plan/objectives/index.html)
Wildlife and Wildlife Habitat	▪ The area covered by the North Coast Land and Resource Management Plan (LRMP) with a focus on Ridley Island and the marine habitat in the vicinity of Ridley Island
Aquatic Environment	▪ Areas of Chatham Sound west to Triple Islands and south to Porcher Island
Human Health	▪ Same as Air Quality LAA (in keeping with largest relevant VEC boundary)
Archaeological and Heritage Resources	▪ The approximate boundary of the claimed traditional territory of the Tsimshian Nation extending south to Kitasoo, north to the mouth of the Nass River, and up to the Skeena River just east of Terrace.
First Nations Current Use	▪ The approximate boundary of the claimed traditional territory of the Tsimshian Nation extending south to Kitasoo, north to the mouth of the Nass River, and up to the Skeena River just east of Terrace.
Navigable Waters	▪ Areas of Chatham Sound west to Triple Islands and south to Porcher Island

3.5 Environmental Assessment Methods

3.5.1 Selection of Valued Environmental Components

The assessment focuses on specific components of the biophysical and human environments called Valued Environmental Components (VECs). Selection of VECs for the assessment was based on the environmental setting, professional judgment, and issues raised during consultations. The VEC selection process also considered the temporal and spatial scope of the Project and anticipated potential Project-environment interactions. The Project team considered all VECs in the assessment, however, a full assessment of effects was not completed for VECs where:

- There is no interaction with Project components or Project activities.

- Interaction occurs; however, based on past experience and professional judgment, the interaction would not result in a significant environmental effect, even without mitigation.
- Interaction occurs; however, it would not result in a significant effect due to the application of codified environmental protection practices that are known to effectively mitigate the predicted environmental effect (see Section 3.6.3.4 for definition of significance).

Based on this rationale, VECs considered in this assessment include:

- Air Quality
- Noise and Vibration
- Ambient Light
- Vegetation Resources (including rare vegetation and wetlands)
- Wildlife and Wildlife Habitat (including species-at-risk and avifauna)
- Aquatic Environment (including both fresh and marine waters, and fish and fish habitat)
- Human Health (including country foods)
- Archaeological and Heritage Resources
- First Nations Current Use
- Navigable Waters.

Surface water and groundwater have not been included as VECs because there are no aquifers on Ridley Island and the Project does not include any freshwater extraction. All potable water on Ridley Island is obtained from Port Edward. The Project design will include appropriate drainage infrastructure to manage surface water runoff. Potential environmental effects of runoff on receiving waters are considered within the marine environment VEC.

For each selected VEC, one or more measurable parameters were then identified to facilitate quantitative or qualitative measurement of potential project effects and cumulative impacts. Measurable parameters provide a means to determine the level or amount of change to a VEC. For example, current use and connectivity of habitats during construction and operations was chosen as the measurable parameter for alteration of movement.

3.5.2 Environmental Assessment Framework

The assessment used a framework developed to address the requirements of section 16(1) and 16(2) of the CEAA. The methods are based on a structured approach that assesses the Project-specific effects and then the cumulative effects with other projects. The steps of the assessment included:

1. Identification of possible interactions between the Project and the VECs (see Section 3.6.1.)
2. Identification of other projects that could lead to cumulative effects
3. Assessment of Project-specific effects including:
    - Description of potential effects
    - Identification of mitigation measures

- Characterization of residual effects (i.e., those effects that may persist after all mitigation strategies have been implemented)
- Characterization of the significance of the residual effects.

4. Assessment of cumulative effects:
    - Description of potential cumulative effects
    - Identification of mitigation measures that Canpotex and PRPA can implement
    - Characterization of residual cumulative effects
    - Characterization of the significance of the residual cumulative effects.

3.5.3 Project—Environment Interactions

Assessment of the Project's potential environmental effects begins with a description of Project activities and physical works that could result in an environmental effect of concern. Table 3-4 presents an interaction matrix of Project activities during each phase (described in Section 2.4) and the VECs chosen for inclusion in the assessment (Section 3.4.1.1). Based on relevant literature, other environmental assessments, and professional judgment, Table 3-4 ranks the potential for an activity to interact with one or more VECs.

The intent of the project interaction table is to identify where the higher risk interactions occur and focus the environment, heritage and human effects assessment on these interactions. Lower risk interactions are not carried forward in the effects assessment.

The justification for assigning the rankings for each VEC is provided in the specific environmental assessment section for the VEC. Interactions ranked as "0" or "1" are not discussed in detail in the assessment as significant effects would not result. For example, site clearing may result in sediment runoff into the marine environment but standard sediment and erosion control best management practices and water management measures will be in place to minimize these effects.

Potential cumulative interactions between the environmental effects arising from the Project and effects from other past, present, or announced projects within the area are identified with a checkmark. The projects identified as having a potential interaction with the Project within the defined temporal and spatial boundaries are considered further in the cumulative effects assessment (see Section 3.7).

Potential accidents and malfunctions are addressed in Section 19.

Table 3-4: Interaction of Project Activities with VECs

Project Activities/Physical Works	Project Description Reference for Activity	Air Quality	Noise and Vibration	Ambient Light	Vegetation Resources	Wildlife and Wildlife Habitat	Aquatic Environment	Human Health	Archaeological and Heritage Resources	First Nations Current Uses	Navigable Waters
Construction and Commissioning											
Temporary Construction Infrastructure (trailers, power, sanitary facilities, etc.)	2.4.1.1.3	2	2	1	1	2	0	2	2	2	0
Site Preparation (Clearing and Grubbing, Site Grading)	2.4.1.2	2	2	1	2	2	1	2	2	2	0
Rail Loop Construction	2.4.1.2	2	2	1	1	2	2	2	2	2	0
Onshore Terminal Construction (receiving, storage, reclaim and shiploading facilities, site services)	2.4.1.3	2	2	1	1	2	0	2	2	2	0
69 kV transmission line Construction	2.4.1.5	1	2	0	1	2	0	2	2	2	0
Installation of Canpotex Rail Tracks	2.4.1.4	2	2	0	1	2	0	2	0	0	0
Access Road and Overpass Construction	2.4.1.6	2	2	0	1	2	0	2	2	2	0
Dredging	2.4.1.7	1	2	2	0	2	2	2	1	2	2
Marine Facilities Construction (causeway, trestle and berth)	2.4.1.8	2	2	2	0	2	2	2	2	2	2
Disposal at Sea	2.4.1.9	0	0	0	0	2	2	1	0	2	2
Commissioning		1	2	1	0	1	0	0	0	2	2
Operations											
Potash Handling Operations (receiving, storage, reclaim and shiploading of potash)	2.4.2.1/.2/.3	2	2	2	0	2	0	2	0	2	0
Waste Management (Sewage, Stormwater and Wastewater)	2.5	0	0	1	1	2	2	1	0	0	0
Infrastructure Maintenance	2.4.2.5	1	1	1	1	1	0	0	0	0	0
Arrival and Departure of Vessels	2.4.2.4	2	2	1	0	2	2	2	2	2	2
Arrival and Departure of Trains		2	2	1	0	2	0	2	0	2	0

Project Activities/Physical Works	Project Description Reference for Activity	Air Quality	Noise and Vibration	Ambient Light	Vegetation Resources	Wildlife and Wildlife Habitat	Aquatic Environment	Human Health	Archaeological and Heritage Resources	First Nations Current Uses	Navigable Waters
Decommissioning											
Removal of Site Infrastructure (potash handling system/buildings)	2.4.3	1	2	2	0	1	0	2	2	2	0
Waste Disposal and Site Clean-up	2.4.3	0	0	0	0	1	0	0	0	0	0
Interaction of Other Projects											
Ridley Terminals Inc.		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Prince Rupert Grain Ltd		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Ridley Island Log Sort		–	–	–	✓	✓	✓	✓	✓	✓	✓
China Paper Group Pulp Mill[1].		–	–	–	✓	✓	✓	✓	✓	✓	–
Fairview Terminal (existing and II)		✓	–	–	–	✓	✓	✓	✓	✓	✓
Quickload Terminals Prince Rupert Container Examination Facility		–	✓	✓	–	✓	–	✓	–	–	–
CN Aquatrain facility		–	–	–	–	✓	✓	✓	–	–	✓
BC Ferries and Cruise ship Terminal		✓	–	–	–	✓	✓	✓	–	–	✓
PRPA Land Use Plan[2]		–	–	–	✓	✓	–	✓	✓	✓	–

NOTES:

Ranking of each interaction was assigned as follows:

0 = No measurable interaction

1 = Nominal interaction occurs; however, based on past experience and professional judgement, the interaction would not result in a significant environmental effect if no mitigation is applied; or interaction would not be significant due to application of codified environmental protection practices that are known to effectively mitigate the predicted environmental effects.

2 = Interaction could result in an environmental effect of concern and the potential environmental effect is considered further in the environmental assessment.

✓ = Potential cumulative interaction with the Project.

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[1] Potential emissions from the pulp and paper mill will not be included in the air quality assessment due to the age of the infrastructure and the extended period of time the mill has been shut-down. Both facts indicated that it is not economically feasible to restart the mill.

[2] Due to the preliminary nature of the land use plan only cumulative effects associated with wildlife and vegetation will be assessed.

3.5.4 Project Inclusion List

The Project inclusion list includes all past, present, and reasonably foreseeable (those that are likely to occur) projects, activities and actions with residual environmental effects that could interact spatially and temporally with the residual environmental Project effect being considered. For the proposed Project, the following information sources were used to compile this list:

- British Columbia Environmental Assessment Office's Project Information Centre (e-PIC) (http://a100.gov.bc.ca/appsdata/epic/html/deploy/epic_home.html)
- Canadian Environmental Assessment Registry (http://www.ceaa-acee.gc.ca/050/index-eng.cfm)
- Prince Rupert Port Authority.

Specific projects and activities that were identified for inclusion in the cumulative effects assessment are described in Table 3-5.

Table 3-5: Project Inclusion List

Project or Activity Name	Project or Activity Description
Fairview Terminal (Phase I and II)	Fairview Terminal is a container terminal with ship-to-rail transfer located on Kaien Island. Phase II is currently in the environmental assessment process.
Ridley Terminals Inc.	Ridley Coal Terminal, built in 1984 is a deep sea bulk terminal that handles the export of coal and petroleum coke volumes from western Canada. Bulk material is received by train and is shipped in vessels up to 250,000 DWT.
Ridley Island Log Sort	Ridley Island Log Sort was a dry land operation that produced shingles for the Vancouver market, produced wood chips for pulp mills and sorted, stored ad transported logs. This business shut down in 2009.
Prince Rupert Grain Terminal	The Prince Rupert Grain Terminal, opened in 1985, cleans and exports in excess of 6 million tonnes of Canada Wheat Board grains such as wheat and barley annually. Terminal can accommodate vessels up to 145,000 DWT.
China Paper Group Pulp Mill	This mill is not currently operational, but was in operation between 1957 and 2001 as the Skeena Cellulose Pulp Mill.
Houston Pellet Inc. Wood Pellet Facility	The facility consists of a pellet railcar unloading building, pellet storage silo, and conveyors. Wood pellets will be loaded onto vessels through RTIs existing berth and ship loading equipment.
Quickload Terminals Prince Rupert Container Examination Facility	This Container Examination Facility is located on Ridley Island and enables Canada Border Services Agency to inspect container traffic from the Fairview Container Terminal prior to being loaded onto rail. The facility is comprised of a pre-engineered steel warehouse and administrative building.
CN Aquatrain facility	This terminal is located on the western edge of Kaien Island in Prince Rupert. The facility is used for the shipment of various types of products (including diesel fuel and propane) to Alaska via rail cars.

Project or Activity Name	Project or Activity Description
BC Ferries	BC Ferries offers year-round service from Prince Rupert to the Queen Charlotte Island (QCI) and south through the Inside Passage to Port Hardy. Ferries between Prince Rupert and Port Hardy travel every other day in the summer (May – September) and two to three times per month in the winter. Ferries between Prince Rupert and QCI travel three days per week in the winter and six days per week in the summer.
Cruise Ship Terminals	Two cruise ship terminals currently service Prince Rupert: Northlands terminal (accommodates large cruise vessels up to 300 m in length) and Atlin Terminal (accommodates private yachts and smaller cruise ships). The Northland Terminal was built in 2004. Cruise ships are berthed for 6 to 10 hours during which time up to 2,500 passengers can disembark and visit Prince Rupert and surrounding communities. The number of Cruise ship visits was 36 in 2004, 50 in 2005 and 55 in 2006. Atlin Terminal is located next to the Prince Rupert Rowing and Yacht Club and currently handles small explorer-class ships.
Permitted air emission sources from Prince Rupert and Port Edward	Permitted air emissions include industrial and commercial emissions in Prince Rupert and Port Edwards that are not already included in the above.
PRPA Land Use Plan	The Land Use Plan was developed to provide guidance over future development in Prince Rupert Harbour and includes an outline of major industrial opportunities on Ridley Island. It is unknown at this time what these opportunities will include and whether there will be any in water components.

The NaiKun Wind Farm Project is not included in the Table 3-5 because the proposed landfall for the cable will no longer be on Ridley Island. The land previously available to the NaiKun Project is no longer available. Mount McDonald Wind Power Project was also excluded because it was not successful at securing a power purchase agreement. There is no future call for power currently scheduled and the project has been inactive for almost two years.

3.5.5 Assessment of Project-Specific Effects

3.5.5.1 Description of Project Effects Mechanisms

For each VEC, the mechanisms whereby specific Project activities and actions are anticipated to result in the respective environmental, heritage, or health effect have been described. Where possible, the spatial and temporal extents of these anticipate changes (i.e., where and when the environmental effect might occur) are also described.

3.5.5.2 Mitigation of Project Effects

Mitigation is defined as changes to reduce or eliminate potential adverse project effects. These changes may be in the temporal or spatial aspects of the Project and/or the means in which the Project will be constructed, operated, or decommissioned. Mitigation can also include specialized measures such as habitat compensation, replacement, transplant and timing considerations.

Mitigation measures that will help reduce or eliminate an environmental effect are described, with an emphasis on how these measures will help alter the environmental effect. Where possible, the effectiveness of the proposed mitigation measure(s) is expressed in terms of the expected change in the measurable parameter(s) for the effect. In some cases, mitigation measures may include monitoring to verify results.

3.5.5.3 Characterizing Residual Project Effects

Under CEAA, the determination of significance is central to decision-making. Accepted practice in meeting this requirement involves establishing and applying evaluation criteria for the determination of significance. Standard characterization terms (in bold) are defined below. Rating criteria (in brackets) were defined within each VEC section to provide the threshold for determining the significance of residual adverse environmental effects, specific to that VEC.

- **Direction:** the ultimate long-term trend of the environmental, heritage and human effect (i.e., positive, neutral, adverse)
- **Magnitude:** the amount of change in a measurable parameter or variable relative to baseline case (i.e., negligible, low, moderate, high)
- **Geographical extent:** the geographic area within which an environmental, heritage or human effect of a defined magnitude occurs (i.e., site-specific, local, regional)
- **Frequency:** the number of times during a project or a specific project phase that an effect may occur (i.e., once, sporadic, regular, continuous)
- **Duration:** the period of time required until the VEC returns to its baseline condition or the effect can no longer be measured or otherwise perceived (i.e., short-term, medium-term, long-term, permanent)
- **Reversibility:** the likelihood that a measurable parameter will recover from an effect (i.e., reversible or irreversible)
- **Ecological or socio-economic context:** the general characteristics of the area in which the project is located (i.e., undisturbed or disturbed).

3.5.5.4 Determination of Significance of Residual Effects

A conclusion on the significance of any residual Project effects is included for each VEC. Where possible, threshold criteria or management standards are identified beyond which a residual effect is considered significant. Standards are recognized government or industry regulations or objectives for physical aspects such as air quality, water quality, or effluent release. These thresholds reflect the limits of an acceptable state for an environmental component based on resource management objectives, community standards, scientific literature, or ecological processes (e.g., desired states for wildlife habitats or populations). Where standards or thresholds do not exist, significance criteria have been defined and justifications for the criteria provided.

In addition to the above characterization terms (Section 3.6.3.3), the **prediction confidence** and **likelihood** of significant residual environmental effects are also described. Prediction confidence (i.e., low, moderate, or high) rates the professional certainty in the accuracy of the effects characterization and significance determination. This prediction considers scientific certainty relative to:

- Scientific certainty relative to quantifying or estimating the effect, including the quality and/or quantity of data and the understanding of the effect mechanisms
- Scientific certainty relative to the effectiveness of the proposed mitigation measures
- Professional judgement from prior experience including tried and true mitigation measures.

Higher confidence in all three variables produces greater confidence in the effect predictions, assessment of significance, and the selection of mitigation measures.

3.6 Assessment of Cumulative Effects

Not all residual effects can contribute to measurable cumulative impacts. To determine whether a detailed cumulative impacts assessment is necessary a screening is completed using the predicted residual effects on each VEC. The screening determines if all three of the following conditions are met for the environmental, heritage, and health effects under consideration. The three conditions are based on conclusions made by the National Energy Board and the Joint Review Panel for the Express Pipeline Project and are consistent with those outlined by CEAA in the CEA *Agency's Cumulative Effects Assessment Guidance* document.

- **Condition 1**—the Project must result in a measurable, demonstrable or reasonably-expected residual environmental effect on a component of the biophysical or human environment (i.e., is there an environmental effect that can be measured or that can be reasonably expected to occur?).
- **Condition 2**—the Project-specific residual environmental effect on that component must, or is likely to, act in a cumulative fashion with the environmental effects of other past, current or likely to occur future projects and activities (i.e., is there overlap of environmental effects that result in cumulative environmental effects?).
- **Condition 3**—there is a reasonable expectation that the Project's residual effects will contribute to cumulative environmental effects in a manner that will affect the viability or sustainability of the resource or value.

A cumulative effects assessment proceeded past this screening only when all three conditions are met.

The focus of the detailed cumulative effects assessment is on the incremental effect directly attributable to the Project on the VEC. The cumulative effects assessment considers the baseline effects that have resulted or are resulting from other past physical works and activities. Then, the cumulative contribution of the residual environmental effects of the Project is considered. Finally, the cumulative contribution of other known and announced projects and activities (as determined by the Project Inclusion list in Section 3.6.2 above) is considered. Cumulative effects are considered for each VEC that is shown to have residual effects. The residual cumulative environmental or socio-economic effects are then characterized and evaluated using the same criteria and significance thresholds established for the VEC.

3.6.1 Description of Cumulative Effects

The assessment of each cumulative effect begins with a description of the effect and the mechanisms whereby the effects from the Project might interact with other projects and activities in the VEC-defined spatial boundaries. For each VEC, potential cumulative effects are ranked as follows:

0 = Project effects do not act cumulatively with those of other projects and activities.

1 = Project effects act cumulatively with those of other projects and activities, but are unlikely to result in significant cumulative effects OR Project effects act cumulatively with existing levels of cumulative effects but will not measurably change the state of the VEC.

2 = Project effects act cumulatively with those of other projects and activities, and may result in significant cumulative effects OR Project effects act cumulatively with existing levels of cumulative effects and may measurably change the state of the VEC.

Where possible, the cumulative effect is quantified in terms of the degree of change in the measurable parameter(s) and the spatial and temporal extent of these changes (i.e., where and when the interactions between the Project residual effects and the residual effects of other projects and activities are expected to occur).

3.6.2 Mitigation of Cumulative Effects

Mitigation measures available to Canpotex and PRPA to reduce any identified potentially adverse Project cumulative effects are described for each effect, including a discussion of how these measures might modify the characteristics of an effect. Mitigation measures that would require government action or a broader industry approach are briefly identified but not discussed in detail.

3.6.3 Characterization of Residual Cumulative Effects

Residual cumulative effects, after application of the mitigation, are described. Where practical, the residual cumulative effects are characterized by direction, magnitude, geographic extent, frequency, duration, reversibility and context. The focus is on the incremental effects directly attributable to the Project on those components affected.

3.6.4 Determination of Significance of Cumulative Effects

A determination of the significance of the cumulative effects is made using the standards or thresholds established for the effects on individual VECs. The determination of significance also included a discussion of the “prediction confidence” based on:

- Scientific certainty relative to quantifying or estimating the environmental effect, including the quality and/or quantity of data and the understanding of the effect mechanisms
- Scientific certainty relative to the effectiveness of the proposed mitigation measures
- Professional judgment from prior experience including tried and true mitigation measures.

Higher confidence in all three variables produces greater confidence in the effect predictions, assessment of significance, and the selection of mitigation measures.

3.7 Follow-up and Monitoring

The CEAA defines the purpose of follow-up programs as:

- Verifying the accuracy of the environmental assessment of a Project
- Determining the effectiveness of any measures taken to mitigate the adverse environmental effects of the Project.

In contrast, monitoring primarily relates to compliance monitoring, which establishes whether proposed mitigation measures were implemented, rather than assessing their effectiveness. Recommended follow-up and monitoring programs are described for each VEC and/or environmental effect, as appropriate.

3.8 Accidents and Malfunctions

Potential accidents and malfunctions are assessed for the Project. Details on the types of potential accidents and malfunctions considered in this environmental assessment are provided in Section 19.

For each scenario, each discipline conducted a preliminary screening to determine if the scenario is likely to affect the VEC. Potential interactions are ranked using the same criteria as for the Project-environment interactions (Section 3.6.1).

For interactions ranked as a ‘2’, potential environmental effects on the VEC are assessed in a similar fashion to Project environmental effects (Section 3.6.3). Environmental effects are characterized using the same terms as routine Project environmental effects (Section 3.6.3.3). The significance of the environmental effect is then determined using the same thresholds as used for the routine Project environmental effects (Section 3.7.4).

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4 ASSESSMENT OF PROJECT ALTERNATIVES

Pursuant to Section 16(2)(b) of CEAA, an assessment of alternatives to the Project is required. This assessment was completed with guidance from CEAAs Operational Statement *Addressing “Need for”, “Purpose of”, “Alternative to” and “Alternative Means” under the Canadian Environmental Assessment Act*. As per the Operational Statement, “alternatives to” the Project refer to the functionally different ways to achieve the Project purpose and meet the Project needs (Project purpose and need are defined in Sections 2.1 and 2.2 respectively and summarized in Section 4.1 below). Alternative means of carrying out the Project are the various technically and economically feasible ways the Project can be implemented or carried out. A description of alternative means to carry out various components and activities in relation to the proposed Project are discussed in Section 4.2.

4.1 Alternative to the Project

As discussed in Section 2.0 the need for and purpose of the Project is to meet the growing global demand for fertilizer by providing a means of exporting potash from Saskatchewan, one of the largest potash deposits in the world, overseas. This must be done in a way that is both efficient and economical to ensure that both market and stakeholder needs are being met. Given the location of potash reserves relative to regions requiring potash, the only feasible way to transport large volumes of potash to global markets is by rail and ocean going vessel. As a result, there are no viable alternatives to the Project.

4.2 Alternative Means of Carrying out the Project

Alternative means of carrying out the project that are economically and technically feasible are discussed below along with general environmental effects associated with such alternative means and the rational for selection of the preferred alternative. Special consideration was given to the following alternatives:

- Alternative project locations
- Alternative construction methods specifically in relation to the causeway and trestle
- Alternatives to the rail loop and access road design
- Alternatives to and alternative locations for disposal at sea and disposal on land.

Preferred alternatives are summarized in Section 4.3.

4.2.1 Alternative Locations

4.2.1.1 Alternative Terminal Locations

As discussed in Section 2.1.1, Canpotex undertook a detailed pre-feasibility process prior to selecting Prince Rupert for the location of its new terminal. A full review of current terminal operations and terminal expansion options was conducted, with the objective of identifying the most effective way to create additional capacity on the West Coast. Prince Rupert was selected based on transportation costs, terminal development costs and operational considerations. Alternative locations and scenarios considered after the initial industry review included:

- Expansion of existing Canpotex terminals (Neptune Terminals in Vancouver, BC and/or Portland Terminals in Portland, OR)
- Development of a greenfield location (Prince Rupert, BC and/or Cherry Point, WA).

An initial assessment included consideration of general business parameters and specific analytical details including: marketing, product supply, site details, site ownership, railway systems, terminals systems, ocean transportation, special interest groups, legal issues, and construction activities. Management also met and consulted with industry, leading to commercial proposals being presented by potential service providers and Port Authorities. Subsequent to the presentation of commercial proposals, the general advantages and disadvantages of each terminal expansion option were identified and ranked. Three major steps were taken to arrive at the recommended terminal expansion option:

1) **Key Issues Identification and Mitigating Steps**

   Key issues identification and mitigating steps involved a detailed review of each expansion option site and the respective commercial proposals outlining risks and critical issues. Issues considered key to the viability of each terminal option were highlighted. The respective service providers were then asked to resolve these issues to a level of acceptable risk.

2) **Total Operating Systems Cost Comparison**

   Based on operating and capital cost assumptions developed by Canpotex Management, total operating system costs were compared across the site options. This included costs of the respective inland transportation, terminal construction/operation and ocean transportation activities. The results indicated that Prince Rupert has the lowest overall total operating system cost, followed by Neptune Terminals and then Cherry Point.

3) **Business Risk Assessment**

   Willis Canada was commissioned to perform a business risk assessment of the terminal expansion options. The key issues previously identified were evaluated and assessed to determine the terminal expansion option with the lowest risk score (i.e., the most preferred option). The analysis showed Prince Rupert to have the least risk, followed by Cherry Point and then Neptune Terminals.

Prince Rupert was selected as the preferred terminal expansion site based on its:

- Lowest overall system cost
- Lowest business risk assessment
- Lack of rail congestion
- Availability of land for future expansion.

4.2.1.2 Alternative Locations within Prince Rupert Harbour

Geotechnical information showed that the chosen location for construction of the berth and trestle was the optimum location, based on: minimum piling lengths, the need to be able to extend the berth in the future for a second phase should one be required, and the ability to transfer the shiploader from berth I to berth II on a common rail system.

4.2.2 Alternative Layouts and Constructions Methods

4.2.2.1 Trestle Support Structure

Piling was deemed the only valid option for construction of the berth and trestle. Gravity based foundations (caissons or cells) were excluded for various geotechnical reasons.

In the layout of the piles for both the trestle and berth, consideration was given to keeping the location and piles in groups and batters so that repositioning of the driving rig can be kept to a minimum.

4.2.2.2 Causeway

Construction of a causeway was deemed the only economically feasible option for securing the trestle to Ridley Island. Two alternate designs for the terminal causeway were considered: one extending 401 m southwest of Ridley Island, and one extending 185 m. Although both options were feasible from an engineering perspective and the costs were similar, the shorter causeway was selected in order to minimize the impact on marine habitats.

4.2.3 Alternatives to Rail Loop and Access Road Design

Due to the nature of Ridley Island and the presence of existing rail lines there were limited options for the design and layout of the rail loop and access road. The existing rail line splits just north of Zinardi Rapids such that the CN mainline travel northward along Kaien Island towards Fairview Terminals and other customers, while the RTI track splits in two and travels westward between the existing RTI and Prince Rupert Grain Terminals. To avoid interacting with these existing rail lines the new rail loop had to split to the south of the RTI track thus hugging the shoreline at the northern end of Porpoise Harbour. Once on Ridley Island the track follows the existing ring road except in the southwest corner where for stability purposes the track is required to follow the original shoreline to the north of the on-land disposal site.

4.2.4 Disposal at Sea Alternatives

Construction of the terminal's marine wharf will result in the dredging and necessary disposal of 840,000 m^3 of sediment. Rocks removed from the dredge site will be reused where possible (i.e., construction of the causeway or the subtidal reef being proposed for habitat compensation), but there is no known use for the dredged sediment. Given the amount of sediment requiring disposal and the lack of a sufficiently large on-land disposal site, disposal at sea will be the only economically sound alternative for clean material. Disposal at sea will require a permit under the Disposal at Sea Regulations (subsection 127(1) of the *Canadian Environmental Protection Act* [CEPA]). An assessment of the potential effects of disposal of dredged material at two proposed new disposal sites has been prepared and submitted to Environment Canada for approval (Stantec, 2011). Results of this report are summarized briefly below.

Environment Canada's designated disposal site in the Prince Rupert area is Brown Passage, which is approximately 30 km east of the Project site. In an initial screening assessment, eight potential new disposal sites plus Brown Passage were identified for potential use for the Canpotex Project. All sites were compared from biological, physical, human use and economic perspectives. Given the distance to EC's designated disposal site, identification of a site located closer to the Project would reduce the amount of vessel activity required, thus providing a more economical option with lower transportation related emissions. For the most part, biological and human use differences between sites were negligible. Based on economics (proximity of the dredge site) and physical differences (site capacity) only two of the sites, sites A and B, were deemed suitable. As a result, sites A and B were the only new sites carried forward in the alternatives assessment.

Sites A and B are located within the Prince Rupert Port Authority boundaries. Site A is approximately 1 km west of the dredge site, offshore of Coast Island. Site B is approximately 6 km southwest of the dredge site, near the Kinahan Islands. Although it is less economical, Brown Passage was also assessed because it has been previously approved as a disposal site.

A comparison of sites A, B and Brown Passage revealed minimal ecological and physical differences given the amount of dredgeate being disposed. However, there were economic and human use differences (Table 4-1). The closer proximity of sites A and B relative to Brown Passage would result in reduced travel time between sites and an associated reduction in emissions, costs, and risk of collision or interference with other vessels. Travel time and emissions would be further reduced at site A, which is sufficiently close (1 km) to use a suction dredge (instead of a barge) to transport the majority of material to the disposal site. Use of the suction dredge will also result in reduced total suspended solids (TSS) because the disposal pipe would be approximately 10 m above the ocean floor as opposed to at the ocean surface. Differences in current speed will also affect dispersal of TSS. Currents are stronger at Brown Passage which will result in greater dispersal of TSS.

As a result, site A was selected as the preferred option. The primary reasons in support of site A as a new disposal at sea site, are as follows:

- Location will allow use of a suction dredge instead of transportation by barge
- Minimize TSS plume
- Minimize emissions
- Minimize interference with vessel activity
- Material is stable over the long term
- Expect rapid recovery where disposed sediments are <1 cm thick and rapid recolonization where sediments are deeper.

Selection of site B would result in increased vessel traffic relative to site A; however, relative to Brown Passage, site B will reduce vessel traffic approximately five-fold. Site B would therefore be the preferred second choice. It is unlikely that Canpotex would submit disposal at sea permit applications for both sites; however, depending on final project design (i.e., amount of dredgeate) one site may be preferred to the other.

Table 4-1: Comparison of Preferred Disposal Site Options

	Site A	Site B	Brown Passage
Travel Distance (one-way)	1 km	6 km	30 km
Number of one-way trips	200*	850	850
Number of barge loads per day	0	5	5
Number of disposal days	45	85	85
Total SO_2 emissions (kg)	0.58	14.58	72.9
Total NO_x emissions(kg)	113.14	2,885.09	14,425.46
Typical current speed (m/s)	0.05 – 0.2	0.1 – 0.5	0.05 – 0.8
Ranking of preferred disposal site options	**1st**	**2nd**	**3rd**

NOTE:
*Assumes two tugs for relocation of the suction dredge when needed

4.2.4.1 Strategies to Reduce Volume to be Disposed

The volume of material considered in the potential disposal at sea site assessment (840,000 m^3 of dredgeate) represents the maximum possible volume. It may not be necessary to dispose of all of this material at sea, as portions may be re-used elsewhere for the Project. The disposal volume will be confirmed closer to the time that the Disposal at Sea Permit application is prepared. However, alternatives to disposal at sea are limited within the Prince Rupert region.

4.3 Analysis of Alternatives and Summary of Findings

Identification of the preferred project options involved comparison of the project alternatives to the following criteria:

- Technical feasibility
- Economic feasibility
- Environmental and/or socio-economic considerations.

If an alternative was deemed to be technically or economically unfeasible, further assessment of that alternative using other criteria (environmental and/or socio-economic considerations) was not considered, as per CEAA guidance. The preferred options are technically, economically and environmentally feasible. These options were carried forward as the Project to be assessed in the EIS.

Table 4-2: Project Alternatives Assessment

Alternatives	Technical Feasibility	Economic Feasibility	Environmental and/or Socio-economic Considerations	Preferred Option
Alternative Sites				
Prince Rupert, BC	Considered Feasible	Closest proximity to Asia Markets therefore lowest operating costs	Closer proximity to export market will result in reduced vessel time therefore reduced emissions, costs and potential for vessel interactions	✓
Vancouver, BC	Considered not feasible. Rail congestion could make expansion difficult	Considered Feasible	n/a	
Cherry Point, WA	Considered not feasible. Rail congestion could make expansion difficult	Considered Feasible	n/a	
Portland, OR	Considered Feasible	Considered not feasible. Greater distance to export market will result in greater costs. There are also greater costs associated with accessing inland transportation.	Labour uncertainty due to current economic downfall.	
Trestle Support Structures				
Pilings	Feasible	Considered feasible	Some loss of fish habitat	✓
Caissons or cells	Disregarded due to geotechnical issues	Considered feasible	n/a	
Length of Causeway and Trestle				
554 m trestle – 185 m causeway	Considered feasible	Considered feasible	A 401 m jetty would result in a large amount of habitat loss and may significantly alter water flow and sediment deposition in the area	
360 m trestle – 401 m causeway	Considered feasible	Considered feasible	Limited impacts on marine habitat relative to larger causeway option	✓
760 m Trestle	Considered feasible	Considered not feasible due to cost ($8 million)	n/a	

Alternatives	Technical Feasibility	Economic Feasibility	Environmental and/or Socio-economic Considerations	Preferred Option
Alternatives to Disposal at Sea				
Brown Passage	Considered Feasible, previously designated disposal site	Dredging cost would be \$6-7M CAD more than alternative options due to distance	Distance from site will result in greater shipping distance therefore greater costs, emissions, and risk of collision or vessel interference. First Nations have indicated concerns with this option due to proximity to traditional fishing area.	
Site A	Considered Feasible	Considered Feasible	Reliance on underwater discharge pipe would result in limited effects on shipping activity, and reduced emissions and costs	✓
Site B	Considered Feasible	Considered Feasible	Greater shipping distance than Site A but five times less than Brown Passage thus reducing emissions, costs and risk of collision	✓
On-land disposal	No on-land disposal sites of sufficient size given amount of dredging required	unknown	n/a	

NOTE:
n/a = not applicable if alternative is not technically or economically feasible

4.4 References

Stantec. 2011. Proposed new disposal at sea sites. Final report submitted to Environment Canada in support of the federal comprehensive study of the Canpotex Potash Export Terminal Project on Ridley Island, Prince Rupert, BC. October 2011

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5 COMMUNICATION AND CONSULTATION

As set out in the *Comprehensive Study List Regulations* there is a provision to consult with the public residing in communities located in the vicinity of a proposed project regarding their issues and concerns. The purpose of this public consultation program is to facilitate the exchange of information about the proposed project, keep the public informed regarding key steps in the assessment process, provide opportunities for public input regarding interests and potential effects, and ensure that issues raised by the public that are relevant to the assessment are addressed. As part of the public consultation process the CEA Agency, on behalf of the RAs and proponent, conducted a public consultation period for the *"Background Document: Initial Federal Public Comment Period"* between August 29 and September 28, 2011. Notice of the public comment period appeared in daily and weekly newspapers, was advertised on local radio and posted on the CEAA website along with digital copies of the document. The document was also available in printed form in viewing centres in Prince Rupert, BC (Prince Rupert Library, Prince Rupert City Hall, Prince Rupert Port Authority, and Prince Rupert Visitor's Centre/Museum of Northern BC).

Two written comments were received from the public as a result of this consultation period. The comments are provided in Table 5-1.

Table 5-1: Public Comments

Comment	Addressed in EIS
For years, the beach on Ridley Island has become synonymous with some of the greatest outdoor recreational opportunities that Prince Rupert and Port Edward have to offer. With the expansion of the existing grain and coal terminals, access to these once public beaches have been cut off. With that, the outdoor recreational opportunities in the area have significantly decreased. There are no other easily accessible beaches in the immediate area which the public can utilize. If and when this project goes forward, I would like to suggest that the extended road and water access be at least somewhat accessible to the public, even if this only equates to a small area of beach access. Other than this one concern, I would also like to voice my utmost support of this project. It brings a multitude of high quality, good paying jobs. I foresee many local people benefitting from this project. I have the utmost confidence in your agency to complete a thorough environmental assessment, and I truly believe this project can be sustainably developed if due consideration and due time are taken	Section 13.2
I am very excited to see the strong possibility of the potash plant opening in Prince Rupert, BC. It's been a long process, but it looks like it will becoming a reality. Prince Rupert can really use the boost in our economy, and this project will help! I cannot wait to see Prince Rupert bounce back and become a real going concern again!	No comment required

A second public comment period will be held in Q1 2012 to obtain public feedback on the EIS. A third and final comment period will likely be held in Q2 2012 on the Comprehensive Study Report.

5.1 Aboriginal Consultation

First Nations can expect to be closely involved in Project planning where their traditional lands, communities, people and culture may be affected. A specific and directed First Nation consultation program has been implemented by the Project proponents and government official. The goal of this program has been to inform First Nations of the Project and nature of proposed works to identify First Nation interests, issues and concerns related to the Project and to consider and address such interests, issues and concerns within the context of Project planning, assessment and design.

The Project footprint lies within the claimed traditional territories of the Metlakatla First Nation and the Lax'Kwalaams First Nation, which are situated in the vicinity of Prince Rupert; however, the Gitxaala Nation has also expressed interest in the area. The Project spatial footprint also lies within the area where Kitsumkalum Band and Kitselas Indian Band may have Aboriginal Rights and interests. These five First Nations have been informed of, and have had the opportunity to participate in, the Project's public consultation program, as well as Technical Working Groups meetings with other government representatives having responsibilities for the environmental process. A summary of proponent led consultation initiatives is provided in Table 5-2. Only meetings are reported in this table, details on correspondence by email, letter and telephone are available upon request.

Table 5-2: Stakeholder Consultation Summary

Stakeholder	Date	Consultation Activity
Allied Tribes of Lax Kw'alaams 206 Shashaak Street Port Simpson, BC V0V 1H0	February 12, 2008	Mine Tour and Meeting in Saskatoon
	April 24, 2008	Dinner meeting with Canpotex, CN and PRPA
	June 12, 2008	Meeting with legal counsel, G. Wouters, PRPA, D. Eyford, D0J and Federal Treaty Negotiations Office(FTNO)
	June 23, 2008	Protocol Agreement executed with Canpotex, CN and PRPA
	September 8, 2008	Conference call with legal counsel and federal government chief negotiator Doug Eyford
	February 12, 2009	Meeting with legal counsel and Doug Eyford
	April 8, 2009	EA Project Description sent via courier with a letter offering to come to the community to discuss the EA process
	June 24, 2009	Breakfast meeting
	July 21, 2009	Meeting regarding EA process with Doug Eyford and PRPA
	August 31, 2009	Revised EA Project Description sent via courier
	September 10, 2009	Electronic invitation, poster and handout sent regarding attending the Prince Rupert Public Information Session on September 22, 2009
	September 10, 2009	Meeting with D. Eyford, Metlakatla and PRPA in Vancouver
	September 17, 2009	Meeting with D. Eyford, PRPA, and Canpotex
	September 24, 2009	Meeting with D. Eyford, T. Molloy, and Canpotex
	October 16, 2009	Meeting with D. Eyford, G. Wouters and PRPA in Vancouver
	October 29, 2009	Framework for Negotiations Agreement executed by Canpotex, Metlakatla and Lax Kw'alaams

Stakeholder	Date	Consultation Activity
	February 3, 2010	Meeting with Canpotex regarding capacity funding
	July 6, 2010	Meeting with Stantec and Canpotex in Vancouver
	August 25, 2010	Meeting with Canpotex
	October 5, 2010	Meeting with CN, PRPA, and Canpotex in Prince Rupert
	November 18, 2010	Meeting with Metlakatla, Ledcor and Canpotex in Vancouver
	November 30, 2010	Meeting with Metlakatla, Ledcor and Canpotex in Vancouver
	December 9, 2010	Meeting with Metlakatla, Ledcor and Canpotex in Vancouver
	March 4, 2011	Meeting with Metlakatla, T. Molloy and Canpotex in Vancouver regarding IBA
	April 12, 2011	Meeting with Metlakatla, T. Molloy and Canpotex in Vancouver
	April 13, 2011	Meeting with T. Molloy and Canpotex in Prince Rupert
	April 18, 2011	Meeting with Metlakatla, and Canpotex in Vancouver
	June 17, 2011	Meeting with Canpotex, PRPA and Metlakatla in Vancouver
	July 13, 2011	Conference call between D. Eyford, G. Wouters, PRPA and Transport Canada re: IBA negotiations
	July 26, 2011	Meeting with legal counsel and PRPA in North Vancouver re: IBA negotiations
	July 27, 2011	Meeting with Metlakatla, PRPA and Canpotex in Vancouver
	August 10, 2011	Meeting with PRPA in Vancouver
	August 10, 2011	Conference between G. Wouters and PRPA
	August 17, 2011	Meeting with Metlakatla, Canpotex and PRPA in Vancouver
	August 22, 2011	Meeting with Metlakatla, Canpotex and PRPA in Vancouver re: business opportunities
	August 25, 2011	Meeting with Metlakatla and PRPA in Vancouver re: contracting benefits
	August 30, 2011	Conference call with PRPA re: IBA negotiations
	August 30, 2011	Conference call with G. Wouters and PRPA re: IBA negotiations
	August 31, 2011	Meeting with Metlakatla, Gitxaala, D. Eyford, PRPA, CN and Canpotex in Vancouver
	September 1, 2011	Meeting between G. Wouters, PRPA and T. Molloy in Vancouver re: IBA Negotations
	September 2, 2011	Meeting with Coast Tsimshian (W. Drury, G. Wouters, G. McDade), Gitxaala (M. Ignas, B. Newby), PRPA (A. Mayer) and Canpotex (J. Somers, T. McDougall, T. Molloy, T. Nieman) in Vancouver
	September 16, 2011	Term Sheet signed by Lax Kw'alaams, Metlakatla and Gitxaala
	October 20, 2011	Meeting w/ Coast Tsimshian (G. Reece, H. Leighton, G. McDade, G. Wouters, W. Drury), Heenan Blaikie (J. McDonald, D. Doyle) and Canpotex (T. Nieman, J. Somers, T. McDougall, T. Molloy) in Vancouver for final agreement of BBOA

Stakeholder	Date	Consultation Activity
	October 28. 2011	CTL Resolutions in respect of BBOA w/ Coast Tsimshian and Gitxaala
	October 31, 2011	Execution copy of Benefits and Business Opportunity Agreement between Canpotex Terminals Limited and Lax Kw'alaams and Metlakatla signed by Canpotex
Metlakatla First Nation	February 12, 2008	Canpotex Project
	April 24, 2008	Dinner meeting with Canpotex, CN and PRPA
	June 12, 2008	Meeting between legal counsel, G. Wouters, PRPA, D. Eyford, D0J and FTNO
	June 23, 2008	Protocol Agreement executed with Canpotex, CN and PRPA
	September 8, 2008	Conference call with legal counsel and federal government chief negotiator Doug Eyford
	February 12, 2009	Meeting with legal counsel and Doug Eyford
	April 8, 2009	EA Project Description sent via courier with a letter offering to come to the community to discuss the EA process
	June 24, 2009	Breakfast meeting
	July 21, 2009	Meeting regarding EA process with Doug Eyford, PRPA and CN
	August 31, 2009	Revised EA Project Description sent via courier
	September 10, 2009	Electronic invitation, poster and handout sent regarding attending the Prince Rupert Public Information Session on September 22, 2009
	September 10, 2009	Meeting with D. Eyford, Lax Kw'alaams and PRPA in Vancouver
	September 17, 2009	Meeting with D. Eyford, PRPA, and Canpotex
	September 24, 2009	Meeting with D. Eyford, T. Molloy, and Canpotex
	October 16, 2009	Meeting with D. Eyford, G. Wouters and PRPA in Vancouver
	October 29, 2009	Framework for Negotiations Agreement executed by Canpotex, Metlakatla and Lax Kw'alaams
	February 3, 2010	Meeting with Canpotex regarding capacity funding
	July 6, 2010	Meeting with Stantec and Canpotex in Vancouver
	August 25, 2010	Meeting with Canpotex
	August 30, 2010	Meeting with Canpotex
	October 5, 2010	Meeting with CN, PRPA, and Canpotex in Prince Rupert
	November 18, 2010	Meeting with Lax kw'alaams, Ledcor and Canpotex in Vancouver
	November 30, 2010	Meeting with Lax kw'alaams, Ledcor and Canpotex in Vancouver
	December 9, 2010	Meeting with Lax kw'alaams, Ledcor and Canpotex in Vancouver
	March 4, 2011	Meeting with Metlakatla, and Canpotex in Vancouver
	April 12, 2011	Meeting with T. Molloy and Canpotex in Vancouver
	April 18, 2011	Meeting with Lax kw'alaams and Canpotex in Vancouver

Stakeholder	Date	Consultation Activity
	May 30, 2011	Meeting between G. Wouters, PRPA and Canpotex
	June 17, 2011	Meeting with Canpotex, PRPA and Lax kw'alaams in Vancouver
	July 13, 2011	Conference call between D. Eyford, G.Wouters, PRPA and Transport Canada re: IBA negotiations
	July 27, 2011	Meeting with Lax Kw'alaams, PRPA and Canpotex in Vancouver
	August 17, 2011	Meeting with Lax Kw'alaams, Canpotex and PRPA in Vancouver
	August 22, 2011	Meeting with Lax Kw'alaams, Canpotex and PRPA in Vancouver re: business opportunities
	August 25, 2011	Meeting with Lax Kw'alaams and PRPA in Vancouver re: contracting benefits
	August 30, 2011	Conference between G. Wouters and PRPA re: IBA negotiations
	August 31, 2011	Meeting with Lax Kw'alaams, Gitxaala, D. Eyford, PRPA, CN and Canpotex in Vancouver
	September 1, 2011	Meeting between G. Wouters, PRPA and T. Molloy in Vancouver re: IBA Negotiations
	September 2, 2011	Meeting with Coast Tsimshian (W. Drury, G. Wouters, G. McDade), Gitxaala (M. Ignas, B. Newby), PRPA (A. Mayer) and Canpotex (J. Somers, T. McDougall, T. Molloy, T. Nieman) in Vancouver
	September 8, 2011	Working Group Meeting (4) with HC, EC, TC, Gitxaala, Kitselas, Metlakatla, PRPA and Canpotex
	September 16, 2011	Term Sheet signed by Lax Kw'alaams, Metlakatla & Gitxaala
	September 23, 2011	Meeting w/ Coast Tsimshian (G. McDade) and Canpotex (T. McDougall, T. Molloy) in Vancouver
	October 20, 2011	Meeting w/ Coast Tsimshian (G. Reece, H. Leighton, G. McDade, G. Wouters, W. Drury), Heenan Blaikie (J. McDonald, D. Doyle) and Canpotex (T. Nieman, J. Somers, T. McDougall, T. Molloy) in Vancouver for final agreement of BBOA
	October 28. 2011	CTL Resolutions in respect of BBOA w/ Coast Tsimshian and Gitxaala
	October 31, 2011	Execution copy of Benefits and Business Opportunity Agreement between Canpotex Terminals Limited and Lax Kw'alaams and Metlakatla signed by Canpotex

Stakeholder	Date	Consultation Activity
Gitxaala Nation PO Box 149 Kikatla, BC V0V 1C0	February 12, 2008	Canpotex Project; EA process
	April 24, 2008	Dinner meeting with Canpotex, CN and PRPA
	October 15, 2008	Dinner meeting in Prince Rupert
	November 14, 2008	Meeting in Vancouver
	January 22, 2009	Meeting with Canpotex, PRPA and CN
	April 8, 2009	EA Project Description sent via courier with a letter offering to come to the community to discuss the EA process
	June 24, 2009	Breakfast meeting
	July 21, 2009	Meeting regarding EA process with Doug Eyford, PRPA and CN
	August 31, 2009	Revised EA Project Description sent via courier
	September 10, 2009	Electronic invitation, poster and handout sent regarding attending the Prince Rupert Public Information Session on September 22, 2009
	December 9, 2009	Working Group Meeting (2) with MPMO, CTA, TC, EC, Kitsumkalum, Kitselas, PRPA and CEAA
	January 21, 2010	Meeting with CEAA, PRPA and Canpotex in Gitxaala
	February 4, 2010	Working Group Meeting (3) with HC, DFO, EC, TC, PRPA and Canpotex
	March 26, 2010	Meeting with PRPA, CN, and Canpotex in Vancouver
	May 12, 2010	Meeting with Canpotex
	October 8, 2010	Meeting with CN, PRPA and Canpotex in Vancouver
	April 13, 2011	Meeting with M. Ignas in Prince Rupert
	August 18, 2011	Conference call with legal counsel, PRPA and D. Eyford
	August 26, 2011	Meeting with PRPA and Canpotex in Vancouver
	August 30, 2011	Meeting with PRPA and Canpotex in Vancouver
	August 31, 2011	Meeting with Metlakatla, Gitxaala, D. Eyford, PRPA, CN and Canpotex in Vancouver
	September 2, 2011	Meeting with Coast Tsimshian (W. Drury, G. Wouters, G. McDade), Gitxaala (M. Ignas, B. Newby), PRPA (A. Mayer) and Canpotex (J. Somers, T. McDougall, T. Molloy, T. Nieman) in Vancouver
	September 8, 2011	Working Group Meeting (4) with HC, EC, TC, Gitxaala, Kitselas, Metlakatla, PRPA and Canpotex
	September 16, 2011	Term Sheet signed by Lax Kw'alaams, Metlakatla and Gitxaala
	October 6, 2011	Meeting w/ Gitxaala (Chief Moody, M. Ignas, B. Newby, A. Hudec) and Canpotex (J. Somers, T. McDougall, T. Molloy)
	October 28. 2011	CTL Resolutions in respect of BBOA w/ Coast Tsimshian/Gitxaala
	October 31, 2011	Execution copy of Benefits and Business Opportunity Agreement between Canpotex Terminals Limited and Gitxaala signed by Canpotex
	February 12, 2008	Meeting to discuss the Canpotex Project and EA process
	April 24, 2008	Dinner meeting with Canpotex, CN and PRPA

Stakeholder	Date	Consultation Activity
Kitsumkalum First Nation PO Box 544 Terrace, BC V8G 4B5	November 14, 2008	Meeting in Vancouver
	January 22, 2009	Meeting with Canpotex, PRPA and CN and Community Meeting
	March 17, 2009	Meeting regarding the Project
	April 8, 2009	EA Project Description sent via courier with a letter offering to come to the community to discuss the EA process
	August 31, 2009	Revised EA Project Description sent via courier
	March 26, 2010	Meeting with PRPA, CN, and Canpotex in Vancouver
	December 9, 2009	Working Group Meeting (2) with MPMO, CTA, TC, EC, Gitxaala, Kitselas, PRPA and CEAA
	February 12, 2008	Meeting to introduce the Canpotex Project
	June 23, 2008	Protocol Agreement executed with Canpotex, CN and PRPA
Kitselas First Nation 2225 Gitaus Road Terrace, BC V8G 0A9	November 14, 2008	Meeting in Vancouver
	April 8, 2009	EA Project Description sent via courier with a letter offering to come to the community to discuss the EA process
	August 31, 2009	Revised EA Project Description sent via courier
	September 10, 2009	Electronic invitation, poster and handout sent regarding attending the Prince Rupert Public Information Session on September 22, 2009
	December 9, 2009	Working Group Meeting with MPMO, CTA, TC, EC, DFO, Gitxaala, Kitsumkalum, PRPA and CEAA
	September 8, 2011	Working Group Meeting (4) with HC, EC, TC, Gitxaala, Kitselas, Metlakatla, PRPA and Canpotex

In addition to the above efforts, on July 8, 2011 letters were sent to Metlakatla, Lax kw'alaams and Gitxaala requesting their participation in an Archaeological Impact Assessment (AIA) and Traditional Use Study for the Canpotex Potash Export Terminal. A response was received from Gitxaala who participated in the AIA, however, comments on the draft AIA have not been provided nor has a TUS. No response was received from the Metlakatla and Lax kw'alaams on either the AIA or TUS.

The First Nations were given the opportunity to comment on the *Background Document: Initial Federal Public Comment Period* as well as the EIS Guidelines prior to their release to the public. Comments received from their review resulted in a modification of the scope of project to be considered in the assessment. Comments provided by First Nations on the EIS Guidelines are listed in Part II of the Concordance Table. Verbal comments received from the First Nations during working group meetings are summarized in Table 5-3.

Table 5-3: First Nation Issues

Issue	Originated by	Addressed in EIS
Include consideration of locations other than Brown's Passage to conduct Disposal at Sea	Gitxaala/Metlakatla	Section 12.3.2.1
Toads moving across the road may be present at the site – therefore the seasonality of the assessment is important.	Gitxaala	Section 11 and 11.3.3.2
Concern regarding the effect of the increase in rail traffic on wildlife mortality in Kitselas territory.	Kitselas	Section 19.9
For effects on Traditional Use, the boundary of the PRPA is not sufficient for this assessment. The extra ships go by their traditional areas, and the scope simply is not large enough. The EA will have to consider the Triple Islands pilotage station and the anchorages next to Stephen's Island, not only in terms of harvesting impacts, but invasive species.	Metlakatla/Gitxaala	Shipping addressed in Section 3.4.2.1 Invasive organisms addressed in Section: 12.3.5.1

Canpotex and the PRPA are committed to on-going engagement of the affected First Nations in the Project and the environmental assessment process. For the environmental assessment, Canpotex and the PRPA will focus on understanding the potential environmental effects of the Project on the current use of land and resources by Aboriginal persons for traditional purposes. An equal level of priority will be dedicated to establishing a relationship with the First Nations communities where benefits and opportunities for the community can be realized through both business and employment opportunities. Canpotex will work collaboratively with the PRPA and other federal government agencies involved with Crown consultation with First Nations in respect of the impact of the Project on Aboriginal rights, interests and title.

In addition to proponent driven engagement initiatives the CEA Agency will coordinate appropriate engagement activities with First Nations groups and RAs during the conduct of further phases of the environmental assessment.

5.2 Consultation with Government Agencies

Canpotex and the PRPA have initiated consultation with a variety of government agencies including DFO, EC, TC and HC. The proponents are committed to an open consultation program throughout the environmental assessment process. Consultation conducted to date include Project update meetings, working group meetings and agency specific meetings to address such topics as regulatory requirements, habitat compensation, wetland compensation and disposal at sea. A brief summary of consultation conducted to date is summarized in Table 5-4.

Table 5-4: Government Consultation Summary

Stakeholder	Date	Consultation Activity
City of Prince Rupert and District of Port Edward	March 16, 2009	Meeting regarding the project
Fisheries and Oceans Canada	November 7, 2008	Meeting regarding the Project
	June 16 – 17, 2009	Working Group Meeting(1) with DFO, CEAA, TC, EC, HC and the MPMO
	February 4, 2010	Working Group Meeting (3) with HC, EC, TC, Gitxaala, PRPA and Canpotex
	September 8, 2011	Working Group Meeting (4) with HC, EC, TC, Gitxaala, Kitselas, Metlakatla, PRPA and Canpotex
	September 20, 2011	Meeting to discuss habitat compensation options with DFO, Canpotex and Stantec
	October 28, 2011	Meeting to discuss habitat compensation options with DFO, Canpotex, PRPA and Stantec
Environment Canada	November 17, 2008	Meeting in Vancouver with TC, PRPA and Canpotex.
	December 11, 2008	EA Process, Project Description
	June 5, 2009	Project update meeting with CEAA, TC, PRPA and Canpotex
	June 16 – 17, 2009	Working Group Meeting (1) with DFO, CEAA, TC, EC, HC and the MPMO
	December 9, 2009	Working Group Meeting (2) with MPMO, CTA, TC, DFO, PRPA, Gitxaala, Kitsumkalum, Kitselas and CEAA
	February 4, 2010	Working Group Meeting (3) with HC, DFO, TC, Gitxaala, PRPA and Canpotex
	August 18, 2011	Meeting with EC and Stantec to discuss Wetland Compensation
	September 8, 2011	Working Group Meeting (4) with HC, EC, TC, Gitxaala, Kitselas, Metlakatla, PRPA and Canpotex
	October 2, 2011	Meeting to discuss on-land disposal sites and wetland compensation policy with EC, DFO, CEAA, PRPA and Stantec
Transport Canada	November 17, 2008 December 11, 2008	Meeting in Vancouver with EC, PRPA and Canpotex EA Process, Project Description
	June 5, 2009	Project update meeting with CEAA, EC, PRPA and Canpotex
	June 16 – 17, 2009	Working Group Meeting(1) with DFO, CEAA, TC, EC, HC and the MPMO
	December 9, 2009	Working Group Meeting (2) with MPMO, CTA, EC, DFO, PRPA, Gitxaala, Kitsumkalum, Kitselas and CEAA
	February 4, 2010	Working Group Meeting (3) with HC, EC, DFO, Gitxaala, PRPA and Canpotex
	July 13, 2011	Conference call with Coast Tsimshian, D. Eyford and PRPA re: IBA negotiations
	September 8, 2011	Working Group Meeting (4) with HC, EC, TC, Gitxaala, Kitselas, Metlakatla, PRPA and Canpotex

Stakeholder	Date	Consultation Activity
BC Ministry of Transport	November 14, 2008	Meeting in Vancouver
BC Environmental Assessment Office	December 11, 2008	EA Process, Project Description
Indian and Northern Affairs Canada	December 2, 2010	INAC Briefing on status of First Nation Negotiations/Transport Canada meeting with D. Eyford, Transport Canada, CN, PRPA, T. Molloy, and Canpotex

Comments were received from working group members on the EIS Guidelines. These comments have been incorporated in the EIS and are referenced in the concordance table.

6 EXISTING ENVIRONMENT

The Project site is located on the west side of Ridley Island, near Prince Rupert on the north coast of British Columbia. This section provides an overview of the existing local and regional geophysical, biophysical and socio-economic conditions in the vicinity of the Project site. It is based on information provided in the *Ridley Island Master Development Plan Environmental Resource Assessment and Recommendations* (JWA 2008) and cited literature.

6.1 Geophysical Environment

6.1.1 Geology

Ridley Island is situated within the Hecate Lowland of the Hecate Depression in the Coastal Trough physiographic region (Holland 1976). This region is characterized by a rough topography composed primarily of metamorphic rock from the Paleozoic and Mesozoic era. Bedrock in the Prince Rupert area is predominantly a low-grade metamorphic rock composed of metasediments (schists) and gneisses associated with intruded igneous bodies. The schist is rich in mica, amphibole, graphite and chlorite. Rocky outcrops in the area indicate highly fractured rock with two or three major bedding and joint sets, giving rise to a block structure. Local intense folding of the rock is known to exist and to have structural controls in a north-northeast direction.

Ridley Island and surrounding area is considered to be flat low plain that is mostly below 30 m elevation and is underlain by a variety of rocks of which granite predominates. Many of these low areas, including Ridley Island are occupied by large expanses of muskeg where drainage is poorly established.

Offshore sediments consist of normally consolidated silts and clays with lesser amounts of fine sand, with the thickness increasing away from the shoreline. The offshore subsoil is comprised of mica schist bedrock overlain by a thin and discontinuous dense glacial till and an extensive soft silty clay layer. The silty clay layer is expected to be very weak and compressible with very small shear resistance in the first 8 m.

Western Canada experiences higher than average seismic activity due to its location near some major plate tectonic boundaries (the Juan de Fuca Plate near Vancouver Island, the North American Plate, upon which most of Canada rests, and the Pacific Plate, near Haida Gwaii [formerly the Queen Charlotte Islands]). Movements along these boundaries cause ongoing small earthquakes and, occasionally cause earthquakes large enough to cause damage to buildings and infrastructure. As it is not possible to accurately predict the timing of large earthquakes, it is important that Project proponents along the west coast of Canada be prepared for such events.

Between 1965 and 1991, five earthquakes were reported in the vicinity of Prince Rupert (from east of Graham Island to west of Terrace). Four were magnitude 3.0 to 4.9 on the Richter scale, and the fifth was greater than 6.5, with an epicentre in Hecate Straight, south of Dixon Entrance. In 2001, a magnitude 6.1 earthquake occurred just east of the Queen Charlotte-Fairweather Fault, which was felt in the Prince Rupert area (Rogers *et al.* 2002). Seismic activity may also result in tsunami risk. The largest tsunamis tend to be caused by earthquakes with offshore epicentres (Bobrowsky 2001). Even distant earthquakes can generate tsunamis that reach the coast of British Columbia (BC; Clague *et al.* 2003). The 6.1 magnitude earthquake near Haida Gwaii that occurred in 2001 generated a very small but measurable tsunami on Vancouver Island to the south, with an onshore vertical height above sea level (ASL), or run-up, of 20 cm (Rogers *et al.* 2002). However, much larger run-ups of up to 20 m ASL have been predicted for some coastal areas of BC (Bobrowsky 2001), with run-ups of about 10 m ASL considered the most common (Dorner and Wong 2003).

6.1.2 Climate

Ridley Island is located in the Pacific climate region, a thin coastal strip of west-facing slopes, uplands and indented fjords that extend no more than 150 km inland from the sea. Moist, warm air streams carried by westerly winds from the Pacific drop large amounts of rain or snow as the warm air is forced up the Coast Mountains and cooled. The Coast Mountains also restrict the westward flow of cold continental Arctic air masses located east of the Rocky Mountains, resulting in a more moderate winter climate along the west coast of BC than in the rest of Canada. The summer climate is warm, but cool relative to inland areas, and because the frequency and intensity of Pacific storms are reduced in the summer, precipitation is less than in the winter. The combination of cool and wet climatic conditions in the Prince Rupert area supports lush and diverse vegetation typical of coastal temperate rainforests.

Prince Rupert is Canada’s wettest city, with an average of 2,469 mm of rainfall and 126 mm of snowfall per year at the airport (2,594 mm total annual precipitation). October is the wettest month (average of 21 rainy days) and July the driest (average of 8 rainy days). The north coast experiences an average of 20 days of fog per year, compared to 110 days on the southern tip of Haida Gwaii.

In the summer, Prince Rupert experiences average high temperatures of 15°C to 17°C and average lows of 7°C to 10°C. In the winter, average highs are 3°C to 5°C, with an average low of about 0°C. January is the coldest month, with an average daily temperature of 1°C, while August is the warmest month, with an average temperature of 13°C.

Climate change is a global issue, believed to be a result of increasing concentrations of greenhouse gases (GHG) in the atmosphere (IPCC 1990; IPCC 1995). Increasing temperatures are expected to contribute to a rise in sea level (Wigley and Raper 1992; IPCC 1995; Forbes *et al.* 1997), storm events, and other changes relevant to coastal stability such as surface winds, ocean waves, storm surges, and ice conditions (Forbes *et al.* 1997).

The Province of British Columbia and the Government of Canada have investigated sea level changes along the BC coastline. The 90-year projected sea level rise for the Prince Rupert area ranges from extreme low estimates of 0.10 to 0.31 m to extreme high estimates of 0.95 to 1.16 m (Bornhold, 2008). The mean estimated rise is 0.25 to 0.46 m. These changes in sea level should be considered during jetty design; however, given the elevation of Ridley Island, they are unlikely to affect terminal infrastructure.

6.1.3 Air Quality

Existing air quality in the Prince Rupert area is generally good, due to the region's location well away from other major industrial sources of air contaminants in BC and the presence of westerly winds that position the region well downwind of air contaminants from Asia. The primary influences on air quality in the Prince Rupert area are the regional industrial emitters, including local terminals that accommodate industrial cargos and passenger traffic. These are located within the boundaries of the Prince Rupert harbour, and include marine terminals, ferry terminals, and docks on Kaien Island and industrial sites on Ridley Island.

Monitoring results from a recent environmental assessment completed in Prince Rupert (Stantec, 2009) concluded that of the substances generally considered when assessing air quality (i.e., CO, NO_x, SO_2, VOCs, TSP, H_2S, $PM_{2.5}$, PM_{10}) only H_2S concentrations historically exceeded the applicable regulatory objectives and standards as regulated by the British Columbia Ministry of Environment. The China Paper Group pulp mill was responsible for the historic H_2S exceedances. The mill is currently closed, and due to the age of the infrastructure it is unlikely that it will be reopened at a later date.

6.1.4 Sediment Quality

Sediment quality has been assessed on the southeast end of Ridley Island in two disposal ponds: the muskeg disposal pond and the settling pond. Two independent studies were conducted to characterize contaminant concentrations in these ponds: a study by Stantec Consulting Ltd. (Stantec) in 2010 and a study by Premier Environmental Services Inc. in 2011. A summary of the results of these studies is presented below.

6.1.4.1 History of Disposal Ponds

The muskeg disposal pond and settling pond were originally part of the marine environment and comprised an area known as Mudflat Bay. This area was isolated from Porpoise Channel in the 1980s to accommodate the disposal of overburden stripped from Ridley Island during construction of the grain and coal facilities. In 1982, 730,000 m^3 of dredged materials from Chatham Sound (at the RTI berth area) was pumped into the south pond. In 1989, approximately 4,000 m^3 of dredgeate removed from Prince Rupert harbour for construction of the Fairview Terminal was deposited into the settling pond. Correspondence between BC MoE and PRPA reported concentrations of cadmium, copper, and zinc in the dredgeate from Fairview Terminal to be above the maximum allowable concentrations for disposal at sea.

6.1.4.2 Muskeg Disposal Pond

Two sediment samples were collected within the muskeg disposal pond and two samples were collected at the marine outfall. All samples were analyzed for polycyclic aromatic hydrocarbons (PAHs) and metals. Results were compared with Canadian Council of Ministers of the Environment (CCME) Canadian Interim Sediment Quality Guidelines (ISQGs) for the Protection of Aquatic Life.

PAH concentrations did not exceed the CCME ISQGs in any of the samples collected from within the muskeg disposal pond or at the marine outfall. However, all four samples exceeded the CCME ISQG for copper, and one sample exceeded the CCME ISQG for arsenic.

6.1.4.3 Settling Pond

Six sediment samples were collected within the settling pond and four were collected on the opposite side of the berm separating the pond from the marine environment. All ten samples were analyzed for PAHs, and eight samples were analyzed for metals. Two samples collected within the pond exceeded the CCME ISQG for 2-Methylnapthalene (a PAH), and one sample exceeded the CCME ISQG for Phenanthrene (a PAH). None of the samples collected on the marine side of the berm (outfall) exceeded the CCME ISQGs for PAHs. Copper and arsenic concentrations in all eight samples exceeded the CCME ISQGs.

6.1.4.4 Background Environment

To assess whether the contaminants present in sediments in the disposal ponds were natural or anthropogenic in origin, control sites were sampled in the vicinity of the ponds. This included ten sediment samples collected at land-based stations to the west and north of the ponds and one sample collected in the marine environment to the east of the muskeg disposal pond.

All 11 control sediment samples were analyzed for PAHs, and three were analyzed for metals (two land-based and one marine). PAH concentrations did not exceed the CCME ISQGs in any of the samples. Copper concentrations exceeded the CCME ISQG at the two land-based stations but not at the marine station. Arsenic concentrations did not exceed the CCME ISQG in any of the samples.

These results suggest that PAH levels are not elevated in the natural environment. The exceedances observed in the settling pond may be the result of historical disposal of contaminated sediments, or may simply reflect natural variability. Copper concentrations were elevated in all control samples collected on Ridley Island, suggesting that copper is naturally abundant in this area. This is supported by a study conducted for BC MoE which reported elevated background concentrations of copper and arsenic in the Skeena Region (Silicon Laboratories Ltd. 1997). The background levels published in the BC MoE study (50 mg/kg copper, 15 mg/kg arsenic) are greater than any of the levels characterized by the two studies discussed here.

6.2 Biophysical Environment

6.2.1 Vegetation Resources

The Project site is located in the Very Wet Hypermaritime subzone of the Coastal Western Hemlock (CWHvh2) biogeoclimatic (BGC) variant. Lowland coastal areas of this variant are typically poorly drained and support open bog and bog woodland plant communities (Banner *et al.* 1993).

Ridley Island is typical of low elevation sites in the CWHvh2 in that the vegetation consists of low productivity forests surrounding a slope bog/wetland complex. Forests are dominated by western hemlock (*Tsuga heterophylla*), western red cedar (*Thuja plicata*), and shore pine (*Pinus contorta* var.

contorta) with various shrubs and herbs. Wetlands consist of coastal slope bogs, poor fens, bog ponds, open water areas and one estuarine mudflat. Wetland vegetation is dominated by low-growing shore pine and juniper shrubs (*Juniper communis*), sweet gale (*Myrica gale*), Labrador tea (*Galium labridoricum*), tufted club-rush (*Trichophorum cespitosum*), peat mosses (*Sphagnum* spp.), cloudberry (*Rubus chamaemorus*), and sundew species (*Drosera* spp.), among others.

Ridley Island does not support any plants listed on the federal *Species at Risk Act* (SARA); however, two provincially blue-listed plants have been recorded on Ridley Island. These are Alaska holly fern and Gmelin's sedge. The Alaska holly fern is located on the western shoreline of Ridley Island, outside of the Project footprint, immediately south of the marine terminal causeway. The Gmelin's sedge is located on the southwestern shoreline of Ridley Island well outside of the Project footprint.

6.2.2 Wildlife

Information on wildlife and wildlife habitat in the Prince Rupert region was collected from a number of sources including field guides, atlases, and peer-reviewed and grey literature (e.g., government reports). The Costal Western Hemlock (CWH) BGC zone provides habitat for many seasonal and year-round resident wildlife species in the region. A total of 359 terrestrial vertebrate species, comprising five amphibians, two reptiles, 288 birds and 62 terrestrial mammals have been identified in the broader Prince Rupert region (Radcliffe *et al.* 1994).

6.2.2.1 Mammals

Common mammals present throughout much of the Prince Rupert region include moose (*Alces alces*), black-tailed deer (*Odocoileus hemionus*), marten (*Martes americana*), red squirrel (*Tamiasciurus hudsonicus*), snowshoe hare (*Lepus americanus*), beaver (*Castor canadensis*), muskrat (*Ondatra zibethicus*), porcupine (*Erethizon dorsatum*), short-tailed weasel (*Mustela erminea*), gray wolf (*Canis lupus*), grizzly bear (*Ursus arctos*), black bear (*Ursus americanus)*, southern red-backed vole (*Myodes gapperi*), and several species of coastal bats, such as Keen's long-eared myotis (*Myotis keenii*) and the silver-haired bat (*Lasionycteris noctivagans*). Species found through much of the region but that reach their northerly limits in the Yukon include the deer mouse (*Peromyscus maniculatus*), heather vole (*Phenacomys intermedius*), least chipmunk (*Eutamias minimus*) and long-tailed vole (*Microtus longicaudus*).

Wildlife known to utilize Ridley Island includes porcupine, black-tailed deer, beaver, muskrat, and gray wolf.

6.2.2.2 Avifauna

There have been 288 birds species recorded in the Prince Rupert area (Radcliffe *et al.* 1994). Of those, 188 species have been recorded breeding, including marine birds, songbirds and raptors.

Common marine birds in the area include species of seabirds, seaducks and gulls, such as common loon (*Gavia immer*), red-necked grebe (*Podiceps grisegena*), common merganser (*Mergus merganser*), double-crested cormorant (*Phalacrocorax auritus*), great blue heron (*Ardea herodias*), marbled murrelet (*Brachyramphus marmoratus*), Barrow's goldeneye (*Bucephala islandica*), surf scoter (*Melanitta perspicillata*) and glaucous-winged gull (*Larus glaucescens*).

Habitats within the region support a variety of breeding and overwintering songbirds. Common species in the area include orange-crowned warbler (*Vermivora celata*), hermit thrush (*Catharus guttatus*), American robin (*Turdus migratorius*) song sparrow (*Melospiza melodia*), dark-eyed junco (*Junco hyemalis*), pine siskin (*Carduelis pinus*), and gray jay (Perisoreus canadensis).

In addition to songbirds, many raptor species breed and overwinter in the region (Stevens 1995, Campbell *et al.* 1997, Cannings *et al.* 1999, Sibley 2000, Campbell *et al.* 2001). Diurnal raptors such as Cooper's hawk (*Accipiter cooperii*), sharp-shinned hawk (*A. striatus*), northern goshawk (*A.r. gentilis*), red-tailed hawk (*Buteo jamaicensis*), rough-legged hawk (*B. lagopus*), bald eagle (*Haliaeetus leucocephalus*), osprey (*Pandion haliaetus*) and peregrine falcon (*F. peregrines pealei*) occur regionally. The range of several nocturnal raptors also overlaps with Ridley Island; these include great-horned owl (*Bubo virginianus*), northern saw-whet owl (*Aegolius acadicus*), western screech-owl (*Otus kennicottii kennicottii*), northern pygmy-owl (*Glaucidium gnoma*), and barred owl (*Strix varia*).

A variety of avian species are known to utilize Ridley Island. These include bald eagle, double-crested cormorant, glaucous-winged gull, pelagic cormorant, ring-necked grebe, western grebe, surf scoter, pigeon guillemot, Barrow's goldeneye, great blue heron, killdeer, bufflehead, mallard duck and Canada goose.

6.2.2.3 Amphibians

There are five amphibians [the western toad (*Bufo boreas*), coastal tailed frog (*Ascaphus truei*), rough skinned newt (*Taricha granulosa*), long-toed salamander (*Ambystoma macrodactylum*), and northwestern salamander (*A. gracile*; Corkan and Thoms 2006, Matsuda *et al.* 2006)] and two reptiles [common garter snake (*Thamnophis sirtalis*) and western garter snake (*T. elegans*; CARCNET 2009, Thompson Rivers University and BC MoE 2006)] that occur in the region. Western toad and coastal tailed frog are listed as species of Special Concern under SARA, but their population is considered secure (Yellow-listed) in the province of British Columbia. Western toads are found on Ridley Island.

6.2.3 Aquatic Environment

6.2.3.1 Freshwater

The main freshwater habitat type on Ridley Island is sphagnum bog, which has low pH (high acidity) water and is generally considered unsuitable as fish habitat. Previous studies conducted on Ridley Island have confirmed the low pH levels and the poor quality of fish habitat on most of the island (Jacques Whitford AXYS 2006; 2007). The only exceptions are two disposal ponds located in the southeast corner of the island. These ponds were originally part of the marine environment but became landlocked in the 1970s when the PRPA converted the area into an overburden disposal site for development of the coal and grain terminals on Ridley Island. The only species of fish identified within these ponds was the three-spined stickleback (*Gasterosteus aculeatus*).

6.2.3.2 Marine

The marine environment around Ridley Island is typical of the north coast of British Columbia. Cold, nutrient-rich waters drive high primary production, which supports a diverse assemblage of invertebrates, fish, and marine mammals.

The western shoreline of Ridley Island and is composed primarily of bedrock, boulder and cobble. The steep, rocky intertidal zone experiences high wave action and supports a diverse community of marine biota. Dominant algal species include rockweed (*Fucus gardneri*), sea lettuce (*Ulva* spp.), Turkish washcloth (*Mastocarpus papillatus*), sea sac (*Halosaccion glandiforme*), and various understory kelps (e.g., *Laminaria* spp., *Alaria* spp.). Common invertebrate species include barnacles (*Balanus* spp.), snails (*Tegula* spp., *Littorina* spp.), limpets (*Tectura* spp., *Lottia* spp.), and chitons (*Tonicella* spp.).

The eastern shoreline of Ridley Island, in Porpoise Harbour, is much more protected than the western shoreline. Boulder, cobble and gravel dominate the mid and high intertidal zones whereas the low intertidal zone is predominantly mudflat. Marine biota in Porpoise Harbour is less diverse and abundant than on the western shoreline of Ridley Island. The dominant algal species are rockweed (*Fucus gardneri*) and sea lettuce (*Ulva* spp.). Common invertebrate species include barnacles (*Balanus* spp.), snails (*Littorina* spp.), and limpets (*Tectura* spp.).

The seafloor around Ridley Island is composed almost entirely of fine-grained sediments such as mud, silt, and sand. Rock substrates are found only in the shallow waters along the shoreline of Ridley Island, around Coast Island, in the vicinity of Baker Rock, and on the unnamed subtidal reef between Coast Island and Ridley Island. A subtidal survey conducted on the west side of Ridley Island found the highest species richness within these rocky habitats (Ocean Ecology 2009). Species commonly encountered on the soft sediment bottom include orange sea pens (*Ptilosarcus gurneyi*), spiny pink shrimp (*Pandalus eous*) Dungeness crab (*Metacarcinus magister*), and California sea cucumber (*Parastichopus californicus*).

Important marine fish habitats found along the coast of Ridley Island include Bull kelp beds (*Nereocystis luetkeana*) and eelgrass beds (*Zostera marina*). Bull kelp is a highly productive canopy-forming kelp that provides high value habitat for a variety of marine organisms including juvenile salmon, Pacific herring and rockfish. Kelp canopies help to stabilize hydrodynamic conditions, slowing water movement and trapping zooplankton. Fish commonly utilize kelp canopies to feed on other fish and invertebrates and to escape predation by larger fish. Eelgrass beds are extremely productive and provide important nursery habitat for a number of economically, culturally, and ecologically important species including juvenile salmon, Pacific herring, eulachon, rockfish, and Dungeness crab. In addition, the soft sediment associated with eelgrass beds supports rich bivalve communities.

Over 300 species of marine fish inhabit the productive waters of the northeast Pacific Ocean, many of which occur within the Prince Rupert area. Key species harvested for commercial, recreational and/or Aboriginal fisheries include: Pacific salmon (sockeye, Chinook, coho, pink and chum; *Oncorhynchus* spp.), halibut (*Hippoglossus stenolepsis*), Pacific herring (*Clupea pallasii*), rockfish

(*Sebastes* spp.), lingcod (*Ophiodon elongates*), Pacific cod (*Gadus macrocephalus*), sole, and eulachon (*Thaleichthys pacificus*). All of these species are expected to occur within the Prince Rupert area for at least part of their life histories.

Several species of marine mammals occur regularly in the Prince Rupert area including: humpback whales (*Megaptera novaeangliae*), northern resident killer whales (*Orcinus orca*), harbour porpoises (*Phocoena phocoena*), Dall's porpoises (*Phocoenoides dalli*), Pacific white-sided dolphins (*Lagenorhynchus obliquidens*), Steller sea lions (*Eumetopias jubatus*) and harbour seals (*Phoca vitulina richardsi*). Among these species, the northern resident killer whale is listed as *Threatened* under SARA and the harbour porpoise is listed as *Special Concern*. The abundance of marine mammals in the Prince Rupert area generally increases during summer months to coincide with the seasonal abundance of migratory fish (e.g., salmon, Pacific herring).

6.3 Human Environment

6.3.1 First Nations

6.3.1.1 Archaeological and Heritage Resources

Archaeological research in the Prince Rupert area has documented continuous occupation of the region by First Nations for at least the last 5,000 years, since stabilization of sea levels following the recession of glaciers in the late Pleistocene and Holocene. Dozens of archaeological sites in the Prince Rupert—Port Edward area attest to its use over this period by Tsimshian peoples. Based on recent research it is deemed unlikely that subtidal archaeological sites would be present in the area. Research on Late Pleistocene and Holocene relative sea level fluctuations in the Prince Rupert area indicate that relative sea levels were never more than 3.5 m below present in the area since the last glaciation (Eldridge and Parker 2007; Eldridge *et al.* 2008; McLaren 2008).

The main types of archaeological sit present in the Prince Rupert area include culturally modified tree (CMT) sites, archaeological shell middens, lithic scatters and petroforms. Only the first two have been found among the 17 archaeological sites recorded on Ridley Island: fifteen sites are CMT sites, while the remaining two are shell middens.

A CMT is a tree that has been altered by First Nations as part of their traditional use of the forest. Modifications normally take one of two forms: bark-stripping or Aboriginal logging. In bark-stripping, a tree, usually a cedar, was stripped to obtain the inner bark, which was used to manufacture numerous items such as rope, baskets, mats, or clothing. In Aboriginal logging, trees, logs or stumps show evidence of plank removal for house construction, kindling removal for fuel, shaping into canoes or posts, and/or chopping to test their soundness prior to subsequent use. The CMTs comprising the 15 sites on Ridley Island display bark-stripping (41), plank removal (7), kindling removal (4) or testing (1).

A shell midden is recognizable by the presence in the soil of shellfish remains that were discarded after their consumption, mixed in with other elements such as stone, bone, antler and/or shell artifacts, fire-broken or burnt rock, charcoal, ash, burnt soil, and/or faunal or human skeletal remains.

Shell middens are unique in that the shell neutralizes normal soil acidity, leading to the preservation of archaeological materials that would otherwise quickly degrade. They are usually found near the shoreline but can also be located inland. Shell midden sites can range significantly in length and width from a few metres to several hundred metres, and in depth from 10 cm to 4 m or more. They may represent short-term single-use occupation as a temporary campsite, repeated use on a seasonal basis or long-term occupation over several hundred or thousand years. In the Prince Rupert region, twelve recorded shell middens have been dated to between 1,500 and 3,500 years old, and another four to between 3,500 to 5,000 years old. Of the two shell middens recorded on Ridley Island, one has been dated to almost 3,000 years old. Both sites have been severely disturbed or destroyed by previous developments.

6.3.1.2 First Nations Communities

The Project spatial footprint is located within the claimed traditional territory of the Tsimshian Nations. Five Tsimshian First Nation communities claim Aboriginal Rights and/or interests in the Prince Rupert Harbour area to Kitaelas Canyon. These are:

1. Metlakatla First Nation
2. Lax Kw'alaams First Nation
3. Gitxaala Nation
4. Kitselas Indian Band
5. Kitsumkalum Band.

Metlakatla, Kitselas, and Kitsumkalum are part of the treaty group known as the "Tsimshian First Nations". Lax Kw'alaams and Gitxaala were formerly part of the Tsimshian First Nation treaty group; however, they withdrew from that treaty group and are currently independent nations (BC MARR 2009). For purposes of this report, the five Aboriginal groups named above will be referred to as the "Tsimshian Nation" when referred to as a whole. The Project site is located within the claimed traditional territory of the Coast Tsimshian Nation (Metlakatla and Lax kw'alaams), however, the Gitxaala have also indicated use of the area.

According to data collected and maintained by Indian and Northern Affairs Canada, the regional First Nations have a combined population of 6,981, with an average of 30% of the population living on reserve (INAC 2009). Metlakatla has the lowest percentage of the population living on reserve (15%), while Kitselas has the highest (52%). Lax Kw'alaams is the largest community, with a registered population of 3,233.

Some of the Tsimshian had summer villages on the lower Skeena River and winter villages around the Prince Rupert Harbour area. The ownership and occupation of these sites, and the right to harvest resources from them is significant to each of the tribes. The west coast of Kaien Island has traditionally been used as a resource harvesting area for the harvesting of medicinal plants (including devil's club, hellebore, cedar planks and bark), and berries (salmonberries, blueberries, gooseberries). The Prince Rupert harbour area is used as shellfish harvesting grounds, and off-shore marine harvesting grounds. The members of the Tsimshian Nation who live in the Prince

Rupert area continue to harvest shellfish and other seafood (clams, crabs, cockles, urchin, shrimp, sea cucumbers, and geoduck) in the Prince Rupert harbour area.

6.3.2 Socio-economic Setting

6.3.2.1 Regional Overview

The Project site is located on the west side of Ridley Island, within the city limits of Prince Rupert. Ridley Island is approximately 11 km south of the centre of the City of Prince Rupert and approximately 3 km east of the Village of Port Edward.

Prince Rupert is the major business centre for the north coast of BC. It was founded as a terminus of the Grand Trunk Pacific Railway and was incorporated in 1910. The railway reached Prince Rupert in 1914 and is now owned by CN. Prince Rupert is the terminus of western Canada's Yellowhead Highway (Highway 16 also known as the northern Trans-Canada Highway) and the northern line of CN; it is also the hub for ferry service to Vancouver Island, Alaska and Haida Gwaii. The railway provides service to the port and to points throughout North America. The railway and port play pivotal roles in economic development in the area. Historically, the area has supported resource-based industries such as commercial and recreational fishing, and forestry. The growing importance of shipping and tourism has led to more recent expansion of port facilities.

Prince Rupert is a well-established community with a range of municipal infrastructure and services (including water and sewer systems, and municipal landfills) and visitor accommodation (hotels, motels, bed and breakfasts). The city is accessible by ground, air and marine transportation systems. The top three employment sectors are services (including transportation and warehousing), retail, and manufacturing.

Port Edward is a small community located in Porpoise Harbour, approximately 15 km south of Prince Rupert. The community is locally administered and has an elementary school (K-7) and a community center. Medical and government services are provided in nearby Prince Rupert. Most working-age residents of Port Edward are employed in the fishing and forestry sectors.

6.3.2.2 Population Statistics

Based on the most recent census results (2006), the total populations of Prince Rupert and Port Edward are 12,815 and 577 residents, respectively (BC STATS 2010). The combined population (13,392) has declined 23% since the 1990s (the population was 17,414 in 1996, and 15,302 in 2001), a time frame during which the provincial population has been growing (BC STATS 2010). This decline is likely linked to the reduction of the forestry and fishery sectors which has led to high unemployment. The 2006 unemployment rate for the combined labour force in Prince Rupert and Port Edward (6,285 people) was 13.1% (BC STATS 2010). The unemployment rate for BC during the same time period was 6%. This discrepancy is likely linked to the lack of economic development in Prince Rupert. Average housing prices in Prince Rupert and Port Edward in 2006 were $164,644 and $119,110 respectively (BC STATS 2010).

6.3.2.3 Schools and Colleges

There are approximately 1,640 school age children and 11 schools in School District 52 (Prince Rupert, Port Edward, Kitkatla, Hartley Bay), including one secondary schools, one middle school, five elementary schools and one store-front distributed learning site. Prince Rupert is home to a satellite campus of the Northwest Community College; the main campus is located in Terrace, BC.

6.3.2.4 Health Care Services

Health care services in Prince Rupert are provided by the Northern Health Authority, which is funded by the provincial Ministry of Health. There are four facilities providing health care services:

1. **Prince Rupert Regional Hospital** (has approximately 71 beds and offers services in emergency health care, trauma, intensive care, cancer care and medical imaging)
2. **Prince Rupert Community Health** (a health care clinic)
3. **Summit Residences** (an assisted living facility that provides meals and support for people who can take care of most but not all of their living needs)
4. **Acropolis Manor** (a long-term care residential facility which provides all care needs for elderly people who cannot live independently).

There are a number of other health care support services provided by Northern Health and local societies including meals, mental health, addiction, and needle exchange services.

The College of Physicians & Surgeons of British Columbia maintains a database of all doctors in the province. This database indicates that 26 physicians live in Prince Rupert; six are specialists and the rest have general family practices.

6.3.2.5 Social and Recreational Services

There is a range of social and recreational infrastructure in the greater Prince Rupert area including churches, libraries and museums, a performing arts centre, shopping plazas, grocery stores, day cares, sports and social clubs, and various restaurants and night clubs. The numerous hiking, skiing, biking and snowmobiling trails in the area offer opportunities for a wide variety of recreational activities. There are a number of parks in the Prince Rupert region, the closest being Kitson Island Marine Provincial Park, which is located 5 km south of Port Edward at the mouth of the Skeena River. There are no parks or protected areas on Ridley Island.

Hunting, trapping and fishing (commercial, recreational and sport) are popular activities. These are carried out by area residents and attract several thousand visitors each year to the Prince Rupert area. The waters around Ridley Island, apart from the southwest corner, are designated a “No Fishing” zone in accordance with the Port Authorities Operations Guidelines made pursuant to the *Canada Marine Act*. In this zone, the use of nets, traps or floats is prohibited. This does not completely preclude recreational or subsistence fishing, particularly with hook and line. Recreational and subsistence fishers can obtain permits from PRPA to fish within the inner harbour if the fishing does not interfere with navigation.

6.3.2.6 Emergency Services

The City of Prince Rupert has a Royal Canadian Mounted Police (RCMP) detachment, firefighting services, and ambulance services.

Police services for Prince Rupert and surrounding areas are provided by the Prince Rupert Detachment of the Royal Canadian Mounted Police. The city detachment consists of 28 regular members in the following capacities: 1) the general investigation section, a police service dog and dog handler; 2) one forensic identification specialist; and 3) a crime prevention/media relations officer. The rural section provides policing from Port Simpson to Hartley Bay. The Border Integrity Section has three members working in Prince Rupert to protect the marine and ports branch of the RCMP. The Border Integrity Program protects Canadians from terrorism, organized crime, smuggling, and other border-related crime.

The Prince Rupert Fire Department (PRFD) consists of a Fire Chief, Deputy Chief, four shift Captains 14 career firefighters, and four auxiliary firefighters. The firefighters are highly trained in all aspects of firefighting as well as first responder emergency medical protocols, hazmat response, auto extrication and angle/confined space rescue.

The ambulance service in Prince Rupert is provided by the British Columbia Ambulance Service (BCAS), which is a public ambulance service. The BCAS lease a dedicated air ambulance aircraft and participates in the air-evacuation program which includes bases in Victoria, Vancouver, Kelowna, Prince Rupert, and Prince George. The dispatchers for this service are located in Victoria.

6.3.2.7 Transportation

Transportation to and from Prince Rupert is either by commercial air, car, bus, ferry or train. Ridley Island relies heavily on rail transport but can be reached by road form Kaien Island to the north. Access to Ridley Island is limited for private citizens, due to port security measures. Entry to the Prince Rupert Harbour by ship or ferry is from the south between Digby and Kaien Islands. Large ships over 350 gross tonnes entering the harbour must stop at Triple Island, 35 km west of Prince Rupert, in order to be piloted into the harbour along established shipping lanes. Transportation by air is either by commercial airlines (Air Canada and Hawkair) or by private charter (Inland Air Charters Ltd, North Pacific Seaplanes or locally owned and operated charter companies). Local helicopter service is also available for charter. Companies include Alpen Helicopters Ltd. and Vancouver Island Helicopters.

6.3.2.8 Solid and Liquid Waste Management

The only solid waste disposal facility in the area is the Prince Rupert Landfill, which is owned and operated by the City of Prince Rupert. The landfill accepts material from residential, commercial, industrial, institutional, demolition, land clearing, and construction sources. Recycling of wood, metal, concrete, and soil/overburden is provided by the facility. It does not accept hazardous materials or a number of other products that are recycled through specialized programs (e.g., tires, batteries, waste oil, cardboard, computers, TVs, monitors, or printers). The landfill has approximately 75 years of capacity remaining (at the current rate of fill).

Liquid wastes including sanitary sewage and stormwater runoff from the City of Prince Rupert are collected within a combined sewer system and discharged into the Prince Rupert Harbour through ten separate outfalls. There is little or no treatment for these wastewaters. The City's permit to discharge wastewater was updated in 2000, at which time the Ministry of Environment requested that the City develop a Liquid Waste Management Plan (LWMP) that outlines future wastewater management. The City is in phase two of this three-phase plan but has not yet undertaken any infrastructure improvements.

6.3.2.9 Water Infrastructure

Water supply to the Prince Rupert area varies depending on location. The City of Prince Rupert has a water licence for withdrawal of up to 23.4 million cubic metres per year from Woodworth Lake and/or Shawatlans Lake. These licences are designated for supply of residences and businesses. The City supplies all areas of the municipality, except Ridley Island and Watson Island. Ridley Island receives its water supply from Port Edward which draws from Alwyn Lake.

6.3.2.10 Power Infrastructure

Prince Rupert is serviced by BC Hydro circuit 2L101, a 287 kV hydroelectric transmission line that runs from the Skeena Substation in Terrace to the Rupert Substation off Highway 16, east of Port Edward. From the Price Rupert Substation, separate lines service the Prince Rupert townsite, Watson Island and Ridley Island. Two lines service Ridley Island, a 69 kV line with a capacity of 70 megawatts (MW) intended for large scale developments with energy demands in the range of 10 to 20 MW, and a 25 kV line with a capacity of 12 MW, intended for smaller development projects. In the early 1980s BC Hydro estimated approximately 20 MW of spare capacity on the 69 kV line. There is likely more capacity today as the pulp mill has closed and there has been limited construction on Ridley Island since this time.

6.3.3 Land Use and Zoning

6.3.3.1 City of Prince Rupert

The City of Prince Rupert updated its Official Community Plan (OCP) in June 2010 (City of Prince Rupert 2010) as a "Quality of Life Community Plan", blending traditional land use planning with a strong focus on community consultation to integrate social, environmental and economic values. The number of land use designations has been reduced to four (Open Space and Park, Residential, Business Commercial, and Business Industrial), to allow flexibility and respond to changing economic and community conditions.

The steep slopes on Kaien Island restrict much of the developable area to the lowland coastal areas, and much of the upland is designated "parks and open space". The OCP also has an objective of developing a downtown waterfront plan jointly with the two main land owners, PRPA and CN, with the aim of improving public access to the waterfront and view corridors in discrete locations.

The Business Industrial zoning is designed to accommodate major industrial sites (generally 2 ha and larger in area), including marine, transportation and port uses. Lands on much of the west, north and northwest coast of Kaien Island and all of Watson and Ridley Island are zoned for Business Industrial. The City is also considering designating a 200 ha area in the southeast of Kaien Island for long term industrial use. Ridley Island, while part of the City, has a separate land use plan developed by PRPA (see sections below).

The November 2009 Investment-Ready Community Profile (City of Prince Rupert 2009) indicates there are 14 vacant land titles in Prince Rupert, ranging in size from 0.2 to 6.2 ha, a total of 10 ha. Overall, the City has 60 vacant industrial properties, totalling 1,300 ha, mostly near Highway 16 in northeast Kaien Island, bordering the narrow Fern Passage.

6.3.3.2 Port of Prince Rupert

Prince Rupert was designated a National Harbours Port in 1972, and in 1984 the Port became a Crown Corporation. On May 1, 1999, the Government of Canada created the PRPA under the *Canada Marine Act*, making it a federally-appointed, locally-run, not-for-profit agency with administration over the Port. The PRPA is responsible for over 965 ha of land holdings on Kaien, Ridley, Coast and Lelu Islands (including 400 ha of waterfront land) and 14,000 ha of owned harbour. Navigable waters encompass more than 350 km of coastline. Lands and waters managed by the PRPA include all the waters of Prince Rupert Harbour, encompassing the southern portion of Tuck Inlet, Morse Basin, Wainwright Basin, Porpoise Harbour, and portions of Chatham Sound and associated land areas.

The PRPA reports to the federal Minister of Transportation and has a Board of Directors. It is responsible for overall planning, development, marketing and management of commercial port facilities within Prince Rupert Harbour. The Port's vision is to be "internationally recognized as one of the most competitive and diversified gateway ports on the west coast". They intend to accomplish this vision by growing the Port in an aggressive, economical, safe and environmentally sound manner (see Port of Prince Rupert 200 Land Use Management Plan, 2011 for further detail).

The Port is located along the Pacific Great Circle Route between Asia and the west coast of North America, making it the first inbound and last outbound port of call. The Port is the second largest deep-sea gateway on the west coast of Canada with the deepest natural harbour (ranging from 34 to 44 m at the harbour entrance) in North America. It handles commodities produced throughout Western Canada including lumber, pulp, grains and coal destined for export markets. The Port also handles imports of steel and wax destined for manufacturing plants in Alberta.

Several facilities in the Port of Prince Rupert reside on land owned by the Federal Government and managed by the PRPA. PRPA also owns some of these facilities; Fairview, Westview, Atlin and Northland. BC Ferries, Alaska Ferry, Ridley Terminals and the Prince Rupert Grain Terminal facilities are independently owned and operated. Additionally, there are a number of smaller leisure boat terminals for recreational fishing charters and yachts. There are an estimated 780 commercial and recreational fishing vessels based in Prince Rupert.

Marine vessel traffic in in the Prince Rupert area, including Chatham Sound, Prince Rupert Harbour and Porpoise Harbour, is controlled by the Canadian Coast Guard's Marine Communication Traffic Services (MCTS), located in Prince Rupert. Large marine vessel traffic within the Prince Rupert

Harbour has increased steadily over the past five years, from 215 in 2006 to 380 in 2010. This includes grain, coal, log, wood pellet, wax, and container vessels. Approximately 50 cruise ships transit through the harbour each year as well.

6.3.3.3 Ridley Island

Ridley Island is owned by the federal government and managed by the PRPA. The island has more than 400 ha of waterfront industrial land available for development, with some port and rail infrastructure in place. Ridley Island has been designated for marine terminal use through various land use planning processes since 1977. In 2000, the PRPA prepared the Prince Rupert Port Land Use Plan in which Ridley Island was earmarked for major industrial development. As part of the land use planning process, the PRPA conducted public consultation which included publishing an advertisement in the Prince Rupert Daily News on February 23, 2000, providing notice of a public meeting to discuss the draft land use plan. This notice included the time and place of the public meeting, as well as information for obtaining copies of the draft plan for review. The public meeting was held on February 29, 2000 and included a presentation on the potential development area on Ridley Island. This presentation and the land use plan show the areas the PRPA has earmarked for medium and large industrial projects. Following the public meeting, no comments were received identifying concerns with the land use plan and on April 20, 2000 it was adopted by the PRPA Board of Directors. This plan has since been updated with the Port of Prince Rupert 2020 Land Use Management Plan (2011). This plan has also been through all necessary consultation requirements.

There are two existing industrial marine terminals on the northwest (outer) side of Ridley Island: Ridley Terminals Inc. and Prince Rupert Grain Limited. Both terminals have rail and road access, as well as jetties for marine shipping traffic that are capable of handling vessels greater than 300 m in length. Ridley Terminals Inc. is a 55 ha bulk terminal built in 1984 to transport metallurgical and thermal coal and petroleum coke on ships outbound to Asian markets. With an annual shipping capacity of 12 million tonnes and an on-site storage capacity of 1.2 million tonnes, the terminal has available capacity to handle additional product from other sources. The recent expansion of world-wide commodity markets, particularly China, has increased the demand for coal and, as a result, an increase in coal exports is expected. The Prince Rupert Grain Limited facility was built in 1985 to store and export Canadian grain shipments. It is owned by the four largest grain companies in Canada and has the capacity to store 202,000 tonnes of grain and to ship more than 5 million tonnes per year.

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7 AIR QUALITY ASSESSMENT

Air Quality has been selected as a VEC because of its intrinsic importance to the health and well-being of humans, wildlife, vegetation and other biota. The atmosphere is an important pathway for the transport of contaminants to the freshwater, terrestrial and human environments.

Some Project activities will result in the release of substances that owing to their physical and chemical properties are regarded as air contaminants. These discharge characteristics depend on the nature of the activities. As examples, dust is raised to the atmosphere during site preparation, construction and operations; exhaust gases are released during marine vessel powering and rail-based locomotive operations.

This section focuses on key aspects of the Air Quality VEC that were compiled after considering the Project description (Section 2.0) and including other Project-related emissions that are considered to be substantive. They are further sub-divided into two categories for potential air quality effects: criteria air contaminants (CACs) and greenhouse gases (GHGs). Volatile organic compounds (VOCs) are also considered, and although not CACs, are grouped with that category to simplify the assessment.

7.1 Scope of Assessment

7.1.1 Regulatory/Policy Setting

Table 2-5 (Section 2.5.1) lists the air contaminants whose effects are treated in this assessment. CACs include sulphur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), particulate matter (PM) less than 10 microns (PM_{10}) and particulate matter less than 2.5 microns ($PM_{2.5}$). PM_{10} is often referred to as inhalable particulate matter. Similarly, $PM_{2.5}$ is referred to as respirable particulate matter. GHGs include carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). Details of these air contaminants are found below and in the Air Quality Technical Data Report (Stantec 2011), from now on referred to as the "Air Quality TDR".

Environment Canada and Health Canada (2009) have established Canada (or National) Ambient Air Quality Objectives (NAAQO) for a number of air contaminants (Table 7.1). The NAAQO have been defined as follows:

- **Maximum Desirable Level** is the long-term goal for air quality and provides a basis for anti-degradation policy for unpolluted parts of the country and for the continuing development of control technology.
- **Maximum Acceptable Level** provides adequate protection against effects on soil, water, vegetation, materials, animals, visibility, personal comfort and well-being.
- **Maximum Tolerable Level** denotes time-based concentrations of air contaminants beyond which, due to a diminishing margin of safety, appropriate action is required to protect the health of the general population.

The BC Ministry of Environment (BC MOE 2007) has established Ambient Air Quality Objectives (BC AAQO) for a number of air contaminants (Table 7.1). The BC AAQO for $PM_{2.5}$ was adopted by the Ministry of Healthy Living and Sport (BC MHLS 2009).

The BC AAQO are denoted as Levels A, B, and C and are generally defined as follows:

- **Level A** is set as the objective for new and proposed discharges and, within the limits of best practicable technology, to existing discharges by planned staged improvements for these operations.
- **Level B** is set as the intermediate objective for all existing discharges to meet within a period of time specified by the Director, and as an immediate objective for existing discharges which may be increasing in quantity or altered in quality as a result of process expansion or modification.
- **Level C** is set as the immediate objective for all existing chemical and petroleum industries to reach within a minimum technically feasible period of time.

For ease of reference, the NAAQO and BC NAAQO re collectively referred to as the “regulatory objectives”.

Table 7-1: National and Provincial Ambient Air Quality Objectives

Substance (units)	Averaging Time Period	British Columbia[a]			Canada[b]			
		Level A	Level B	Level C	Canada Wide Standards (pending)	Ambient Air Quality Objectives		
						Maximum Desirable	Maximum Acceptable	Maximum Tolerable
Sulphur Dioxide (µg m^{-3})	One-hour	450	900	900 – 1,300	–	450	900	–
	3-hour	375	665	–	–	–	–	–
	24-hour	160	260	360	–	150	300	800
	Annual	25	50	80	–	30	60	–
Nitrogen Dioxide (µg m^{-3})	One-hour	–	–	–	–	–	400	1,000
	24-hour	–	–	–	–	–	200	300
	Annual	–	–	–	–	60	100	–
Carbon Monoxide (µg m^{-3})	One-hour	14,300	28,000	35,000	–	15,000	35,000	–
	Eight-hour	5,500	11,000	14,300	–	6,000	15,000	20,000

Substance (units)	Averaging Time Period	British Columbia[a]			Canada[b]			
		Level A	Level B	Level C	Canada Wide Standards (pending)	Ambient Air Quality Objectives		
						Maximum Desirable	Maximum Acceptable	Maximum Tolerable
PM_{10} (µg m^{-3})	24-hour	–	50	–	–	–	–	–
$PM_{2.5}$ (µg m^{-3})	24-hour	25 [c]			30 [d]	–	–	–
	Annual	8 [c]						

SOURCES:

[a] BC Ministry of Environment. Air Quality Objectives and Standards. 2009. Available at: http://www.bcairquality.ca/reports/pdfs/aqotable.pdf

[b] Health Canada. National Ambient Air Quality Objectives. Available at: http://www.hc-sc.gc.ca/ewh-semt/pubs/air/naaqo-onqaa/index-eng.php and http://www.hc-sc.gc.ca/ewh-semt/air/out-ext/reg-eng.php#a3

[c] British Columbia Ministry of Healthy Living and Sport, Air Quality Objectives and Standards. 2009. Available at: http://www.bcairquality.ca/reports/pdfs/aqotable.pdf . The $PM_{2.5}$ 24-hour average is based on 98th percentile value for one year.

[d] CCME (2000), Canada-Wide Standards for Respirable Particulate Matter ($PM_{2.5}$). The $PM_{2.5}$ standard is based on the annual 98th percentile averaged over three consecutive years.

7.1.2 Key Issues

CAC discharges to the receiving atmosphere have the potential to result in adverse environmental effects, which include vegetative injury, ecosystem changes and increases in certain health concerns such as cardiac and pulmonary stress. GHG emissions will contribute to Canada and British Columbia GHG emission totals. Therefore, the identified potential Project effects on Air Quality were changes in CACs and GHGs.

Table 3-4 lists the potential interactions of the Project Activities with the receiving environment. While virtually all those activities have the potential to emit CACs and GHGs, some are not carried forward in this assessment. The Project activities ranked as “0” are reasoned to have virtually no effect on the receiving environment and are not considered further. Project activities ranked as “1”, have some but unlikely significant effects, for the following reasons:

- Construction of the transmission line, dredging and commissioning activities are intermittent, have small amounts of air discharges and are short-term in duration.
- Operations maintenance activities are intermittent, have only small amounts of air discharges, and are short-term.
- During decommissioning, removals of site infrastructure result in air discharges that are of short durations.

Table 7-2 provides a summary of the Project activities ranked as “2” in Table 3-4. These activities will produce emissions that should result in residual air quality effects. Cumulative contributions from other present and future projects are included.

Table 7-2: Potential Environmental Effects to Air Quality Associated with this Project

Project Activities and Physical Works	Potential Effects on Air Quality	
	Change in Criteria Air Contaminants	Change in Greenhouse Gases
Construction and Commissioning		
Temporary Construction Infrastructure (trailers, power, sanitary facilities, etc.)	✓	
Site Preparation (Clearing and Grubbing, Site Grading)	✓	
Rail Loop Construction	✓	
Onshore Terminal Construction (receiving, storage, reclaim and shiploading facilities, site services)	✓	
Installation of Canpotex Rail Tracks	✓	
Access Road and Overpass Construction	✓	
Marine Facilities Construction (causeway, trestle and berth)	✓	
Operations		
Potash Handling Operations (receiving, storage, reclaim and shiploading of potash)	✓	✓
Arrival and Departure of Vessels	✓	✓
Arrival and Departure of Trains	✓	✓
Interaction of Other Projects and Activities in the Boundary for Assessment (potential for cumulative effects; see rankings below)		
Ridley Terminals Inc.	2	1
Prince Rupert Grain Ltd.	2	1
Fairview Terminal (existing and II)	2	1
ICEC Terminals Company Ltd.	2	1
JS McMillan Fisheries	2	1
BC Ferries and Cruise ship Terminal	2	1

NOTES:

Project Environmental Effects

Only Project – environment interactions ranked as 2 in Table 3-4 are carried forward to this Table. A ✓ indicates that an activity is likely to contribute to the environmental effect.

Cumulative Environmental Effects

Cumulative environmental effects were ranked as follows:

0 = Project environmental effects do not act cumulatively with those of other projects and activities

1 = Project environmental effects act cumulatively with those of other projects and activities, but are unlikely to result in significant cumulative environmental effects OR Project environmental effects act cumulatively with existing significant levels of cumulative environmental effects but will not measurably change the state of the VEC

2 = Project environmental effects act cumulatively with those of other projects and activities, and may result in significant cumulative environmental effects OR Project environmental effects act cumulatively with existing significant levels of cumulative environmental effects and may measurably change the state of the VEC.

7.1.3 Selection of Measurable Parameters

Project effects on Air Quality are framed with reference to measurable parameters. Measurable parameters facilitate quantitative or qualitative measurement of Project potential residual and cumulative effects, and provide a means to determine the level or amount of change to a VEC. As functions of potential effects, the selected measurable parameters for the Air Quality VEC are outlined in Table 7-3. Descriptions of CACs and GHGs are provided afterward.

Table 7-3: Measurable Parameters for Air Quality

Project Effect	Measurable Parameter(s) for the Effect	Rationale for Selection of Measurable Parameter
Effect 1: Change in Criteria Air Contaminants	BC AAQO and NAAQO for SO_2, NO_2, CO, PM_{10}, $PM_{2.5}$. Comparison with background and baseline conditions	Exceeding the BC AAQO and NAAQO can negatively affect human and ecological health.
Effect 2: Change in Greenhouse Gases	Comparison with totals across Canada, Alberta, BC and all Territories	High levels could result in climate change

7.1.3.1 Criteria Air Contaminants

Sulphur Dioxide

Sulphur dioxide (SO_2) is a colourless gas with a distinctive pungent sulphur odour. In combustion processes, it is produced by the oxidation of the sulphur contained in fuel. At high enough concentrations, SO_2 can have negative effects on plant and animal health, particularly with respect to their respiratory systems. In addition, SO_2 can be further oxidized and may combine with water to form the sulphuric acid component of acid rain.

Anthropogenic emissions comprise about 95 percent of global atmospheric SO_2. The largest anthropogenic contributor to atmospheric SO_2 is the industrial and utility use of heavy fuel oils and coal. Oxidation of reduced sulphur compounds emitted at the ocean surfaces account for nearly all biogenic emissions. Volcanic activity accounts for much of the remainder. Motor vehicles are relatively small contributors to the SO_2 content of the atmosphere (Wayne, 1991).

During the operations phase, project-related SO_2 emissions will be released through the combustion of fuels containing substantial amounts of sulphur.

Oxides of Nitrogen

Oxides of nitrogen (NO_X) are produced in most combustion processes and are almost entirely made up of nitrogen oxide (NO) and nitrogen dioxide (NO_2). Together, they are often referred to as NO_X. NO_2 is a respiratory irritant, while NO is relatively inert. As such, regulatory NAAQO exist for NO_2 but not for NO or NO_X.

NO_2 is an orange to brown gas that is corrosive and irritating at high concentrations. Most NO_2 in the atmosphere is formed by the oxidation of NO, which is emitted directly by combustion processes, particularly those at high temperature and pressure such as within internal combustion engines. The levels of NO and NO_2, and the ratio of the two gases, together with the presence of hydrocarbons and sunlight, are the most important factors in the formation of ground-level ozone and other oxidants. Further oxidation of these compounds and their combination with water in the atmosphere forms nitric acid, another component of acid rain.

Anthropogenic emissions comprise approximately 93% of global atmospheric emissions of NO_X ($NO + NO_2$). The largest anthropogenic contributor to atmospheric NO_X is combustion of fuels such as natural gas, oil, and coal. Forest fires, lightning, and anaerobic processes in soil account for nearly all biogenic emissions (Wayne, 1991). Project-related NO_X emission sources include vehicle traffic and land-based diesel equipment such as bomb carts and reach stackers.

Carbon Monoxide

Carbon monoxide (CO) is a colourless, odourless gas. A product of incomplete combustion, its sources include fossil fuel combustion (e.g., motor vehicles), industrial processes and natural sources (e.g., forest fires). The typical CO concentration in the atmosphere is 120 $\mu g\ m^{-3}$ while the minimum level known to produce cardiovascular symptoms in people who smoke is about 35,000 $\mu g\ m^{-3}$.

Project-related CO emissions will result from incomplete combustion of fuel, mainly from vehicles and construction equipment.

Particulate Matter

Sources of airborne particulate matter (PM) include soil dust, road dust, agricultural activities, forest fire smoke, vehicle exhaust and industrial activities. Particulate matter is classified by particle size. Size determines the velocity with which gravitational settling occurs and the ease with which particles penetrate the human respiratory tract. Generally, large particles settle out very close to the source; very fine particles can be airborne for weeks.

Total Particulate Matter (TPM), sometimes referred to as Total Suspended Particulate (TSP), encompasses all size ranges from about 40 micrometres (µm) to the sub-micrometre range. Inhalable (PM_{10}) and respirable ($PM_{2.5}$) PM consist of very small particles of diameters less than 10 and 2.5 µm, respectively. Fine particles are more of a health risk as they can penetrate deep into the respiratory tract. Regional air quality objectives related to PM have shifted in recent years from an emphasis on TPM to a focus on the effects of finer particles (particularly $PM_{2.5}$) as a result of concerns related to potential human health effects.

In the construction and decommissioning phases, Project-related PM emissions are associated primarily with motor vehicle and off-road construction equipment exhaust. In the operations phase, the primary sources of PM will include marine vessel engine and railroad locomotive exhaust.

TPM emissions larger than PM_{10} are not considered to be an issue and are not considered further for the following reasons:

- Most health effects are due to particulate matter smaller than PM_{10}.
- Most of the TPM emissions will occur over the berth area and along the fenceline coast, where public access is non-existent or extremely limited.
- The heavier particles do not remain suspended very long and deposit close to the source.

Volatile Organic Compounds

Volatile Organic Compounds (VOCs) are carbon-containing (organic) compounds that readily evaporate into the air under ambient conditions. Many VOCs are of natural origin, including methane. Others may be potentially harmful to the environment, either directly or indirectly, as a contributor to ground-level ozone and smog formation. Relevant sources of VOCs include the engine exhaust from the operation of heavy equipment (construction phase) and locomotive and marine vessels (operations phase).

Some VOCs may have short- and long-term adverse health effects. Key signs or symptoms associated with exposure to VOCs include eye irritation, nose and throat discomfort, headache, allergic skin reaction, declines in serum cholinesterase levels, nausea, fatigue and dizziness. No Canada or provincial objectives or standards exist for assessment of exposures to Total Hydrocarbons (THC), of which VOCs are a sub-set. However, in a study conducted for the Canadian Association of Petroleum Producers (CAPP), the occupational exposure limits used for evaluation of THC data were an 8-hour time-weighted average (TWA) of 100 parts per million (ppm), a 12-hour TWA of 50 ppm, and a short-term exposure limit (STEL) of 200 ppm (Verma *et al.*, 2000). These exposure limits were derived from the American Conference of Government Industrial Hygienists' (ACGIH) gasoline threshold limit value (TLV) of 300 ppm. Other relevant TLVs developed by the ACGIH include a TLV of 1,000 ppm for liquefied petroleum gas, a TLV of 1,000 ppm for aliphatic hydrocarbon gas and a TLV of 200 ppm for total hydrocarbon vapour (ACGIH, 2005).

7.1.3.2 Greenhouse Gases (GHG)

A GHG is defined as any gas in the atmosphere that absorbs infrared radiation and transfers this energy to other compounds in the form of heat, a process that results in atmospheric temperature increases. GHGs include water vapour (H_2O), carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), halogenated fluorocarbons (HCFCs), ozone (O_3), perfluorinated carbons (PFCs) and hydrofluorocarbons (HFCs). GHGs are transparent to incoming solar radiation, but absorb outgoing terrestrial (infrared) radiation which is reemitted into the atmosphere. The net effect is a trapping of energy and a tendency to warm Earth's atmosphere, land and water surfaces.

Current scientific theory suggests that increases in atmospheric concentrations of GHGs (mainly CO_2, CH_4 and N_2O) have altered Earth's climate. Climate scientists have linked these GHG increases to alterations in temperature, moisture and the occurrence of severe weather events such as droughts, floods and storms. Long-term changes such as melting glaciers and polar ice, desertification, sea-level rise and ecosystem-level alterations are also linked to GHG emissions. Climate change-related health and ecological effects include an expansion of the range of diseases and infestations (e.g., pine beetle) to areas previously unaffected and deaths related to extreme heat and other severe weather.

Project-related sources of GHGs include exhaust from construction and decommissioning phase equipment. During the operations phase, marine vessel engines and railroad locomotives will be the primary sources of GHGs.

7.1.4 Characterization of Residual Effects

Terms that will be used to characterize residual effects are provided in Table 7-4.

Table 7-4: Characterization Criteria for Residual Air Quality Effects

Criterion	Ranking/Description
Direction	**Adverse:** condition of the atmospheric environment is worsening in comparison to baseline conditions and trends. **Positive:** condition of the atmospheric environment is improving in comparison to baseline conditions and trends. **Neutral:** no change in the condition of the atmospheric environment compared to baseline conditions and trends.
Magnitude	**Negligible:** no measurable adverse effect anticipated. **Low:** effect occurs that is detectable but is within normal variability of baseline conditions. **Moderate:** effect occurs that would cause an increase with regard to baseline but is within regulatory limits and objectives. **High:** effect occurs that would singly or as a substantial contribution in combination with other sources cause exceedances of objectives or standards beyond the Project boundaries.
Geographical Extent	**Site-specific:** effect restricted to the Project footprint within the local assessment area (LAA). **Local:** effect restricted to the LAA. **Regional:** not used since the assessment is for the LAA.
Frequency	**Once:** effect occurs once. **Sporadic:** effect occurs at sporadic intervals. **Rarely:** effect occurs on a regular basis and at regular intervals. **Frequently:** effect occurs continuously throughout the Project life.
Duration	**Short-term:** effect occurs for less than three years. **Medium-term:** effect occurs for between 3 and 20 years. **Long-term:** effect persists beyond 20 years.
Reversibility	**Reversible:** effect ceases when Project operations cease. **Irreversible:** effect continues after Project operations cease.
Ecological Context	**Undisturbed:** effect takes place within an area that is relatively or not adversely affected by human activity. **Disturbed:** effect takes place within an area with human activity. Area has been substantially previously disturbed by human development or human development is still present.

7.1.5 Standards or Thresholds for Determining Significance

Relevant regulatory criteria for ambient air quality will be used to determine if a change in air contaminants of interest will be significant or not. Significance will be determined as follows:

- **Not Significant**—ambient concentrations of air contaminants are likely to be below relevant regulatory criteria for ambient air quality (i.e., always to be of low to moderate magnitude throughout the LAA).

- **Significant**—Residual effects ambient concentrations of air contaminants are likely to exceed relevant regulatory criteria for ambient air quality (i.e., to be high in magnitude) and are of concern relative to the geographical extent of predicted exceedances and/or their frequency of occurrence.

7.2 Baseline Conditions

An understanding of existing climate conditions in the LAA is required as these environments can influence the Project construction, operations, and decommissioning phases. As an example, extreme ambient air temperatures are important factors to consider for the selection of construction materials and equipment, and extreme precipitation is an important factor to consider for the design of drainage systems. Climate parameters also influence the transport and dispersion of Project air emissions and must be considered as part of the Project environmental assessment. Specifically, wind speed, wind direction and atmospheric turbulence are major climatic elements that influence the dispersion of air emissions. The climate baseline considers measurable parameters at the nearest regional climate stations in the assessment area (Air Quality TDR).

Understanding the existing air quality conditions in the LAA helps establish the link between the causes (emissions) and effects (resultant adverse changes in air quality). This understanding allows for an assessment of potential air quality effects of the Project-related emissions. The air quality baseline considers measurable parameters at the nearest continuous hourly monitoring stations which are most representative of Project site conditions.

7.2.1 Climate Baseline

To determine the possible effect of existing climate on the Project, patterns of air temperature, precipitation, humidity, and wind were characterized. Specifics are detailed in Section 3.1 of the Air Quality TDR.

Ridley Island is located on the BC North Coast, which extends from north of Vancouver Island to the Canadian border with the Alaska panhandle. This region is characterized by frequent cloud cover and substantial precipitation (Nav Canada 2001). Ambient temperatures and precipitation type are primarily influenced by the Pacific Ocean; however, outflow winds from the inland valleys can carry air from the interior, resulting in extremely variable precipitation types, particularly during the winter (Nav Canada 2001).

7.2.2 Air Quality Baseline

Project area baseline air quality is primarily influenced by regional industrial air emission sources. Ambient air quality conditions were characterized based on monitoring data collected at nearby stations that are most representative of LAA conditions. Ambient concentrations were only available for sulphur dioxide (SO_2), hydrogen sulphide (H_2S), and inhalable particulate matter (PM_{10}).

The data are analyzed and presented in detail in Section 3.2 of the Air Quality TDR. Based on available data, the existing regional air quality was determined to be good. All monitored concentrations of SO_2 and PM_{10} were below the applicable regulatory objective (Table 7-1).

Ambient concentrations for $PM_{2.5}$, CO, NO_2 and VOCs were not available from nearby monitoring stations and could not be used as part of the regional air quality analysis. Consequently, regional concentrations for these measurable parameters were defined by emissions produced by other permitted projects located within a 15 km radius of the Project footprint. Emission rates for other permitted projects near the Project footprint are summarized in the Air Quality TDR.

7.3 Effects Assessment

7.3.1 Assessment Methods

Criteria Air Contaminants Analysis Methods

The CAC assessments were completed using the results from the CALMET/CALPUFF dispersion modelling system. The simulations determine the potential adverse effects of emissions from the proposed Project on ambient air quality. CALMET/CALPUFF is described in greater detail in Appendix A of the Air Quality TDR.

All dispersion modelling was conducted in accordance with regulatory guidance provided by the BC MOE in the *Guidelines for Air Quality Dispersion Modelling in British Columbia* (BC MOE, 2008). Four dispersion modelling scenarios were considered in accordance with the Terms of Reference for the Project: 1) Baseline Case, 2) Project Case, 3) Application Case, and, 4) Cumulative Effects Assessment (CEA) Case.

Further details regarding emissions estimation for these cases, dispersion modelling scenarios, model selection, meteorological data, and terrain and receptors are included in the Air Quality TDR.

Greenhouse Gases Analysis Methods

The analysis for GHGs was completed in a manner that is consistent with the CEA Agency document *Incorporating Climate Change Considerations in Environmental Assessments: General Guidance for Practitioners* (CEA Agency 2003). This document is the primary source of guidance for the incorporation of climate change considerations into environmental assessments in Canada (CEA Agency, 2003).

Guidance provided by the CEA Agency (2003) suggests an examination of the following aspects, in a stepwise fashion, to assess the potential effects of a project on climate or the potential effects of climate on a project:

- Establish the quantities of GHG emissions for each phase of the project
- Estimate the marginal contribution of the project emissions to the provincial and national emissions
- Establish relevant jurisdictional policies
- Establish the industry profile for GHG emissions and best practices for projects that are similar in nature to the project
- Identify whether the project is a low, medium, or high intensity emitter of GHGs.

Once these steps are completed, it is suggested that the following questions be answered:

- Will the project be a medium or high emitter?
- Will the project exceed relevant jurisdictional policies?
- Will the project exceed the industry profile?
- Will best practices be used in all phases of the project?

Climatological modelling presented in the *Third Assessment Report of the Intergovernmental Panel on Climate Change* (IPCC, 2001) was used to understand the general magnitude of climatic change. The IPCC was established by the World Meteorological Organization (WMO) and the United Nations Environment Program (UNEP). Of direct interest is the regional interpretation of this and later works as published from time to time by Canada and BC, including *Climate Change Impacts and Adaptation: A Canadian Perspective* (Government of Canada, 2004).

The net quantities of GHG emissions were estimated and considered in the provincial and national context. The Project was examined for all related GHG emissions and for all possible opportunities to reduce emissions using the criteria of: current availability, proven technology and economic feasibility. The effects of the Project on climate considered mitigation and adaptive management of GHG emissions and the application of Best Available Technology Economically Achievable (BATEA).

7.3.2 Change in Criteria Air Contaminants

7.3.2.1 Potential Effects

Construction

CAC emissions from construction activities may have a temporary effect on local air quality. These emissions are associated with land clearing, ground excavation, cut-and-fill operations, and equipment traffic on the site. Generally, construction CAC emissions are proportional to the disturbed land area and the level of construction activity and limited to periods of the day and week when the construction activities take place.

Table 7-5 presents a summary of predicted Project-related CAC emissions during the construction phase in units of tonnes per year (tpy). These emissions are limited to the 42-month construction period. PM construction emissions are considered as PM_{10} and $PM_{2.5}$. PM generated through construction phase ground disturbance is larger in size and settles out of the atmosphere close to the source. Further detail regarding construction phase CAC emission estimation is available in the Air Quality TDR.

Table 7-5: Summary of Predicted CAC Emissions from Project during Construction Phase

Equipment Type[a]	CAC Emissions (tpy)					
	SO_2	NO_X	CO	PM_{10}	$PM_{2.5}$	VOCs
Land-based [b]	0.14	3.1	24.8	0.2	0.2	1.4
Marine-based [c]	0.04	5.3	11.4	0.2	0.2	0.9
Total	**0.18**	**8.4**	**36.2**	**0.4**	**0.4**	**2.3**

NOTES:
[a] Detailed equipment list is provided in the Section 4.1 of the Air Quality TDR.
[b] Based on emission factors and methodologies developed by the US EPA for Non-Road Diesel Equipment (US EPA 2004).
[c] Based on emission factors and methodologies developed by the US EPA for commercial marine vessels (US EPA 2000).

Construction equipment operating on-site is responsible for most CAC emissions. Tugs and barges are also responsible for some CAC emissions; however, these emissions are much smaller. Total Project CAC construction emissions are relatively low (see Table 7-5) and are consistent with those estimated for similar projects.

As a basis for comparison with the expected construction CAC emissions, the year 2000 emissions in the LAA are shown in Table 7-6. These emissions include permitted point sources, area sources, mobile sources and road dust. These data are from the British Columbia Ministry of Environment (BC MOE) year 2000 emission inventory of CACs from various area and mobile sources (BC MOE, 2008). The Ministry's Air Contaminant Emissions (ACE) inventory system is capable of extracting these area and mobile sources for any given region in the province. The ACE data model is described in BC MWLAP (2005).

Construction emissions are low (0.01 – 0.5%) when compared to the year 2000 area estimates. For this reason, construction emissions were not included in the dispersion simulations. They are short-term, transient and will not contribute measurably to any regional cumulative issues of concern.

Table 7-6: Construction and Total Existing (year 2000) CAC Emissions in the Local Assessment Area

Source	CAC Emissions (tpy)					
	SO_2	NO_X	CO	PM_{10}	$PM_{2.5}$	VOCs
Total predicted construction emissions	0.18	8.4	36.2	0.4	0.4	2.3
Total existing emissions in the LAA	1,946	3,893	6,886	2,910	1,793	1,012
Construction emissions relative to existing emissions in the LAA (%)	0.01	0.2	0.5	0.01	0.02	0.2

Operations

The interactions between Air Quality and Project CAC emissions are expected to occur primarily in the immediate vicinity of the Project footprint. CAC emissions during the operations phase are expected to occur from marine vessels, dust collectors and rail traffic. After operations start, there will be increased on-road vehicle traffic. This is a result of workers commuting to and from the facility and from the delivery of supplies to the facility. However the emissions are expected to be minimal and therefore are not considered further.

CAC emissions will be generated by the operation of marine vessels exporting the potash and tug boats used to manoeuvre the vessels to and from the marine wharf. The berths will be designed to handle a range of vessel sizes. Dust emissions will result from potash unloading at the railcar unloader, transporting the potash to the storage facility, subsequent recovery, conveyor usage and eventual shiploading. Two land-based dust collectors and seven berth-based dust collectors, all equipped with baghouses, will minimize the atmospheric discharges.

To reach the potash annual export target, 400-600 trains will deliver 18,000 tonnes of potash each. Each train will be powered by three or four locomotives. CAC emissions are expected to occur from the internal combustion engines that power the locomotives. A description of locomotive emission estimation techniques and assumptions are presented in Section 4.2 of the Air Quality TDR.

The effects of the CAC emissions were assessed by using dispersion simulations to predict their contributions to ground-level concentrations. The assessment scenarios considered were:

- **Baseline Case**—including emissions from existing industrial sources within the LAA
- **Project Case**—including emissions solely from the Project
- **Application Case**—Baseline Case plus Project Case emissions
- **CEA Case**—Application Case plus publicly disclosed and approved future projects.

The following sections detail the CAC emissions and the dispersion modeling results for each of these cases.

Baseline Case Emissions

Provincially regulated industrial point sources of CAC emissions currently located in the Prince Rupert area include:

- Ridley Terminals Inc.
- Prince Rupert Grain Limited
- J.S. McMillan Fisheries Ltd
- Northland Cruise Terminal
- Prince Rupert Ferry
- Fairview Project Phase I.

Emissions from these sources are presented in Section 4.4 of the Air Quality TDR. In-port marine emissions associated with existing and approved operations in the Prince Rupert area were estimated and included in the dispersion model. These include emissions from Very Large Bulk Carriers, Cape Size Bulk Carriers, cruise ships, BC and Alaska ferries, and assist tugboats (Air Quality TDR, Section 4.4).

Baseline Case Modelling Results

Dispersion modelling results for predicted concentrations of SO_2, NO_2, CO, PM_{10}, $PM_{2.5}$ and VOCs associated with existing and approved sources within the LAA are summarized in Table 7-7. Isopleth maps of modelling results are presented in Appendix B of the Air Quality TDR (Figures B-1 to B-9). For the Baseline Case, all maximum predicted concentrations of SO_2, NO_2, CO, PM_{10} and $PM_{2.5}$ were below the corresponding AAQO. A detailed assessment of the results is presented in Section 6.1 of the Air Quality TDR.

The main regional air quality issue is related to SO_2 emitted by marine vessels operating near Prince Rupert, BC. The one-hour estimate of 442 µg m^{-3} is close to the BC AAQO objective of 450 µg m^{-3}. The dispersion simulations agree reasonably well with the measured results at the monitoring stations.

Table 7-7: Maximum Predicted Ground-level CAC Concentrations Associated with the Baseline Case

Substance	Averaging Period	Maximum Predicted Ground-Level Concentration (µg m^{-3})	BC AAQO (µg m^{-3})			NAAQO (µg m^{-3})		
			Level A	Level B	Level C	Maximum Desirable	Maximum Acceptable	Maximum Tolerable
SO_2	1-hour	442	450	900	900–1,300	450	900	–
	3-hour	259	375	665	–	–	–	–
	24-hour	80.7	160	260	360	150	300	800
	Annual	4.07	25	50	80	30	60	–
NO_2	1-hour	174	–	–	–	–	400	1,000
	24-hour	110	–	–	–	–	200	300
	Annual	46.8	–	–	–	60	100	–
CO	1-hour	963	14,300	28,000	35,000	15,000	35,000	–
	8-hour	430	5,500	11,000	14,300	6,000	15,000	20,000
PM_{10}	24-hour	9.75	–	50	–	–	–	–
$PM_{2.5}$	24-hour [a]	9.74		25			30 (CWS)	
	Annual	2.44		8		–	–	–
VOCs	1-hour	163	–	–	–	–	–	–
	24-hour	35.2	–	–	–	–	–	–
	Annual	6.23	–	–	–	–	–	–

NOTE:
[a] 98^{th} percentile value of 24-hour ground-level concentration.

Project Case Emissions

Project Case emissions are presented in Section 6.2 of the Air Quality TDR. These include emissions associated with marine vessel and dust-collector operations. The majority of Project PM_{10} and $PM_{2.5}$ emissions are from shiploading operations.

Locomotive emissions along the CN rail line between Ridley Island and Lorne Creek are quantified and discussed separately in Section 4.5 of the Air Quality TDR. Potential effects from locomotive emissions generated during normal Project operations are assessed in the Application case by comparing locomotive emissions to regional emissions of a typical community along the rail line corridor.

Project Case Modelling Results

Dispersion modelling results for predicted concentrations of SO_2, NO_2, CO, PM_{10}, $PM_{2.5}$ and VOCs associated with emissions solely from the Project are summarized in Table 7-8. Isopleth maps of modelling results are presented in Appendix B of the Air Quality TDR (Figures B-10 to B-18). The maximum predicted 24-hour averaged PM_{10} concentration of 74.7 µg m^{-3} exceeds the BC AAQO of 50 µg m^{-3}. However there is no NAAQO for 24-hour averaged PM_{10}. As well the predicted maximum is found to the northwest of the berth area over the ocean. All other maximum predicted concentrations of SO_2, NO_2, CO, $PM_{2.5}$ were below the relevant regulatory objective. A detailed assessment of the results is presented in Section 6.2 of the Air Quality TDR.

Table 7-8: Maximum Predicted Ground-level Criteria Air Contaminant Concentrations Associated with the Project Case

Substance	Averaging Period	Maximum Predicted Ground-Level Concentration (µg m^{-3})	BC AAQO (µg m^{-3})			NAAQO (µg m^{-3})		
			Level A	Level B	Level C	Maximum Desirable	Maximum Acceptable	Maximum Tolerable
SO_2	1-hour	48.9	450	900	900–1,300	450	900	–
	3-hour	37.4	375	665	–	–	–	–
	24-hour	22.2	160	260	360	150	300	800
	Annual	0.05	25	50	80	30	60	–
NO_2	1-hour	157	–	–	–	–	400	1,000
	24-hour	128	–	–	–	–	200	300
	Annual	6.94	–	–	–	60	100	–
CO	1-hour	87.8	14,300	28,000	35,000	15,000	35,000	–
	8-hour	57.8	5,500	11,000	14,300	6,000	15,000	20,000
PM_{10}	24-hour	74.7	–	50	–	–	–	–
$PM_{2.5}$	24-hour [a]	21.8	25			30 (CWS)		
	Annual	0.87	8			–	–	–
VOCs	1-hour	35.4	–	–	–	–	–	–
	24-hour	17.2	–	–	–	–	–	–
	Annual	0.26	–	–	–	–	–	–

NOTE:
[a] 98th percentile value of 24-hour ground-level concentration.

Application Case Emissions

The Application Case includes an assessment of emissions from the Project Case in combination with the Baseline Case. A discussion of the emissions, including emission estimation techniques and assumptions, is presented in Sections 4.2 and 4.4 of the Air Quality TDR.

Locomotive emissions along the CN rail line between Ridley Island and Lorne Creek are discussed separately in Section 4.5 of the Air Quality TDR. The length of the rail line from Lorne Creek to Ridley Island is approximately 200 km. Table 7-9 presents a summary of annual rail emissions incurred as a result of normal Project operations compared to emissions estimated within 10 km of Terrace, BC (Stantec 2009). The contributions of Project CACs from railroad activities during the operations phase will be substantially lower than annual air emissions within the Terrace area.

Table 7-9: Regional Locomotive Emissions Compared to Terrace Area Emissions

	Maximum Emission Rates (tpy)					
	SO_2	NO_x	CO	PM_{10}	$PM_{2.5}$	VOC
Regional Locomotive Emissions	0.52	27.80	3.34	1.00	1.00	1.06
Emissions at Terrace Area, BC	44.00	536.60	6,768.10	1,231.50	726.80	1,266.80
Incremental Increase (%)	1.20	5.2	0.05	0.08	0.13	0.07

Application Case Modelling Results

Maximum predicted concentrations associated with the Application Case emissions are presented in Table 7-10. Isopleth maps of the modelling results are presented in the Air Quality TDR (Figures B-19 to B-27). Except for the PM_{10} and $PM_{2.5}$ contributions, the Project emissions have added only incremental amounts to the Baseline Case maximum values, so the Application Case maxima for the other CACs are virtually the same as the Baseline Case maxima. All maximum predicted concentrations of SO_2, NO_2, CO, $PM_{2.5}$ were below the relevant regulatory objectives. As with the Project Case, only the PM_{10} maxima exceed the BC AAQO objective. A detailed assessment of the results is presented in Section 6.3 of the Project Air Quality TDR.

Table 7-10: Maximum Predicted Ground-level CAC Concentrations Associated with the Application Case

Substance	Averaging Period	Maximum Predicted Ground-Level Concentration ($\mu g\ m^{-3}$)	BC AAQO ($\mu g\ m^{-3}$)			NAAQO ($\mu g\ m^{-3}$)		
			Level A	Level B	Level C	Maximum Desirable	Maximum Acceptable	Maximum Tolerable
SO_2	1-hour	442	450	900	900–1,300	450	900	–
	3-hour	259	375	665	–	–	–	–
	24-hour	80.7	160	260	360	150	300	800
	Annual	4.08	25	50	80	30	60	–

Substance	Averaging Period	Maximum Predicted Ground-Level Concentration (µg m^{-3})	BC AAQO (µg m^{-3})			NAAQO (µg m^{-3})		
			Level A	Level B	Level C	Maximum Desirable	Maximum Acceptable	Maximum Tolerable
NO_2	1-hour	174	–	–	–	–	400	1,000
	24-hour	128	–	–	–	–	200	300
	Annual	47.2	–	–	–	60	100	–
CO	1-hour	964	14,300	28,000	35,000	15,000	35,000	–
	8-hour	430	5,500	11,000	14,300	6,000	15,000	20,000
PM_{10}	24-hour	74.7	–	50	–	–	–	–
$PM_{2.5}$	24-hour [a]	21.8	25			30 (CWS)		
	Annual	2.47	8			–	–	–
VOCs	1-hour	164	–	–	–	–	–	–
	24-hour	35.2	–	–	–	–	–	–
	Annual	6.25	–	–	–	–	–	–

NOTE:
[a] 98th percentile value of 24-hour ground-level concentration.

Predictions at Sensitive Receptors

A list of sensitive receptors and their respective locations within the LAA is provided in Section 5.4 of the Air Quality TDR. In Section 6.5 of the Air Quality TDR, concentrations of CACs at these sensitive receptors were determined and assessed for each of the assessment cases. The results at each of the receptors were well below the applicable regulatory standards for all contaminants and averaging periods.

Except for the Port Edward Elementary location, the maximum predicted concentrations at the sensitive receptors generally do not increase much when comparing the Application Case predictions to the Baseline Case predictions. This indicates that existing industrial sources are the primary contributor to CAC concentrations at the other sensitive receptor locations. Project emission sources are largely from berth-based equipment and away from Port Edward. The Application Case predictions at all sensitive receptor locations are less than the relevant regulatory objectives.

Decommissioning

At Project end, it is expected that the buildings, berth and rail line will be used for another industrial application. Only the potash handling infrastructure will require removal. Therefore, the low level of activity should result in equivalently low-level emissions. The potential effects of this phase on Air Quality will be of much lower in magnitude than those of the construction and operations phases.

7.3.2.2 Mitigation

A number of mitigation measures for the protection of the air quality VEC have been determined for this Project. These mitigation measures will support CAC compliance with the regulatory objectives throughout the Project phases.

The use of BATEA to reduce CAC and GHG emissions is important. The planned use of best practices and current technology throughout the Project will serve to reduce emissions at the source.

During the construction phase, on- and off-road construction equipment will be properly tuned and maintained. Equipment will be powered with low sulphur fuel when available. During site preparation, most emissions will be the result of soil disruption causing dust. It is expected that the Ridley Island soil is sufficiently moist as to naturally suppress emissions. If not, dust associated with construction will be minimized with dust suppressants and surface paving.

During the operations phase, conveyers and transfer points will be fully enclosed complete with spill trays to facilitate clean-up. The dust collection system will allow dust to be captured at all transfer points and bagged or returned to the potash handling system. Dust collection will be provided in the potash storage building to capture fugitive dust generated by stacking and reclaim operations. All dust collectors will be maintained at peak efficiency. The bulk-carrier ship emissions currently use residual oil fuels with a sulphur content of 2.7%. After August 1, 2012 vessels operating in the Project area must use residual oil with a sulphur content of 1.0% (Air Quality TDR). Beginning January 1, 2015, the sulphur content limit drops by 90% to 0.10%.

During the decommissioning phase, the removal of the potash handling infrastructure should result in few emissions other than exhaust from fossil-fuelled equipment and vehicles. Low sulphur fuels will be available.

7.3.2.3 Residual Effects

The residual effects associated with CAC emissions during the construction and decommissioning of the Project are predicted to be of low magnitude, largely site-specific, short-term, sporadic and reversible (see Table 7-11).

Similarly, the residual effects associated with Project operations are generally low in magnitude, local in scale, medium-term in duration, regular and reversible. Their temporal and geographic extent is limited. Except for PM_{10}, the dispersion simulations do not predict any exceedances of the applicable regulatory objectives, so no residual effects are expected. The PM_{10} exceedances will occur over the water, northwest of the berth.

7.3.2.4 Determination of Significance

Project effects include emissions of CACs during the construction, operations and decommissioning phases. These effects result from the operation of diesel-fired construction and decommissioning equipment, as well as marine vessels, dust collection and rail traffic associated with Project operations. The primary sources of Project SO_2 emissions are from marine vessel and locomotive traffic, while the primary source of the Project PM_{10} and $PM_{2.5}$ emissions are from potash handling.

The effects of individual substances emitted by the Project vary in magnitude from low to moderate. Most of these effects occur in the immediate vicinity of the ship loading area or on land immediately adjacent to the property line. As such, the effects are site-specific, short-term, sporadic and reversible. Residual Air Quality effects are predicted to be not significant (Table 7-11).

7.3.3 Change in Greenhouse Gases

A full analysis of project-related GHG emissions is conducted in Section 7.0 of the Air Quality TDR. The Air Quality TDR also considers effects of potential changes of climate on the Project, consistent with CEA Agency (2003) and other recent guidance (Environment Canada 2007). It is determined that the Project: 1) is a low emitter; 2) does not exceed jurisdictional policies; 3) does not exceed the industry profile; and, 4) will implement best practices.

With that perspective, the emissions of GHGs are not considered further in the environmental effects characterization and subsequent sections of this environmental assessment.

7.4 Combined Effects and Overall Significance Determination

Combined Project effects on Air Quality include CAC and GHG emissions. However, as noted above, it is not possible to attribute the potential effects of GHG emissions to any specific project, and as such, the significance of effects related to GHG emissions are not assessed.

Combined construction, commissioning and decommissioning effects of CAC emissions are site-specific and short-term. The combined effects from operations are local, medium-term, and continuous (Table 7-11). During operations, while moderate magnitude effects are expected to occur, their duration and geographic extent is limited. While PM_{10} predictions exceed the most stringent BC AAQO, it is not expected that these conditions will manifest in the ambient environment. Therefore, there are only low, occasionally moderate, magnitude Air Quality residual effects. It is also important to note that these effects will occur on the ocean northeast of the berth. There are no sensitive receptors in this area.

Table 7-11: Summary of Project Residual Environmental Effects on Air Quality

Potential Residual Environmental Effects	Proposed Mitigation Measures (see Notes below)	Residual Environmental Effects Characteristics						Significance	Prediction Confidence	Likelihood	Recommended Follow-up and Monitoring
		Direction	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological Context				
Effect #1: Change in CAC Emissions											
Construction and Commissioning	▪ Equipment maintenance ▪ Low sulphur fuel ▪ Dust suppressants ▪ Scheduling ▪ Minimize disturbance ▪ Preserve vegetation ▪ Erosion control structures ▪ Cover trucks ▪ Site paving	A	L	S	ST/S	R	D	N	H	M	None
Operations—Project Site		A	M/L	L	MT/R	R	D				
Operations—Rail Traffic		A	L	L	MT/R	R	D				
Decommissioning		A	L	S	ST/S	R	D				
Residual environmental effects for all Phases		A	L	L	MT/S	R	D				

NOTES:

1. **Equipment maintenance:** Follow equipment maintenance schedules.
2. **Low sulphur fuel:** Use low sulphur fuel for construction equipment.
3. **Dust suppressants:** Application of dust suppressants such as water to minimize the amount of fugitive dust.
4. **Scheduling:** Minimize activities that generate large quantities of dust during high winds.
5. **Minimize disturbance:** Minimize the area of activity
6. **Preserve vegetation:** Preserve natural vegetation where possible
7. **Erosion control structures:** Install erosion control structures such as silt fences and coffer dams
8. **Cover trucks:** Cover truckloads of materials which could generate dust, as necessary
9. **Site paving:** Paving of the site as soon as practicable

KEY

(SEE SECTION 7.1.4 FOR FURTHER DETAILS)

DIRECTION:

(A) *Adverse*

(P) *Positive*

(N) *Neutral*

MAGNITUDE:

(N) *Negligible*: No measurable adverse effect anticipated

(L) *Low*: Effect is detectable but within normal variability of baseline

M *Moderate*: Effect will cause an increase relative to baseline but is within regulatory limits and objectives.

(H) *High*: Effect will cause exceedances of objectives or standards beyond the Project boundaries (whether singly or as a substantial contribution in combination with other sources)

GEOGRAPHIC EXTENT:

(S) *Site-specific*: Environmental effects restricted to the Project footprint

(L) *Local*: Environmental effects extend beyond the Project footprint but remain localized within the LAA

(R) *Regional*: Environmental effects extend beyond the LAA

DURATION:

(ST) *Short-term*: Effects are measurable for <2 years.

(MT) *Medium-term*: Effects are measurable for 2 to 20 years.

(LT) *Long-term*: Effects are measurable for >20 years.

(P) *Permanent*: Effects are permanent.

FREQUENCY:

(O) Occurs *once*.

(S) Occurs *sporadically* at irregular intervals.

(R) Occurs on a *regular* basis and at regular intervals.

(C) *Continuous*

REVERSIBILITY:

(R) *Reversible*

(I) *Irreversible*

ECOLOGICAL CONTEXT:

(U) *Undisturbed*: Area relatively or not adversely affected by human activity.

(D) *Disturbed*: Area has been substantially previously disturbed by human development or human development is still present

SIGNIFICANCE:

(S) *Significant*

(N) *Not Significant*

PREDICTION CONFIDENCE:

Based on scientific information and statistical analysis, professional judgment and effectiveness of mitigation

(L) *Low* level of confidence

(M) *Moderate* level of confidence

(H) *High* level of confidence

LIKELIHOOD:

Based on professional judgment

(L) *Low* probability of occurrence

(M) *Medium* probability of occurrence

(H) *High* probability of occurrence

7.5 Cumulative Effects Assessment

7.5.1 Cumulative Effects Assessment Case Emissions

The CEA Case includes emissions from the proposed Project in combination with the regional emissions as well as emissions from future publicly disclosed projects. There are two publicly disclosed projects located within the assessment area: the ICEC Terminal Company Ltd. Sulphur Forming, Handling and Storage Facility and the Fairview II Project. Potential emissions from the China Paper Group Pulp Mill are not included in the Air Quality assessment due to the age of the infrastructure and the extended period of time the mill has been shut-down[3]. Both facts indicate that it is not economically feasible to restart the mill. The CEA Case emissions are presented in Section 4.4 of the Air Quality TDR.

7.5.2 CEA Case Modelling Results

Maximum predicted concentrations associated with the CEA emissions are presented in Table 7-12. Isopleth maps of the results are presented in Appendix B of the Air Quality TDR (Figures B-28 to B-36). For the CEA Case, nearly all of the maximum predicted ground-level concentrations of SO_2, NO_2, CO, PM_{10}, and $PM_{2.5}$ were below the regulatory objective. Only a small amount of the predicted concentrations are attributable to the Project. Exceptions occurred in the case of one-hour SO_2, where the predicted concentrations were virtually equal to the most stringent BC AAQO of 450 $\mu g\ m^{-3}$. A detailed assessment of the results is presented in Section 6.4 of the Air Quality TDR.

Table 7-12: Maximum Predicted Ground-level CAC Concentrations Associated with CEA Case

Substance	Averaging Period	Maximum Predicted Ground-Level Concentration ($\mu g\ m^{-3}$)	BC AAQO ($\mu g\ m^{-3}$)			NAAQO ($\mu g\ m^{-3}$)		
			Level A	Level B	Level C	Maximum Desirable	Maximum Acceptable	Maximum Tolerable
SO_2	1-hour	449	450	900	900–1,300	450	900	–
	3-hour	259	375	665	–	–	–	–
	24-hour	80.7	160	260	360	150	300	800
	Annual	8.48	25	50	80	30	60	–
NO_2	1-hour	175	–	–	–	–	400	1,000
	24-hour	128	–	–	–	–	200	300
	Annual	50.3	–	–	–	60	100	–
CO	1-hour	985	14,300	28,000	35,000	15,000	35,000	–
	8-hour	436	5,500	11,000	14,300	6,000	15,000	20,000

[3] Pers. Comm. 2007. Conversation between Peter D. Reid and Terry Bennett, re. China Paper Group.

Substance	Averaging Period	Maximum Predicted Ground-Level Concentration (µg m^{-3})	BC AAQO (µg m^{-3})			NAAQO (µg m^{-3})		
			Level A	Level B	Level C	Maximum Desirable	Maximum Acceptable	Maximum Tolerable
PM_{10}	24-hour	74.7	–	50	–	–	–	–
$PM_{2.5}$	24-hour [a]	21.8	25			30 (CWS)		
	Annual	2.63	8			–	–	–
VOCs	1-hour	168	–	–	–	–	–	–
	24-hour	35.7	–	–	–	–	–	–
	Annual	6.63	–	–	–	–	–	–

NOTE:
[a] 98th percentile value of 24-hour ground-level concentration.

7.5.3 Predictions at Sensitive Receptors

The CAC concentrations at sensitive receptors were determined for the CEA Case. Detailed results for each of the sensitive receptors are presented in Section 6.5 of the Air Quality TDR. The results at each of the receptors were well below the applicable regulatory standards for all contaminants and averaging periods. As expected, the maximum predicted concentrations at the sensitive receptors generally increase, but only incrementally so, when comparing the CEA Case predictions to the Baseline Case and Application Case predictions for SO_2, NO_2, CO, PM_{10}, $PM_{2.5}$ and VOCs.

7.5.4 Cumulative Effects Summary for Air Quality

Cumulative effects include emissions of CACs and GHGs from all existing and industrial sources and publicly disclosed projects in combination with the Project emissions. Potential effects of GHG emissions cannot be attributed to any specific project, and as such, the significance of their cumulative effects was not assessed. With respect to CACs, the CEA Case dispersion modelling results indicates that the addition of publicly disclosed projects in the assessment area do not have a substantial effect on maximum predicted concentrations. Also it is expected that the predictions are conservative. Therefore, combined cumulative effects on the Air Quality VEC are considered to be not significant.

7.6 Follow-up Program

The Project's primary Air Quality issue is related to PM, particularly PM_{10} and $PM_{2.5}$. Low to moderate concentrations may be experienced near the marine berth. However, it is believed that the predicted concentrations are conservative (i.e., are over-predictions). As a result no follow-up programs are recommended.

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8 NOISE AND VIBRATION ASSESSMENT

8.1 Scope of Assessment

The acoustic environment with respect to Noise and Vibration is considered a Valued Ecosystem Component (VEC) for the following reasons:

- If not properly managed, sound emissions in the form of noise (unwanted sound) from the Project may adversely affect ambient sound quality in the vicinity of the Project with potentially adverse consequences for a variety of human and ecological receptors.
- Vibration waves have the potential to interact with nearby structures causing structural vibration and/low frequency sounds. These effects have the potential to cause annoyance or, in extreme cases, property damage.

8.1.1 Regulatory/Policy Setting

In Canada, under the Federal Environmental Assessment process, Health Canada provides advice on a number of biophysical areas related to human health, including that of potential noise effects. There are no noise guidelines or regulations published or enforced under Health Canada and they encourage proponents to consult with provincial and municipal authorities to determine if any standards exist in locations of proposed Projects. Health Canada has developed *Draft Guidance on Noise Assessment for CEAA Projects* to aid in the preparation of environmental assessments (Health Canada 2005). The assessment of Noise and Vibration relies on the guidance published in this draft document and in Health Canada's *Useful Information for Environmental Assessments* (Health Canada 2010). These documents outline the assessment process that should be carried out when determining the potential noise exposure on human receptors located near a proposed project site. The suggested information outlined in the above referenced documents will be followed throughout this assessment.

The province of BC does not have any provincial noise standards, guidelines or regulations in force applicable to this Project. The BC Oil and Gas Commission has, however, published the *British Columbia Noise Control Best Practices Guideline* (March 2009), but these guidelines primarily apply to operations, production facilities and gas processing plants under the jurisdiction of the BC Oil and Gas Commission. The City of Prince Rupert maintains Noise Control Bylaw No. 2430 (1982), amended May 23, 1989, which regulates and prohibits the making or causing of noise, nuisance or sounds within the city of Prince Rupert. This bylaw generally states that:

> *No person shall make or cause, or allow or permit to be made or caused, any noise in or on any property which disturbs or tends to disturb the quiet, peace, rest enjoyment, comfort, or convenience of any person or persons in the neighbourhood or vicinity.*

Disturbing noise levels are not quantified. Construction or industrial work is allowed to occur between the hours of 7:00 am and 9:00 pm of the same day. A permit may be applied for where construction or other noise causing activities are expected to occur outside of this time frame.

In the assessment of rail vibration on neighbouring residents, there is one relevant criterion that can be used, ISO 2613: Evaluation of Human Exposure to Whole-body Vibration, Part 2. The ISO standard is based on research on human vibration perception and it considers the frequency-content of vibration (between 1 and 80 Hz) and allows for a correction factor for the number of events per day.

The ISO standard also gives consideration to the orientation of the person receiving the vibration impact (i.e., X/Y are horizontal and Z is vertical). However, in the case where the positioning can vary, a combined curve is recommended that incorporates the most restrictive criteria at each frequency for each direction. This combined curve follows the Z-direction assessment curve above 8 Hz, the X/Y—direction assessment curve below 2 Hz and between 2 Hz and 8 Hz it is interpolated between the two curves.

To illustrate the baseline vibration criteria, Figure 8-1 has been included. This figure shows the baseline (i.e., threshold of vibration perception) in the horizontal, vertical, and combined directions.

The baseline vibration assessment criteria detailed in the ISO standard are the threshold of human vibration perception. In order to apply these criteria to different scenarios, several adjustment factors are detailed in the standard. These adjustment factors are multiplied by the points of the baseline curve to derive the appropriate vibration criteria curves.

8.1.2 Key Issues

The two key issues underlying the assessment of Noise and Vibration are:

- Community annoyance
- Ecological disturbance.

Community annoyance is viewed by Health Canada as a potential impact on community health, hence their involvement in providing guidance on acceptable noise levels. Annoyance cannot be measured directly, but is estimated through other directly measurable quantities.

In addition to the public annoyance criterion of Health Canada, issues may include the disturbance of wildlife, particularly if there are seasonal sensitivities and breeding areas.

Activities associated with the Project may affect the acoustic environment in the following ways:

- Disturbance and/or annoyance at nearby receptors due to higher noise levels from the export terminal and increased rail traffic
- Disturbance and/or annoyance at nearby receptors due to Project construction/ decommissioning related activities
- Annoyance and/or structural damage due to vibration at nearby receptors from increased rail traffic.
- Annoyance and/or structural damage due to vibration from construction/decommissioning activities.

Vibration related to Project construction and operations on Ridley Island will likely not be an issue due to the distance to the closest receptor in Port Edward. Blasting, if required during the construction phase, will be designed to occur within regulation. As a result, vibration will be confined to the project footprint or a few 10s of meters from the rail corridor.

Sound is typically characterized in terms of the type, character, frequency, intensity, and duration of emissions. Since the human ear does not respond to sound on a linear scale, ambient sound pressure levels are characterized using a logarithmic decibel (dB) scale, with the A-weighted (dBA) scale being the most commonly used for environmental sound assessments. Measured parameters for environmental sound or noise are often expressed as an “equivalent sound level” (L_{eq}) that represents an equivalent energy level over a specified period of time (e.g., 1-hour, or 24-hours). The hourly L_{eq} is used to derive other metrics such as L_{50} as well as those advocated by Health Canada. For the assessment of community health impact, the day-night averaged sound level (L_{DN}) is used. L_{DN} is a 24-hour sound level in decibels that is obtained after applying 10 dB to sound levels during the night, 22:00 to 7:00. This nighttime increment, required in the L_{DN} calculation used by Health Canada, is based on the fact that people tend to be disturbed by noise more at night than during the day.

In accordance with the scope of the factors to be considered, this assessment considers the following direct and indirect potential environmental effects:

- Change in noise levels
- Change in vibration levels.

A summary of the potential environment effects resulting from Project-VEC interactions is presented in Table 8-1.

Routine maintenance was given a rank of ‘1’ in Table 8-1. The potential exists for these activities to result in an increase in sound levels, however, this increase will be periodic, temporary in nature and will not result in a significant adverse effect on the acoustic environment. As result, it was not carried forward into the assessment.

Table 8-1: Potential Environmental Effects to Noise and Vibration Associated with Project

Project Activities and Physical Works	Potential Effects on Noise and Vibration	
	Change in Noise Levels	Change in Vibration Levels
Construction and Commissioning		
Temporary Construction Infrastructure (trailers, power, sanitary facilities, etc.)	✓	
Site Preparation (Clearing and Grubbing, Site Grading)	✓	✓
Rail Loop Construction	✓	✓
Onshore Terminal Construction (receiving, storage, reclaim and shiploading facilities, site services)	✓	✓
69 kV transmission line Construction	✓	
Installation of Canpotex Rail Tracks	✓	
Access Road and Overpass Construction	✓	

Project Activities and Physical Works	Potential Effects on Noise and Vibration	
	Change in Noise Levels	Change in Vibration Levels
Dredging	✓	
Marine Facilities Construction (causeway, trestle and berth)	✓	✓
Commissioning	✓	
Operations		
Potash Handling Operations (receiving, storage, reclaim and shiploading of potash)	✓	✓
Arrival and Departure of Vessels	✓	
Arrival and Departure of Trains	✓	✓
Decommissioning (or Closure)		
Removal of Site Infrastructure (potash handling system/buildings)	✓	✓
Interaction of Other Projects and Activities in the Boundary for Assessment (potential for cumulative effects; see rankings below)		
Ridley Terminals Inc.	1	1
Prince Rupert Grain Ltd	1	1
Quickload Terminals Prince Rupert Container Examination Facility	1	1

NOTES:

Project Environmental Effects

Only Project – Environment interactions ranked as 2 in Table 3-4 are carried forward to this Table. A
✓ Indicates that an activity is likely to contribute to the environmental effect

Cumulative Environmental Effects

Cumulative environmental effects were ranked as follows:

0 = Project environmental effects do not act cumulatively with those of other projects and activities

1 = Project environmental effects act cumulatively with those of other projects and activities, but are unlikely to result in significant cumulative environmental effects **OR** Project environmental effects act cumulatively with existing significant levels of cumulative environmental effects but will not measurably change the state of the VEC

2 = Project environmental effects act cumulatively with those of other projects and activities, and may result in significant cumulative environmental effects **OR** Project environmental effects act cumulatively with existing significant levels of cumulative environmental effects and may measurably change the state of the VEC

8.1.3 Selection of Measurable Parameters

The measureable parameters that will be used to facilitate quantitative and qualitative measurement of potential effects on Noise and Vibration are listed in Table 8-2.

The fundamental measurement and prediction for noise level is the energy weighted average sound pressure level (L_{eq}) plus the derived day (L_d), night (L_n), combined metric (L_{DN}), and the computed percent highly annoyed (% HA). The most commonly used short-term (i.e., one hour) noise metric is the L_{eq}. In the Health Canada approach, the L_{eq} levels for the daytime and nighttime hours are computed and then a 10 dB increment is added to the nighttime level to reflect the greater sensitivity of the public to noise issues at night. The metric may also be adjusted to reflect other intrusive characteristics of the noise, such as tonality, or its impulsive nature. This adjusted value is then used to compute the % HA, which is used, in part, to assess the acceptability of the undertaking. For baseline readings, these can be measured and computed. For construction and operation, these can be estimated and modeled over distance.

Table 8-2: Measurable Parameters for Noise and Vibration

Environmental Effect	Measurable Parameter(s) for the Environmental Effect	Rationale for Selection of the Measureable Parameter
Change in Noise Levels	▪ Increases in sound levels (L_{eq} [dBA]) ▪ Changes to Day, Night and Day–Night Averaged Sound Levels (L_d, L_n, L_{DN}) ▪ Public Annoyance (% HA)	▪ Most widely used and understood measure of sound levels, directly comparable to metrics understood by the public ▪ Metrics used by Health Canada to estimate community annoyance to noise ▪ Derived metric of community annoyance
Change in Vibration	▪ Peak particle velocity (PPV)	▪ Used to determine vibration levels from construction/operation equipment

8.1.4 Characterization of Residual Effects

Terms that will be used to characterize residual effects are provided in Table 8-3.

Table 8-3: Characterization Criteria for Residual Effects of Noise and Vibration

Criterion	Description
Direction	**Positive:** condition is improving compared to baseline levels **Neutral:** no change compared to baseline levels **Adverse:** negative change compared to baseline levels
Magnitude	**Low:** effect is detectable but only on a few individuals **Moderate:** effect on many individuals **High:** effect occurs at the population level and exceeds the criterion level
Geographical Extent	**Site-specific:** limited to the Project footprint or rail corridor **Local:** limited to Ridley Island or within 1 km of the rail corridor up to Lorne Creek **Regional:** extending beyond Ridley Island or beyond 1 km of the rail corridor up to Lorne Creek
Frequency	**Once:** effect occurs once **Rarely:** effect occurs monthly **Frequently:** effect occurs daily
Duration	**Short-term:** measurable for less than one month **Medium-term:** measurable for more than one month but less than two years **Long-term:** measurable for more than two years or for the life of the Project

Criterion	Description
Reversibility	**Reversible:** effects will cease following the construction phase or during the operations phase of the Project **Irreversible:** effects will persist for the life of the Project, or longer
Ecological Context	**Undisturbed:** effect takes place within an area that is relatively or not adversely affected by human activity **Disturbed:** effect takes place within an area with human activity. Area has been substantially previously disturbed by human development or human development is still present

8.1.5 Standards or Thresholds for Determining Significance

For the purposes of this assessment, based on Health Canada's draft guidance document on noise assessments for CEAA Projects, a residual effect from noise is considered significant if it meets any of the following four conditions:

1. There is an increase in the percent highly annoyed by greater than 6.5% after mitigation has been applied.
2. The L_{DN} value for construction noise with mitigation exceeds 62 dBA.
3. For schools and pre-schools, sound levels exceed an indoor class time average of 40 dBA after mitigation has been applied.
4. For hospitals and seniors residences, sound levels exceed an indoor L_{eq} of 30 dBA, after mitigation has been applied.

A significant adverse effect due to vibration would be associated with intermittent levels that are high in magnitude, or persistent vibrations with medium-term duration that occur at sensitive receptor buildings.

8.2 Baseline Conditions

The baseline conditions in the local assessment area were assessed based on a combination of field measurement programs and acoustic modelling studies completed in support of other nearby projects.

Baseline measurements were previously conducted by Stantec as a component of preliminary environmental studies in the area. The baseline field measurements were completed over two phases. Phase 1 involved measuring instantaneous noise levels at various locations around Ridley Island and Port Edward, and Phase 2 consisted of a 40-hour noise assessment at one location, which was representative of the potential sensitive receptors in Port Edward. The results of the Phase 1 field investigation showed that Port Edward had an average L_{eq} of 42.9 dBA, the west coast of Ridley Island had an average L_{eq} of 51 dBA, the east coast of the island had a reading of 42.3 dBA and the northwest corner of the proposed Project footprint had a 45.5 dBA reading. The baseline monitoring results from Phase 2 monitoring, in Port Edward, indicated that during the daytime periods the average L_{eq} levels were about 51 dBA and overnight between 38 – 42 dBA. These values are consistent with the default values published by the BC Oil and Gas Commission for the daytime (50 dBA) and nighttime (40 dBA) periods. In this study, it has been conservatively assumed that baseline sound levels in Port Edward are 40 dBA at night and 50 dBA during the day.

8.3 Effects Assessment

8.3.1 Assessment Methods

This section summarizes the analytical methods used to assess the Project-related Noise and Vibration effects on the acoustic environment. The assessment was undertaken in consideration of all Project phases; however, details on decommissioning are not discussed in detail because the effects will be similar to those occurring during the construction phase.

Construction activities associated with the proposed terminal, access road, rail, utility corridor and marine facilities were broken down as follows:

- Site Preparation—Clearing and Hauling
- Site Preparation—Excavating and Hauling
- Site Preparation—Grading
- Land-based Construction
- Marine-based Construction.

Operations activities are associated with the proposed terminal, access road, rail, utility corridor and marine facilities.

This approach was considered appropriate given the relatively independent nature of these portions of the Project (i.e., construction and operation) and the difference in their scope.

This assessment relies on information published by the BC Oil and Gas Commission to characterize the ambient sound quality in rural areas such as the majority of the area surrounding the Project footprint. Background sound levels were therefore assumed to be 50 dBA during the day (7:00 – 22:00) and 40 dBA during the night (22:00 – 7:00), levels that confirm those found in the Phase I work under existing conditions, including rail traffic.

Potential noise sensitive receptors include residences, daycares, schools, hospitals, places of worship, nursing homes and First Nations and Inuit Communities (Health Canada 2009). The closest residents to the proposed Project footprint include those of Port Edward, located approximately 1 km east of the proposed Project footprint across Porpoise Harbour. The only sensitive receptor in Port Edward is Port Edward Elementary School. All other sensitive receptors are in Prince Rupert which is approximately 9.5 km north.

Estimates of sound emissions resulting from the operation of a representative use of clearing and construction equipment, which will be used during the construction of this Project, are presented and their corresponding sound power levels are provided. Predictions of representative sound levels resulting from each phase of the construction of the Project (as listed above) were then made using Cadna. Cadna (Version 4) is a recognized sound attenuation model and, is in full compliance with the predictive methods of ISO 9613-1 and ISO 9613-2. Cadna is well suited to situations involving complex topography on a scale of kilometres such as this, where the distance and relief between the Canpotex facility and Port Edward are important in noise attenuation. The rail noise specific model, STEAM is used for prediction of mainline rail traffic. STEAM is limited to distances of 500 m and less, and to rail speeds consistent with mainline traffic (Schroter, 1990).

Predictions of representative sound levels resulting from the Project operations are also made using Cadna. The occasional maintenance activities are discussed as contributing in a minor way to long-term average sound levels. The methodology advocated by Health Canada is employed to assess the likely long-term impact on community health.

The predicted sound levels at the noise sensitive areas (NSAs) were added to the background noise and then compared to typical noise guidelines. Where the predicted levels exceeded the guidelines, mitigation measures have been provided. In terms of this assessment, the closest resident to the Project footprint was located in Port Edward; this was used as the NSA.

As there are no noise guidelines or standards in the Province of British Columbia directly applicable to this Project, Health Canada's approach to noise assessments was adopted for guidance on this Project. Health Canada's draft guidance document on noise assessments for CEAA Projects provides two assessment methods for Projects that have construction periods less than one year in duration (construction for the present Project will be over a four year period but will consist of a number of construction periods). The first method assumes that if the L_{DN} value for construction noise with mitigation exceeds 62 dBA, then widespread complaints will be expected. In Health Canada's terminology, this is considered a "significant impact". The other method is based on calculating the percent highly annoyed (% HA) using the procedure published in ISO 1996-1:2003. If the % HA increases by 6.5% or more, including mitigation, compared to the baseline condition, then the impact is considered a significant effect. For the operations phase of the Project, the % HA should also be calculated using the same procedure for the baseline and the baseline plus operations conditions. If, after mitigation has been applied, the % HA increases by 6.5% or more, it should be considered a significant effect.

In terms of schools and pre-schools a significant effect during the construction and commissioning and operations phases of a Project, as per the Health Canada guidance, is one that after mitigation has been applied, exceeds an indoor class time average of 40 dBA. In terms of hospitals and seniors residences a significant effect is one that would exceed in an indoor L_{eq} of 30 dBA, after mitigation has been applied.

A summary of Health Canada's guidance to noise assessments, as described above, is provided in Table 8-4.

Table 8-4: Summary of Health Canada's Guidance to Assessing Noise under CEAA

Phase	Criterion	Limit	Period	Rationale	Reference
Construction (<1 year)	L_{DN}	<62 dBA	Day–Night	Likelihood of widespread complaints	US EPA as adopted by Health Canada
Construction (<year) and Operation	% HA	Δ<6.5%	Day–Night	Annoyance is deemed to be a community health impact.	Health Canada
Construction and Operation	SPL indoor at schools	L_{eq} <40 dBA	Class time	Maintenance of 100% speech intelligibility indoors.	Health Canada
Construction and Operation	L_{eq} and L_{max} indoors at schools, hospitals, senior residences	L_{eq} <30 dBA; Fewer than 10 – 15 exceedances of 45 dBA	Night	Sleep interruption	WHO as adopted by Health Canada

8.3.2 Change in Noise Levels

8.3.2.1 Potential Effects

Construction and Commissioning

Construction activities that will result in temporary increased noise levels in the LAA are detailed in Table 8-5. To estimate the additive increase in noise levels to the village of Port Edward, sound pressure level modelling was completed. As not all construction activities occur simultaneously, modelling was conducted for five different phases of construction, to ensure representative predictions. Modelling was done using Cadna, as described in Section 8.3.1. CadnaA (Computer Aided Noise Abatement) version 4.0 is a computer program capable of predicting sound levels at specified receiver positions originating from a variety of sound sources. Applicable national standards, such as ISO 9613, are also included in the analysis.

CadnaA can also account for such factors as:

- Distance attenuation (i.e., geometrical dispersion of sound with distance)
- Atmospheric attenuation (i.e., the rate of sound absorption by atmospheric gases in the air between sound sources and receptors)
- Ground attenuation (i.e., effect of sound absorption by the ground as sound passes over various terrain and vegetation types between source and receptor)
- Screening effects of surrounding terrain
- Meteorological conditions and effects.

The construction phases that were modelled, the type and quantities of equipment in use and typical sound emissions from the equipment are presented in Table 8-5.

Table 8-5: Construction Phases, Equipment and Quantities

Construction Phase	Equipment Type	Maximum Number of Units	Sound Power Levels (dBA)
Site Preparation—Clearing and Hauling	Skidder	1	117
	Dozer	17	117
	Brush Cutter	1	116
	Dump Truck	2	116
	P/U Truck	17	87
	Excavator	28	117
	Haul Trucks	40	116
	Medic Truck	1	100
	Drill Rig	6	112
	Fuel Truck	1	100
	Service Truck	1	100
	Lube Truck	1	100
	Bus	1	100
Site Preparation—Excavating and Hauling	Dozer	20	117
	Excavator	30	117
	Loader	2	112
	Dump Truck (20 m^3)	16	116
	Track Drill	2	117
	P/U Truck	19	87
	Haul Truck	40	116
	Fuel Truck	1	100
	Service Truck	1	100
	Bus	1	100
	Medic Truck	1	100
	Drill Rig	6	112
Site Preparation—Grading	Dozer	19	117
	Grader	2	117
	Dump Truck (10 m^3)	7	116
	Dump Truck (20 m_3)	8	116
	Compactor	2	112
	Water Truck	1	116
	Loader	2	112
	Crushing Plant	1	107

Construction Phase	Equipment Type	Maximum Number of Units	Sound Power Levels (dBA)
	P/U Truck	19	87
	Excavator	28	117
	Haul Truck	40	116
	Drill Rig	6	112
	Fuel Truck	1	100
	Service Truck	1	100
	Lube Truck	1	100
	Bus	1	100
	Medic Unit	1	100
Land-based Construction	Dump Truck (29 tonne)	5	116
	Front End Loader	2	112
	Large Crane (100 tonne)	1	112
	Medium Crane (22 tonne)	2	112
	Rail Alignment Rig	1	116
	Backhoe (8 tonne)	2	112
	Tractor	2	116
	Welding Trucks	4	106
	Garbage Trucks	2	99
	Hydrovac Trucks	1	117
	Drill Rig (12.5 tonne)	7	112
	Grader (25 tonne)	2	117
	Compactor (225 kg)	3	112
	Roller	1	112
	Forklift	6	112
	Aerial Work Platforms	4	112
	Boom Truck	2	112
Marine-based Construction	Large Crane (100 tonne)	1	112
	Medium Crane (22 tonne)	2	112
	Tug Boat (1000 hp)	1	110
	Drill Rig (12.5 tonnes)	1	112
	Dredge (2461 tonne)	1	118
	Vibro-hammer Excavator (17 tonne)	1	133

The modelling conducted assumes that construction activities for the road, rail and utility corridor are conducted during daylight hours only, 14 hours per day (7:00 am to 9:00 pm). Construction activities for the terminal will also primarily occur between 7:00 am and 9:00 pm. However, there may be instances where construction will be required during the night (i.e., between 9:00 pm and 7:00 am). To account for this possibility the modelling conducted assumes construction at the terminal will occur twenty four hours a day except for blasting, which would only occur during daylight hours. The blasting will be of the order of 1.5 km from Port Edward. Under the direction of qualified blasting professionals, the impact may be an audible rumble a few times during the daylight hours for a relatively short period. A 100% duty cycle was also assumed for each piece of equipment when in operation during each construction phase and it was assumed that each piece of equipment will be operating at nominal full load. In reality it is unlikely that the individual pieces of construction equipment will be operating continuously and simultaneously with all other pieces of equipment or at maximum power levels for extended periods. Due to these assumptions the modelling results presented below are conservative and are likely an overestimate of what will actually be experienced during each construction phase of the Project.

The background sound pressure levels, the maximum predicted sound pressure levels, and the background plus predicted sound pressure levels during the day and night, for each phase of construction at the closest receptor in Port Edward are presented in Table 8-6.

Table 8-6: Background and Predicted Sound Pressure Levels in Port Edward during Construction of the Project, Day and Night

Construction Activity	Existing Background 1-hour L_{eq} (dBA)		Predicted 1-hour L_{eq} (dBA)		Background + Predicted 1-hour L_{eq} (dBA)	
	Day	Night	Day	Night[a]	Day	Night
Site Preparation—Clearing and Hauling	50	40	61	41	61	44
Site Preparation—Excavating and Hauling	50	40	61	41	61	44
Site Preparation—Grading	50	40	61	49	61	50
Land-based Construction	50	40	53	45	55	46
Marine-based Construction	50	40	45	45	51	46

NOTE:
[a] There is no predicted night time noise as there no construction during the night.

The L_{DN} and %HA for each phase of construction at the closest receptor in Port Edward and for the existing background condition compared with the proposed Health Canada guidelines are presented in Table 8-7.

Table 8-7: Average Day Night Sound Level and % HA during Construction of the Project

Construction Activity	L_{DN} (dBA)	% HA	Change in % HA from Background	Health Canada % HA Guideline
Background	50	2.19	–	–
Site Preparation—Clearing and Hauling	59	7.00	4.81	6.5
Site Preparation—Excavating and Hauling	59	7.00	4.81	6.5
Site Preparation—Grading	60	8.18	5.99	6.5
Land-based Construction	55	4.29	2.1	6.5
Marine-based Construction	54	3.43	1.24	6.5

The predicted results for the construction of the Project at the closest receptor in Port Edward were within the Health Canada guidance: a change of less than 6.5% highly annoyed and less than 62 dBA L_{DN}. The criteria for schools and health facilities were also met.

Operations

The major activities associated with the operations phase of the Project are:

- Receiving and unloading potash from unit trains to the storage building or directly to the ship (e.g., conveyor, rail and road noise)
- Arrival and departure of vessels from the berth (e.g., vessel noise)
- Arrival and departure of trains.

Potash will be delivered to the Project site via rail and will be dumped from the hopper rail cars onto a conveyor system and conveyed to either the storage building or to a vessel. Noise will be emitted from the operation of both mobile (rail cars, vehicles, vessels) and stationary (conveyors, drive motors, transformers, dust control systems) sources. Shunting noises will be minimized because dumping will occur while trains are at a slow roll. The only times that the trains will come to a complete stop are when the trains arrive (i.e., to swap CN crew for Canpotex crew) and prior to trains departing.

The main potential sources of sound from the rail line are the two large trains, on average, arriving and departing daily. These have been analyzed separately using Cadna to determine their potential impact at Port Edward, the nearest site with residential and sensitive receivers.

A perimeter road will provide access along the rail line, and will be used by employees and other occasional visitors, such as service vehicles, to the Canpotex site. The number of vehicles is estimated to be low, and will be well buffered from Port Edward by the separation distance; therefore, the potential sound impacts are assessed to be not significant, and are screened out from further analysis.

Ships are also mobile sources during approach and docking maneuvers; however, the separation distance between ships on approach and the town is so large that the incidental sounds are assessed to be not significant, and are screened out of further assessment. Ships are also included as a stationary source of sound of the terminal, discussed later.

There are numerous motors used to drive the conveyor belts for the unloading, storage, reclaiming and loading processes at the terminal. An inventory of these sources was made, and equivalent sound sources were used in the sound propagation model to estimate the impacts. The inventory comprised 28 drive motors/conveyors.

Large transformers are located on the south side of the storage conveyor system. These were represented in the noise model by two sources.

Two dust control systems will also be in use, and will be composed of fans and electric motors. These are represented by sound sources in the propagation model.

To estimate the predicted noise levels in the Village of Port Edward as a result of the operation of the Project sound pressure level monitoring was conducted using CadnaA, as described in Section 8.3.1. Two different operating scenarios were modelled and included the following:

- Rail noise on Ridley Island
- Noise from the conveyor system, dust control systems and the transformers.

The noise sources related to the operation of the conveyor system, dust control systems and the transformers were based on the preliminary engineering design. A total of 28 electric motors are in operation associated with the unloading, storage, reclamation and loading conveyors. These were assigned a sound power level of 85.5 dBA, based on in-house library of measurements on a similar facility (chemical unloading). There are also two dust collectors that will have motors and fan noise. They were assigned sound power levels of 100 dBA. On the south side of the conveyor there are two transformers, each of which were assigned sound power levels of 105 dBA. Finally, it was assumed that two ships are present at the loading facility, and that the combination of hotelling (i.e., at dock with a baseload of power) engine emissions and miscellaneous equipment sounds contributed to a sound power level of 106 dBA from each ship. These operational sources were included in Cadna. The receptors of concern in Port Edward are shielded in part by the topography of Ridley Island. Terrain heights were included in the model, and sound sources located at the heights indicated on the engineering design. Sources in the storage building were located relative to existing grade, although the final grade, subject to geotechnical design, will be up to 10 m lower, offering significant additional shielding.

The sound levels during operations are shown on Figure 8-2, which also indicates the location of the sources in the model. This figure does not include the occasional sounds of the railway, discussed separately in the following. The sound levels assume continuous operation of all sources discussed in the previous paragraph. This is likely to be a conservative estimate (i.e., overestimate) of the actual noise during operations. The dominant sources of sound in Port Edward are that of the rail traffic.

The background sound pressure levels, the maximum predicted sound pressure levels and the background plus predicted sound pressure levels during the day and night at the closest receptor in

Port Edward during the operation of the Project (rail noise plus conveyor, dust control, transformer, and ship noise) are presented in Table 8-8.

Table 8-8: Background and Predicted Sound Pressure Levels in Port Edward during Operation of the Project, Day and Night

Construction Activity	Existing Background 1-hour L_{eq} (dBA)		Predicted 1-hour L_{eq} (dBA)		Background + Predicted 1-hour L_{eq} (dBA)	
	Day	Night	Day	Night	Day	Night
Operation	50	40	37	37	50	42

The L_{DN} and % HA for the operations phase of the Project at the closest receptor in Port Edward, compared with the proposed Health Canada % HA guidelines are presented in Table 8-9.

Table 8-9: Average Day/Night Sound Level and % HA during Operation of the Project

Construction Activity	L_{DN} (dBA)	% HA	Health Canada % HA Guideline
Operation	51	2.5	6.5

The predicted results for the operations phase of the Project at the closest receptor in Port Edward was within the Health Canada guidance of less than 6.5% highly annoyed and less than 62 dBA L_{DN}, and met the guidance criteria for schools and health facilities as well as residences.

The sound levels for the railway operations were based on a combination of calculations and observations by Stantec staff. The portion of the rail loop that has the potential to affect the citizens of Port Edward is on the east side of the island, where incoming trains are moving slowly on approach. Estimates from the design team are for one hour approaches for trains comprising 174 rail cars, thus approximately 3 km in length. An average of two trains per day arrives, and two leave. Miller (1981) summarizes a number of research studies and those methods estimate the sound level from slow (10 km/hr) freight cars to be about 56 dBA at 30 m, corresponding to a sound power level of 80 dBA/m for a line source. The trains arriving at Canpotex will slow to about 3 km/hr on the west side; it is assumed conservatively that the speed on the east side will be 10 km/hr. Additionally, there can be three locomotives on the train, each with a sound power level in the range of 120 dBA, sufficient to raise the sound pressure level to 80 dBA at 30 m. Using these estimated sound power levels and speed for the east side of the island, and assuming two trains per day, maximum, hourly, and daily sound levels have been estimated using Cadna. The maximum level due to the locomotives will be approximately 56 dBA at the school and residential areas nearest the southeast turn of the railway for the brief period when the locomotives are directly opposite the town; the passage of the hopper cars will generate sound levels of the order of 36 dBA in these locations for the 20 to 30 minutes that the train takes to pass this point. Given the quiet nature of the town, these levels are likely to be noticeable, but not disturbing.

In addition to the engine and rolling noise of the trains, there will be intermittent noises and whistle calls. Intermittent noises occur during the approach and stop of the train, and during the departure.

The sounds are also confined to the arrivals and departures of two trains per day, therefore likely to provide limited disturbance. Because the unloading process will not involve starting and stopping the train, sounds associated with shunting will not occur during dumping. These arise from a variety of sources, mainly the take-up of the coupling mechanisms between cars. The trains are destined for the western side of the island, and most of these sounds will be emitted there, lessening their impact on Port Edward. Train whistling noise is required at all at-grade crossings where anti-whistling has not been put into effect. This is a safety measure regulated by Transport Canada under the *Railway Safety Act*. The number of grade crossings associated with the rail corridor will be limited to one or two and will be for emergency use only. These will be designated private crossings and it is anticipated that whistling will not be required. Due to the limited number of crossings and because there will be only two train arrivals and departures each day it is predicted that intermittent noises will not be a significant impact. The mainline train noise was assessed separately from the operational noise on Ridley Island. The methods used were developed and applied in the Environmental Impact Statement for the Fairview Terminal Phase II Expansion Project (Stantec, 2009). The model for Canpotex is based directly on the findings of that study with the addition of the Canpotex traffic and increased traffic due to the expanded activities at the Ridley Terminals (RTI) facility on Ridley Island.

Table 8-10 lists the rail traffic estimates based on the Fairview EIS (Stantec 2009), as updated by CN staff for the Canpotex project. Note that the traffic for Fairview is predominantly in the night, passenger traffic is in the day, and the RTI and Canpotex traffic is assumed to be distributed evenly around 24 hours. The train speeds listed are conservative as the maximum train speed at each of the communities is between 35 mph and 50 mph.

Table 8-10: Rail Traffic Volume for Noise Model

Scenario Number	Train Type	Trains Day	Trains Night	D/N Split	Locos	Cars	Speed
1	Baseline Freight	2.1	6.3	25/75	2	150	80
	Baseline Passenger	0.8	0	100/0	1	7	100
2	Baseline Freight	2.1	6.3	25/75	2	150	80
	Baseline Passenger	0.8	0	100/0	1	7	100
	Canpotex Freight	2.5	1.5	62.5/37.5	4	174	80
3	Baseline Freight	2.1	6.3	25/75	2	150	80
	Baseline Passenger	0.8	0	100/0	1	7	100
	Fairview Freight	1.1	3.2	25/75	2	150	80
	RTI Freight	5	3	62.5/37.5	4	140	80
4	Baseline Freight	2.1	6.3	25/75	2	150	80
	Baseline Passenger	0.8	0	100/0	1	7	100
	Fairview Freight	1.1	3.2	25/75	2	150	80
	RTI Freight	5	3	62.5/37.5	4	140	80
	Canpotex Freight	2.5	1.5	62.5/37.5	4	174	80

In the Fairview EIS, a number of receptors were selected to be representative of residences along the mainline. For consistency, these receptors and their identification numbers are retained here, and are listed with coordinates in Table 8-11. Receptors that were influenced by Fairview, but not by Canpotex are excluded from this list.

Table 8-11: Critical Receptors used in Assessment

Receptor ID	UTM Coordinates (m)		Approximate Distance from Study Area Rail Line to Receptor (m)
	X	Y	
R1-1	412014	6017492	1162
R1-2	412028	6017633	1038
R1-3	412525	6017086	970
R1-4	410582	6014608	960
R2-1	415714	6009023	29
R2-2	415851	6008755	81
R2-3	416064	6008537	190
R3-1	505355	6029180	63
R3-2	506588	6029088	65
R3-3	514613	6035050	30
R3-4	516740	6037052	175
R3-5	518258	6038634	81
R4-1	521166	6041651	90
R4-2	525193	6041170	165
R4-3	525701	6041019	91
R4-4	527682	6040851	33
R5-1	530328	6043512	200
R5-2	531765	6043870	42
R5-3	534782	6046208	123
R5-4	536820	6047420	550

The sound levels were predicted using STEAM for both day and night time periods. These results were combined to estimate the L_{DN}, and L_{DN} was used to estimate the %HA metric preferred by Health Canada. These results are summarized in Table 8-12. The calculations are grouped here for convenience. The Baseline set represents the levels estimated from existing traffic on the mainline. The second set represents the Project Case; that is, the level due to existing levels plus the Canpotex traffic. The third set is the future case with Baseline plus the planned expansions of RTI and Fairview terminals. Finally, the fourth set represents the third set plus the Canpotex traffic.

Table 8-12: Summary of Predicted Modelling Results

	Scenario 1					Scenario 2					Scenario 3					Scenario 4				
	Baseline					Baseline + Canpotex (2.5 day, 1.5 night)					Baseline + Fairview (1.1 day, 3.2 night) + RTI (5 day, 3 night)					Baseline + Canpotex (2.5 day, 1.5 night) + Fairview (1.1 day, 3.2 night) + RTI (5 day, 3 night)				
	24 hr	15 hr	9 hr	DNL	% HA	24 hr	15 hr	9 hr	DNL	% HA	24 hr	15 hr	9 hr	DNL	% HA	24 hr	15 hr	9 hr	DNL	% HA
R2-1	68	64	71	77	45	70	67	72	78	47.5	71	69	74	80	53.4	72	70	74	80	54.8
R2-2	62	57	65	71	25.2	63	60	65	71	27.1	64	61	67	73	32	65	63	68	74	33.2
R2-3	51	46	54	60	7.7	52	49	55	61	8.4	59	56	62	67	18.4	59	57	62	68	19.2
R3-1	63	59	66	72	29.5	64	61	67	73	31.6	66	63	69	75	36.9	67	64	69	75	38.2
R3-2	58	54	61	67	17.4	59	56	62	68	18.9	66	63	69	75	36.3	67	64	69	75	37.6
R3-3	68	64	71	77	44.3	69	67	72	78	46.7	71	68	74	80	52.6	72	69	74	80	54.1
R3-4	56	52	60	66	14.8	58	54	60	66	16	59	56	62	68	19.5	60	57	63	68	20.4
R3-5	62	57	65	71	25.2	63	60	65	71	27.1	64	61	67	73	32	65	63	68	74	33.2
R4-1	61	56	64	70	23.5	62	59	65	71	25.3	64	61	66	72	30	64	62	67	73	31.3
R4-2	52	47	55	61	8.6	53	50	56	62	9.4	60	56	62	68	20.3	60	58	63	69	21.2
R4-3	58	54	61	67	17	60	57	62	68	19.7	64	61	66	72	29.8	64	62	67	73	31.1
R4-4	67	63	71	76	42.2	69	66	71	77	44.7	70	68	73	79	50.6	71	69	73	79	52
R5-1	51	46	54	60	7.4	52	48	54	60	8.1	58	55	61	67	17.7	59	56	62	68	18.6
R5-2	61	57	64	70	23.5	62	59	65	71	25.3	69	66	71	77	45.4	70	67	72	78	46.8
R5-3	54	49	57	63	10.8	55	52	58	64	11.8	62	59	64	70	24.7	62	60	65	71	25.8
R5-4	53	49	56	62	9.3	54	51	56	62	10.1	61	58	63	69	21.6	61	59	63	69	22.5

The computation of the change in %HA is summarized in Table 8-13. The project case shows the effect of Canpotex on the current baseline. The future case shows the effect of Canpotex on the cumulative future case.

Table 8-13: Change in Percent Highly Annoyed (% HA)

Receptor	Change in % HA (2-1: Canpotex over Baseline)	Change in % HA (4-3: Canpotex over Baseline plus Planned Development)
R2-1	2.5	1.4
R2-2	1.9	1.2
R2-3	0.7	0.8
R3-1	2.1	1.3
R3-2	1.5	1.3
R3-3	2.4	1.5
R3-4	1.2	0.9
R3-5	1.9	1.2
R4-1	1.8	1.3
R4-2	0.8	0.9
R4-3	2.7	1.3
R4-4	2.5	1.4
R5-1	0.7	0.9
R5-2	1.8	1.4
R5-3	1	1.1
R5-4	0.8	0.9

For all receptors, the change due to the increase provided by Canpotex will be within the criterion of 6.5% set by Health Canada.

Decommissioning

The decommissioning of this Project is expected to create noise effects similar to that of the Project Construction phase. Not accounting for other developments in the area, the acoustic environment is expected to return to pre-Project conditions after decommissioning ends.

8.3.2.2 Mitigation

Even though the results of this assessment did not exceed the Health Canada guidance, a combination of mitigation measures are recommended, particularly when within 1 km of residences (i.e., during construction of the rail line just northwest of Zinardi rapids) and Port Edward Elementary School to be sure that the more stringent Health Canada limits are met inside these facilities. These measures should be incorporated into construction contractual documents and should include, but not be limited to, the following:

- Avoid construction along the east side of Ridley Island during night-time hours and on weekends were practicable.
- Nearby residents will be advised of significant noise-causing activities and these will be scheduled to create the least disruption to receptors. If noise complaints related to rail and truck traffic occur, they will be logged and investigated to assess whether they are linked to Project activities.
- Application of standard best management practices such as well-maintained equipment and internal combustion engines fitted with appropriate muffler systems.
- If possible, the rail loop should be continuously welded rail to avoid additional noise from jointed rail.
- Near sensitive receptors the number of pieces of construction equipment operating simultaneously and engine speed will be reduced where practical.
- A communication and complaint documentation and resolution plan will be developed.
- Construction equipment will be strategically placed such that high noise producing equipment (as presented in Table 8-5) is further away from nearby residents where possible.

Although the rail operations will meet applicable noise criteria, particular attention will be paid to mitigation opportunities at construction site located opposite the town.

The following additional measures will also be implemented during operation of the Project:

- Standard best management practices (e.g. internal combustion engines, quality mufflers and vehicle maintenance)
- Rail lubricators may be advisable where wheel squeal is problematic where sharp track curves occur
- All equipment and vehicles shall have quality mufflers and shall be well maintained
- Proper maintenance of conveyor components.

8.3.2.3 Residual Effects

After the incorporation of the above-listed mitigation measures, the sound pressure levels during construction at Port Edward are unlikely to cause more than brief annoyance during moments of particularly intensive activity. Frequent (i.e., multiple daily occurrences) or sustained (i.e., periods of hours) exceedances are not anticipated because construction activities near Port Edward will be limited to daytime where practical and equipment will be transient and thus not cause elevated noise levels at a stationary receptor for prolonged periods of time.

During operations, the resulting sound pressure levels at the Village of Port Edward will contain a contribution on the order of 24 to 26 dBA due to Project activities. This level is likely to be lower than the background sound levels, and may not be perceptible most of the time by residents of the town due to other background sounds. Closest residents may occasionally perceive the operational sounds, and will see and hear the train passages.

8.3.2.4 Determination of Significance

The effects of Project construction on the acoustic environment are predicted to be as follows:

- Low in magnitude
- Local in geographical extent
- Rare in frequency
- Medium-term in duration
- Reversible.

The effects of Project operations on the acoustic environment are predicted to be as follows:

- Low in magnitude
- Local in geographical extent
- Rare in frequency
- Long-term in duration
- Reversible.

Therefore, significant adverse residual effects on the acoustic environment as a result of changes in noise levels at nearby receptors due to Project activities are not considered likely (see Table 8-11).

8.3.3 Change in Vibration Levels

8.3.3.1 Potential Effects

Construction

Construction vibration is caused as a result of the operation of various pieces of construction equipment and includes activities such as blasting and impact pile driving. The operation of such construction equipment causes ground vibrations which spread throughout the ground and diminish with distance. One of the main concerns when it comes to potential effects from vibration is damage to structures and therefore construction vibration is assessed in terms of peak particle velocity (PPV). The vibration source levels for some typical pieces of construction equipped are presented in Table 8-14.

Table 8-14: Typical Vibration Source Levels

Construction Equipment	PPV at 25 ft (in/sec)
Pile Driver (impact)	0.644
Pile Driver (sonic)	0.17
Clam Shovel drop	0.202
Large bulldozer	0.089
Caisson drilling	0.089

Construction Equipment	PPV at 25 ft (in/sec)
Loaded trucks	0.076
Jackhammer	0.035
Small bulldozer	0.003

REFERENCE: US Department of Transportation 1998

A generic model of construction vibration has been completed by Wiss (1981), and can be used to assess construction vibration as a function of distance from the construction equipment. This model is illustrated in Figure 8-3 and is based on the PPV of various pieces of construction equipment.

As illustrated in Figure 8-3, the PPV of typical construction equipment tends to be diminished at a distance of less than 1 km from the source. Given that that there are no noise sensitive areas located less than 1 km from the Project site, the vibration related to the construction of the Project is expected to be not significant.

Operation

The potential vibration as a result of the operation of the Project will result primarily from the increase in rail traffic. Rail vibration is generated by the dynamic interaction between a train's wheels and its supporting rail. Locally, it is influenced by factors such as train speed, train weight, wheel roughness, rail roughness, and the rail support structure. As the vibration waves propagate away from the rail line factors such as soil properties (density, stiffness, layering, water content, and temperature) and the location of bedrock influence the propagation of the various wave types. Once the vibration waves reach a neighbouring home or other structure they interact with the structure and transmit throughout. This potentially can generate perceptible vibration in the structure, cause rattling of objects hanging from the structure, and/or generate low-frequency sound (i.e., ground-borne sound). All of these different types of impact have the potential to cause annoyance, or in extreme cases, damage.

Project activities will result in an increase in the frequency of vibration events but will not result in an increase in vibration levels. According to the US Department of Transportation the RMS velocity level of a locomotive powered freight train at a distance corresponding to that of the residences would have diminished to levels that would meet the criteria discussed in Section 8.1.1 for human perception or structural effects (US DOT 2006).

Decommissioning

The decommissioning of this Project is expected to create vibration effects similar to that of the Project construction phase. Not accounting for other developments in the area, the acoustic environment is expected to return to pre-Project conditions after decommissioning ends.

8.3.3.2 Mitigation

Vibration is not predicted to have an adverse effect at any nearby receptors during Project construction or operation, therefore specific mitigation measures for vibration are not considered to be necessary. However, it is likely that mitigation measures described above for noise will also reduce vibration effects.

8.3.3.3 Residual Effects

Due to the distance from the Project activities to the nearby receptors located in Port Edward, residual effects on the acoustic environment as a result of changes in vibration levels are not considered likely.

8.3.3.4 Determination of Significance

The effects on the environment of vibration from Project related construction and decommissioning activities are predicted to be as follows:

- Low in magnitude
- Local in geographical extent
- Frequency is frequently
- Medium-term in duration
- Reversible.

The effects on the environment of vibration from Project operations are predicted to be as follows:

- Low in magnitude
- Local in geographical extent
- Frequency is frequently
- Long-term in duration
- Reversible.

Therefore significant adverse residual effects of Project-induced vibration on the environment as a result of changes in vibration levels due to the construction, operation and decommissioning of the Project are not considered likely.

8.4 Combined Effects and Overall Significance Determination

The Project Area is currently subject to terminal and rail activities and associated noise and vibration. The proposed Project will temporarily contribute construction noise and vibration and longer term noise and vibration due to the operation of the Project. This assessment however, indicates that there were no predicted exceedances of the noise and vibration criteria. A communication and complaint documentation and resolution plan will be developed to ensure that Project-related noise does not create nuisance for nearby receptors in Port Edward. No mitigation is suggested or is necessary for the effects of vibration. In conclusion, residual effects of the Project on the acoustic environment are predicted to be not significant (see Table 8-11).

Table 8-15: Summary of Project Residual Environmental Effects on Noise and Vibration

Potential Residual Environmental Effects	Proposed Mitigation Measures	Residual Environmental Effects Characteristics: Adverse or Positive Effect	Magnitude	Geographic Extent	Duration/ Frequency	Reversibility	Environmental Context	Significance	Prediction Confidence	Likelihood	Recommended Follow-up and Monitoring
Effect #1: Noise Effects											
Construction and Commissioning	▪ Avoid night-time and weekend construction activities along the east side of Ridley Island where possible ▪ Use welded track if practical ▪ Maintain mufflers on internal combustion engines ▪ Near sensitive receptors, reduce number of construction equipment in operation simultaneously ▪ Proper maintenance of conveyors	A	M	L	ST/S	R	U	N	H	H	Complaint driven resolution plan
Operation		A	L	L	LT/R	R	U				
Decommissioning		A	M	L	ST/S	R	U				
Residual environmental effects for all Phases		A	L	L	LT/R	R	U				
Effect #2: Vibration Effects											
Construction and Commissioning	Vibration effects at nearby receptors have not been predicted, however the mitigation measures identified for noise will also reduce vibration effects	A	L	S	ST/S	R	U	N	H	H	
Operation		A	L	S	LT/S	R	U				
Decommissioning		A	L	S	ST/S	R	U				
Residual environmental effects for all Phases		A	L	S	LT/S	R	U				

KEY

MAGNITUDE: **(L)** *Low*: Minimal or no impairment of a valued wildlife species' reproductive capacity, survival or habitat suitability. **(M)** *Moderate*: Measureable change in reproductive capacity, survival or habitat suitability over the short and medium-term; however, recovery is expected to pre-Project conditions. **(H)** *High*: Serious impairment to productivity or habitat suitability of any valued wildlife species.	**GEOGRAPHIC EXTENT:** **(S)** *Site-specific*: Environmental effects restricted to the Project site (i.e., Project footprint). **(L)** *Local*: Environmental effects extend beyond the Project footprint but remain localized within the Local Assessment Area. **(R)** *Regional*: Environmental effects extend to the watershed/regional level. **DURATION:** **(ST)** *Short-term*: Effects are measurable for <2 years. **(MT)** *Medium-term*: Effects are measurable for 2 to 20 years. **(LT)** *Long-term*: Effects are measurable for >20 years. **(P)** *Permanent*: Effects are permanent.	**FREQUENCY:** **(O)** Occurs *once*. **(S)** Occurs *sporadically* at irregular intervals. **(R)** Occurs on a *regular* basis and at regular intervals. **(C)** *Continuous*. **REVERSIBILITY:** **(R)** *Reversible* **(I)** *Irreversible* **PREDICTION CONFIDENCE:** Based on scientific information and statistical analysis, professional judgment and effectiveness of mitigation **(L)** *Low* level of confidence **(M)** *Moderate* level of confidence **(H)** *High* level of confidence	**ECOLOGICAL CONTEXT:** **(U)** *Undisturbed*: Area relatively or not adversely affected by human activity. **(D)** *Developed*: Area has been substantially previously disturbed by human development or human development is still present **(N/A)** *Not Applicable* **SIGNIFICANCE:** **(S)** *Significant* **(N)** *Not Significant* **LIKELIHOOD:** Based on professional judgment **(L)** *Low* probability of occurrence **(M)** *Medium* probability of occurrence **(H)** *High* probability of occurrence

8.5 Cumulative Effects Assessment

Noise and vibration from Project construction and operation is expected to overlap with Noise and Vibration from the existing terminals and rail lines on Ridley Island to cause cumulative effects for nearby receptors. The effects from these existing facilities have been previously assessed and are not considered to be significant. Cumulative effects between the Project and other large scale existing or planned noise or vibration generating activities within the assessment area have been analyzed and shown to not be significant. Details are shown in Section 8.3.2.

8.6 Follow-up Program

Should complaints of excessive noise be received during construction or operations, the root cause of these complaints should be determined, and corrective action will be taken as warranted. In the event of complaints, ambient monitoring of noise may be conducted if required to identify the source or extent of such problems.

8.7 References

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8.8 Figures

Please see the following pages.

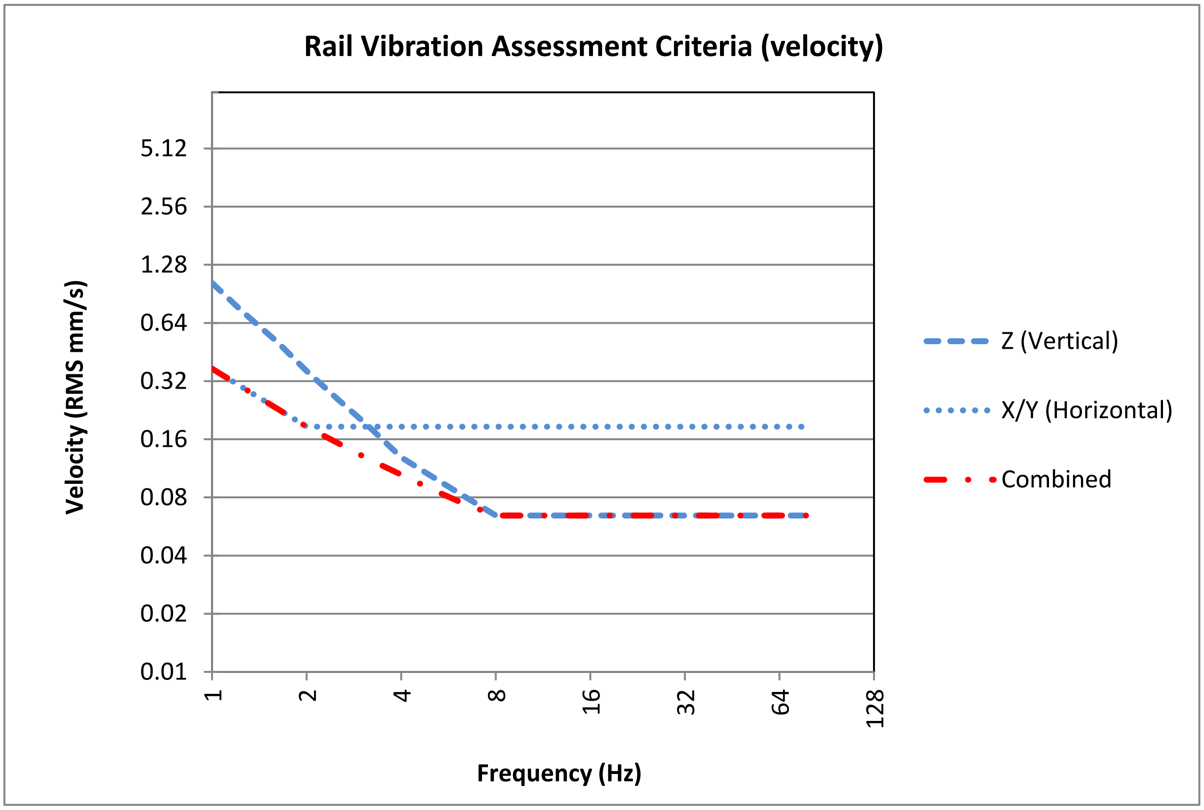

Figure 8-1: ISO Baseline Human Perception Curves

R:\2010Stantec\123110264_Canpotex_Ridley_Island\gis\Figures\Noise\123110264 Fig 8-2_Predicted Operational Sound Levels (Conveyor systems, dust control systems, transformer and ship noise.dwg PRINTED: Oct 04, 2011

Client: Canpotex / PRINCE RUPERT PORT AUTHORITY	Job No.: 123110264	Fig. No.:	
	Scale: 1:20,000	8-2	Stantec
	Date: 04-Oct-11		
PREDICTED OPERATIONAL SOUND LEVELS (CONVEYOR SYSTEMS, DUST CONTROL SYSTEMS, TRANSFORMER AND SHIP NOISE) ENVIRONMENTAL ASSESSMENT RIDLEY ISLAND, BRITISH COLUMBIA	Dwn. By: NP		
	App'd By: AP		

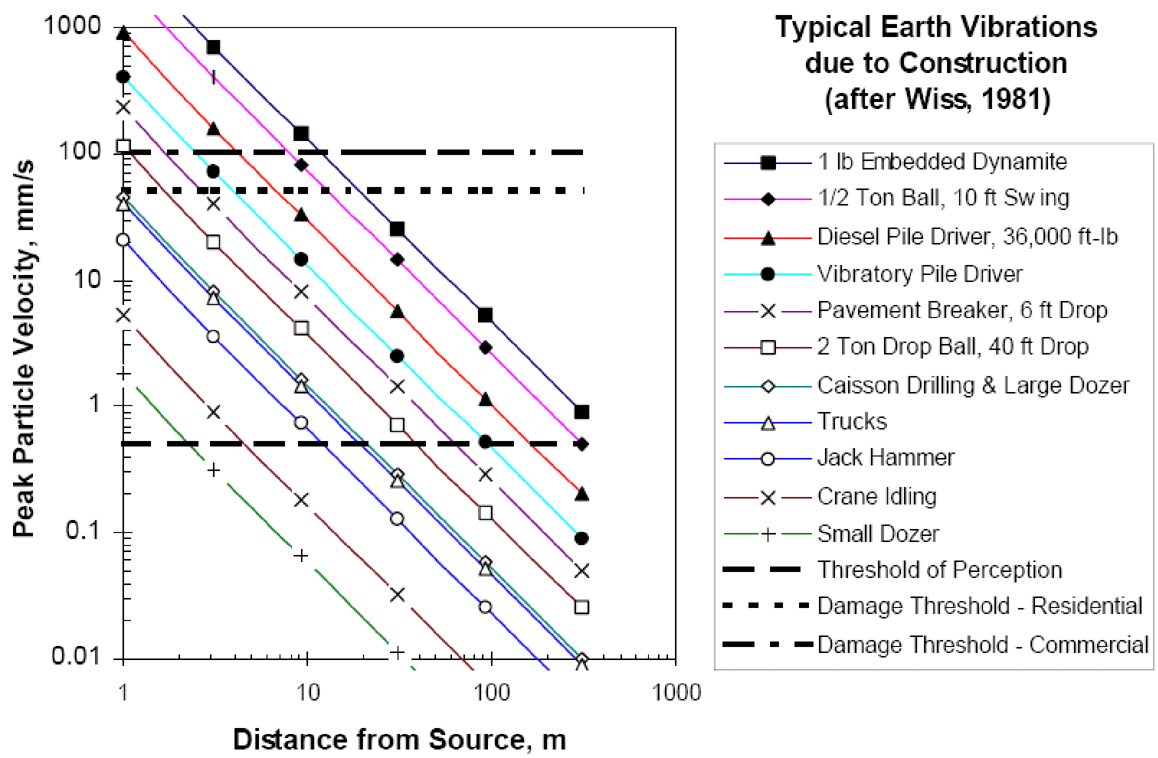

Figure 8-3: Typical Earth Vibrations due to Construction (Wiss, 1981)

9 AMBIENT LIGHT ASSESSMENT

9.1 Scope of Assessment

Light is a Project emission originating from a project's luminaires, or lighting units. Lighting unit consists of all project lamps and their associated parts for distributing and positioning the light. Proper lighting during all phases of the Project is necessary for a safe and productive terminal, rail and utility corridor. However, improperly-designed lighting can result in adverse effects ranging from a minor social nuisance to environmental disruption. The three attributes that are used to describe light, and which can cause lighting to become obtrusive, are generally referred to as light trespass, glare, and sky glow. These are defined below.

- **Light Trespass**—Sometimes referred to as spill or illumination on surrounding properties, light trespass refers to the spilling of light from fixtures within a facility to the environment and receptors outside the facility. The unit of measure for light trespass is a lux. A lux is equal to 1 lumen per square metre (lumen/m^2). For example, problematic light trespass would occur when lights located on the outside of an industrial facility shine in through the windows of nearby residences. In the middle of the night, light trespass at residential properties should not exceed 1 lux (CIE 2003).
- **Glare (intensity of luminaire)**—Glare is a potential environmental effect where intense, harsh, or contrasting lighting conditions reduce humans, birds, and other organisms' ability to see. The most common example is oncoming high-beam headlights that provide lots of light but paradoxically make it difficult to see. The unit of measure for glare, sometimes referred to as luminance, is a candela (cd) (i.e., lumens per steradian).
- **Sky Glow**—Sky glow refers to the illumination of clouds by light sources on the surface of the earth (e.g., street lighting), and haze in the atmosphere that replaces the natural night time sky with a translucent to opaque lighted dome. The unit of measure for sky glow is in magnitudes per square arcsecond (mag/$arcsec^2$). Values for sky glow range from approximately 22 mag/$arcsec^2$ in a rural environment where stars are abundant to approximately 18 mag/$arcsec^2$ in an urban environment where stars are barely visible.

9.1.1 Regulatory/Policy Setting

There are currently no regulations, guidelines, or policies in place within the Province of British Columbia that regulate the amount of obtrusive light being emitted from facilities. However, the Commission Internationale de L'Éclairage (CIE), also known as the International Commission on Illumination, has developed sets of maximum values for both light trespass and glare that should not be exceeded. These guidelines have been adopted in Great Britain and form the basis of a number of recommendations in the Leadership in Energy and Environmental Design (LEED) Green Building Council Certification Program of Canada (LEED 2004). These values are based on environmental zones (see Table 9-1) and time of day.

The CIE has established four environmental zones as a basis for outdoor lighting regulations (CIE 2003). These four zones are summarized in Table 9-1. The location of the Project and surrounding areas (Port Edward) would be considered to fall in an E2/E3 (rural/suburban) category.

Table 9-1: CIE Environment Zones

Zone	Surrounding	Lighting Environment
E1	Natural	Intrinsically Dark
E2	Rural	Low District Brightness
E3	Suburban	Medium District Brightness
E4	Urban	High District Brightness

The maximum values recommended by CIE for light trespass (illumination) on properties by environmental zone and time of day are presented in Table 9-2.

Table 9-2: CIE Maximum Values of Light Trespass (Illumination) on Properties

Time of Day[1]	CIE Maximum Values of Light Trespass on Properties by Environmental Zone (in lux)			
	E1	E2	E3	E4
Pre-Curfew (19:00 – 23:00)	2	5	10	25
Post-Curfew (23:00 – 6:00)	0	1	2	5

NOTES:
[1] Terminology, environmental zones and values defined by CIE (2003)

The maximum values recommended by CIE for glare (intensity of luminaires) offsite by environmental zone and time of day are presented in Table 9-3.

Table 9-3: CIE Maximum Values for Glare (Intensity of Luminaires) Offsite

Time of Day[1]	CIE Maximum Values for Glare in Designated Directions by Environmental Zone (in cd)			
	E1	E2	E3	E4
Pre-Curfew (19:00 – 23:00)	2,500	7,500	10,000	25,000
Post-Curfew (23:00 – 6:00)	0*	500	1,000	2,500

NOTES:
[1] Terminology, environmental zones and values defined by CIE (2003)
* If for public lighting value may be up to 500 cd

Reference levels of sky glow are presented in Table 9-4. The higher the number, the more the sky is dominated by the natural background; the lower the number, the greater the degree of sky glow that is caused by reflection from the atmosphere of anthropogenic lighting.

Table 9-4: Reference Levels of Sky Glow

Sky Glow (mag/arcsec2)	Corresponding Appearance of the Sky
21.7 (Rural)	The sky is crowded with stars that appear large and close. In the absence of haze the milky way can be seen to the horizon. The clouds appear as black silhouettes against the sky.
21.6	The above with a glow in the direction of one or more cities is seen on the horizon. Clouds are bright near the city glow.
21.1	The milky way is brilliant overhead but cannot be seen near the horizon. Clouds have a greyish glow at the zenith and appear bright in the direction of one or more prominent city glows.
20.4	The contrast of the milky way is reduced and the detail is lost. Clouds are bright against the zenith sky. Stars no longer appear large and near.
19.5	Milky way is marginally visible, only near the zenith. Sky is bright and discoloured near the horizon in the direction of cities. The sky looks dull grey.
18.5 (Urban)	Stars are weak and washed out and reduced to a few hundred. The sky is bright and discoloured everywhere.

Source: Berry (1976)

9.1.2 Key Issues

The assessed effect is a change in ambient light quality. The key issues underlying the assessment of effects to ambient light quality include:

- Change in light spill, or trespass
- Change in glare
- Change in sky glow.

These aspects of lighting have the potential to adversely affect community health (i.e., in terms of aesthetics and nuisance lighting). Effects to wildlife are discussed separately (see Section 11), but it is noted that the use of well-designed lighting that minimizes light pollution also mitigates the effects of lighting on wildlife.

Table 9-5 provides a summary of the potential environmental effects resulting from interactions between the Project and Ambient Light. Project activities and physical works that may result in a change in ambient light quality will vary depending on the phase of the Project. Potential cumulative contributions from other present and future projects are also identified.

Table 9-5: Potential Environmental Effects to Ambient Light Associated with the Project

Project Activities and Physical Works	Potential Effects to Ambient Light: Change in Ambient Light Quality
Construction and Commissioning	
Site Preparation (Clearing and Grubbing, Site Grading)	✓
Onshore Terminal Construction (receiving, storage, reclaim and shiploading facilities, site services)	✓
Dredging	✓
Marine Facilities Construction (trestle, wharf and berth)	✓
Operations	
Potash Handling Operations (receiving, storage, reclaim and shiploading of potash)	✓
Decommissioning (or Closure)	
Removal of Site Infrastructure (potash handling system/buildings)	✓
Interaction of Other Projects and Activities in the Boundary for Assessment (potential for cumulative effects; see rankings below)	
Ridley Terminals Inc.	2
Prince Rupert Grain Ltd	2
Quickload Terminals Prince Rupert Container Examination Facility	2

NOTES:

Project Environmental Effects

Only Project – Environment interactions ranked as 2 in Table 3-4 are carried forward to this Table. A ✓ indicates that an activity is likely to contribute to the environmental effect.

Cumulative Environmental Effects

Cumulative environmental effects were ranked as follows:

0 = Project environmental effects do not act cumulatively with those of other projects and activities

1 = Project environmental effects act cumulatively with those of other projects and activities, but are unlikely to result in significant cumulative environmental effects OR Project environmental effects act cumulatively with existing significant levels of cumulative environmental effects but will not measurably change the state of the VEC

2 = Project environmental effects act cumulatively with those of other projects and activities, and may result in significant cumulative environmental effects OR Project environmental effects act cumulatively with existing significant levels of cumulative environmental effects and may measurably change the state of the VEC

9.1.3 Selection of Measurable Parameters

The measureable parameters that will be used to facilitate quantitative and qualitative measurement of potential effects on Ambient Light are listed in Table 9-6.

Table 9-6: Measurable Parameters for Ambient Light

Project Effect	Measurable Parameters for the Project Effect	Rationale for Selection of Measurable Parameters
Change in Ambient Light Quality	▪ Light Spill—Light output from the Project perimeter on vertical surface of receptors ▪ Glare—Horizontal contrast between Project lighting and background lighting ▪ Sky Glow—Ratio of upward directed lighting to total lighting	▪ Light received beyond the Project perimeter is spill or trespass lighting ▪ Increased glare is a safety issue and an aesthetic issue ▪ Increase in sky glow (wasted light shining upwards, and from excessive lighting reflected upwards)

9.1.4 Characterization of Residual Effects

Terms that will be used to characterize residual effects are provided in Table 9-7.

Table 9-7: Characterization Criteria for Residual Effects on Ambient Light

Criterion	Description
Direction	**Positive:** condition is improving compared to baseline conditions **Neutral:** no change compared to baseline conditions **Adverse:** negative change compared to baseline conditions
Magnitude	**Low:** effect is detectable but is minimized through design mitigation **Moderate:** plant lighting is effectively controlled, but navigation, security and other required lighting have a measurable effect **High:** the design is without regard to lighting design criteria
Geographical Extent	**Site-specific:** limited to the Project footprint **Local:** limited to Ridley Island and the Village of Port Edwards (i.e., the LAA) **Regional:** extending beyond Ridley Island and the Village of Port Edwards
Frequency	**Once:** limited to construction, maintenance, or other periodic occurrence **Rarely:** effect occurs monthly **Frequently:** effect occurs nightly
Duration	**Short-term:** measurable for less than one month **Medium-term:** measurable for more than one month but less than two years **Long-term:** measurable for the life of the Project
Reversibility	**Reversible:** effects will cease following the construction phase or during the operations phase of the Project **Irreversible:** effects will persist for the life of the Project, or longer
Ecological Context	**Disturbed:** there are existing disturbances of similar magnitude or the environment is able to withstand adverse effects **Undisturbed:** there are no existing disturbances of comparable magnitude or the environment is unable to withstand adverse effects

9.1.5 Standards or Thresholds for Determining Significance

For the purpose of this assessment, a significant adverse environmental effect on Ambient Light is defined as an increase in Project-related light emissions such that the guidelines presented in Section 9.1.1 for light trespass and glare are exceeded, and where the Project-related sky glow would be typical of an urban environment.

9.2 Baseline Conditions

The Project is located on Ridley Island within the limits of the City of Prince Rupert and approximately 11 km south of the town center. The district of Port Edward is 3 km east of Ridley Island on the opposite side of Porpoise Channel.

There are two existing industrial marine terminals on the northwestern side of Ridley Island: Ridley Terminals and Prince Rupert Grain Limited. (Figure 1-1 in Section 1 shows the location of Ridley Island and other key local and regional landmarks.)

The topography on Ridley Island slopes upwards from the coasts of the island towards the inland areas. The elevation of the Project footprint ranges between approximately 18 to 24 m on the southwest side near the proposed marine terminal facilities, 21 m on the northeast side along the rail line route, and 43 m near where the proposed storage buildings will be located. Across Porpoise Harbour, in the village of Port Edward, the elevation increases with distance from the harbour.

A visibility analysis was conducted to determine potential Project view planes from the village of Port Edward. It was determined that the marine terminal and associated infrastructure and vessels would not be visible to the residents in Port Edward, although the rail line and road and a portion of the top of the storage buildings would be visible.

The Project footprint is currently undeveloped and therefore there is no baseline source of light.

9.3 Effects Assessment

9.3.1 Assessment Methods

The analysis of change in ambient light quality focuses on the potential environmental effects of the Project infrastructure and activities on light trespass, glare, and sky glow. The methodology for the Ambient Light assessment included a review of the available electrical and lighting design plans from the Project's conceptual designs. Light sources during construction and commissioning, operations, and decommissioning are briefly described in the following sub-sections.

9.3.2 Change in Ambient Light Quality

9.3.2.1 Potential Effects

Light sources during construction and commissioning, operations, and decommissioning are briefly described below.

Construction and Commissioning

Project-related lighting during construction and commissioning will vary with the stage of construction. No construction will be conducted during the night on the rail or road corridor. The plant and marine terminal will involve evening and possibly nighttime construction. The topography of the island provides a substantial barrier to visibility of lights emanating from the terminal. As a result, during the site preparation work, the use of mobile equipment equipped with headlights will not be visible from Port Edward apart from a small amount of sky glow. As the structures are erected, work lighting will provide somewhat greater sky glow, but will be largely obstructed from direct view by the topography. Good lighting is essential for safe and efficient work and by using directed lighting where and when needed, excessive light spill or sky glow can be avoided. As the Project advances toward completion, the permanent site lighting will become the primary outdoor lighting in use, with diminishing use of construction lights. The contractor will be required to use good lighting practices during construction, with cutoff luminaires where feasible, and to respond promptly to any valid complaints. The tree lines on the higher ground will be retained where possible to provide visual barriers in the construction and operations phases.

Operations

Light sources during operations include building exterior and interior lighting, lighting for conveyors, streetlights as well as the lighting requirements for the marine terminal.

As stated above, the infrastructure associated with the marine terminal component of the Project will not be visible to the residents of Port Edward due to the topography of Ridley Island. Therefore, the terrain will block any potential light spill to Port Edward as well.

The conceptual lighting design shows that outdoor lighting will be required along the conveyor belts, and streetlights will be present around the buildings, within the parking lot and along the proposed road route. The streetlights present around the buildings and within the parking lot will consist of pole-mounted four 54-watt fluorescent luminaires. Those lights used along the conveyors will consist of 175-watt metal halide stanchion-mounted luminaires. All outdoor lighting will be equipped with "dark sky" shielded fixtures that will greatly reduce light pollution factors. All streetlights that are located along the route of the proposed roadway will have shielded and cut-off design, as this roadway will be located directly across and in the view plane of the village of Port Edward.

Even though some of this lighting may be visible to the village of Port Edward, the amount of light trespass, glare and sky glow will be minimal due to the use of the dark sky fixtures, cut-off design, and in some instances the topography of Ridley Island.

Decommissioning

Activities to be conducted during decommissioning are temporary and confined to the same general areas where the facilities will ultimately be located and operated. All activities will, however, be conducted to comply with standards in effect at the time of decommissioning.

9.3.2.2 Mitigation

Luminaires will be selected to reduce the wasted light (i.e., light that is directed upwards, above the horizontal, or directly into the eyes of observers as glare). These design goals are consistent with the Canada Green Building Council LEED guidelines, where applicable (LEED 2004), and the International Commission on Illumination (CIE 2003). The use of such guidelines and the recommended techniques therein can markedly reduce stray light that directly or indirectly contributes to the increase of sky glow and the adverse effect on the night sky.

The following mitigation measures will also be implemented to reduce potential adverse effects on Ambient Light during the operations phase of the Project:

Construction Phase:

- Use of shielded, cut-off design construction lighting
- Directing light to where it is needed while still maintaining human safety
- Control light levels, including reducing use of lights where activities are not occurring.

Operation Phase:

- Streetlights will be shielded and of cut-off design
- Controlling light levels, including reducing use of lights where activities are not occurring
- Centralizing lighting control systems to be able to selectively turn off lights where they are not required.

Local topographic features, vegetative cover, and the use of “dark sky” fixtures are also expected to reduce light spillover to the Village of Port Edward and therefore reduce the amount of light observed.

9.3.2.3 Residual Effects

A properly lit Project footprint is fundamentally required for the safe and efficient operation of the terminal. It is expected that there could be some light from the Project observed in the Village of Port Edward, although the local topography, vegetation, and design specifications will help to reduce the amount. The effects of Project operations on Ambient Light are predicted to be low in magnitude, local in extent, frequent, long-term, and reversible (see Table 9-8).

9.3.2.4 Determination of Significance

As a result of mitigation measures, best management practices through Project design specifications, and the topography of Ridley Island, Project-related light emissions are not expected to result in a substantial increase in light trespass, glare and sky glow to surrounding communities and the RAA or exceed the guidelines presented in Section 9.1.1. Therefore, residual effects of the Project to Ambient Light are considered to be not significant (Table 9-8).

9.4 Combined Effects and Overall Significance Determination

Only one effect was identified in the assessment of Ambient Light: a change in ambient light quality. As a result, there are no combined effects, and residual effects and overall significance are the same as those discussed in Sections 9.3.2.3 and 9.3.2.4, respectively.

Table 9-8: Summary of Project Residual Environmental Effects on Ambient Light

Potential Residual Environmental Effects	Proposed Mitigation Measures	Residual Environmental Effects Characteristics						Significance	Prediction Confidence	Likelihood	Recommended Follow-up and Monitoring
		Adverse or Positive Effect	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological Context				
Effect #1: Change in Ambient Light Quality											
Construction and Commissioning	▪ Use of “dark sky” shielded luminaires for outdoor lighting ▪ Retain tree line directed to Port Edward where possible ▪ Control outdoor light levels ▪ Centralized lighting control systems	A	L	L	ST/O	R	U	N	H	H	Use of a qualified Environmental Monitor to oversee general construction and any other activities that could be disruptive concerning light. Follow-up monitoring during all phases of the Project will be on a complaint-driven basis so that specific light trespass issues can be addresed
Operations		A	L	L	LT/C	R	U				
Decommissioning		A	L	L	ST/O	R	U				
Residual environmental effects for all Phases.		A	L	L	LT/C	R	U				

KEY (See Section 9.1.4 for further details)

DIRECTION:
(P) *Positive*
(N) *Neutral*
(A) *Adverse*

MAGNITUDE:
(L) *Low*: effect is detectable but is minimized through design mitigation
(M) *Moderate*: plant lighting is effectively controlled, but navigation, security and other required lighting have a measurable effect
(H) *High*: the design is without regard to lighting design criteria

GEOGRAPHIC EXTENT:
(S) *Site-specific*: limited to the Project footprint
(L) *Local*: limited to Ridley Island and the Village of Port Edwards (i.e., the LAA)
(R) *Regional*: Extending beyond Ridley Island and the Village of Port Edwards

DURATION:
(ST) *Short-term*: effects are measurable for <1 month
(MT) *Medium-term*: effects are measurable for more than 1 month but less than 2 years
(LT) *Long-term*: effects are measurable for the life of the Project

FREQUENCY:
(O) *Once*: limited to construction, maintenance, or other periodic occurrence
(R) *Rarely*: effect occurs monthly
(F) *Frequently*: effect occurs nightly
(C) *Continuous*: effect occurs continuously

REVERSIBILITY:
(R) *Reversible*
(I) *Irreversible*

ECOLOGICAL CONTEXT:
(D) *Disturbed*: there are existing disturbances of similar magnitude or the environment is able to withstand adverse effects
(U) *Undisturbed*: there are no existing disturbances of comparable magnitude or the environment is unable to withstand adverse effects

SIGNIFICANCE:
(S) *Significant*
(N) *Not Significant*

PREDICTION CONFIDENCE:
Based on scientific information and statistical analysis, professional judgment and effectiveness of mitigation
(L) *Low* level of confidence
(M) *Moderate* level of confidence
(H) *High* level of confidence

LIKELIHOOD:
Based on professional judgment
(L) *Low* probability of occurrence
(M) *Medium* probability of occurrence
(H) *High* probability of occurrence

9.5 Cumulative Effects Assessment

There is potential for the Project to contribute to increased spillover light in the RAA cumulatively with light emitted from other facilities on Ridley Island. However, as a result of the Project's design specifications and mitigation measures, cumulative effects of additional light from the proposed Project are not expected to be substantial. This Project will, by more careful lighting design, occupy a proportionately smaller lighting footprint in the region and help set an example of better design for future projects.

9.6 Follow-up Program

The Proponent will provide a qualified Environmental Monitor to oversee general construction and any other activities that could be disruptive concerning light. The Environmental Monitor will ensure that mitigation measures outlined in the Environmental Management Plan (EMP) to minimize such disruptions are adhered to. Follow-up monitoring during all phases of the Project will be on a complaint-driven basis so that specific light trespass issues can be addressed.

9.7 References

Berry, Richard. 1976. Light Pollution in Southern Ontario. The Journal of the Royal Astronomical Society of Canada, Vol.70, No.3

Commission Internationale de l'Éclairage (CIE). 2003. Guide on the Limitation of the Effects of Obtrusive Light from Outdoor Lighting Installations

LEED, Green Building Rating System. 2004. for New Construction and Major Renovations LEED Canada-NC Version 1.0

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10 VEGETATION RESOURCES ASSESSMENT

The interaction of the Project with terrestrial vegetation resources is assessed in this section. The interaction of the Project with marine plants, including those in the intertidal zone, is addressed in Section 12 (Aquatic Environment).

This section describes the existing conditions for vegetation in the Project area, and the process for assessing potential Project-specific and cumulative environmental effects on vegetation resources. The results of the effects assessment are summarized and the proposed approach for mitigation and monitoring of environmental effects to vegetation is presented.

Vegetation resources are considered in this environmental assessment because of their contribution to biological diversity, sensitivity to Project disturbance and socio-economic and cultural importance. To facilitate the assessment of vegetation resources, the following key indicators (KIs) have been selected:

- Rare vascular plants
- Ecological communities of conservation concern
- Old forest
- Wetland function
- Riparian areas
- Traditional use plants.

Potential Project effects are assessed separately for each KI in Section 10.3.

10.1 Scope of Assessment

10.1.1 Regulatory/Policy Setting

Guidelines relating to the management of vegetation resources relevant to the Project include:

- The Federal *Species at Risk Act*
- The Federal Policy on Wetland Conservation
- The British Columbia Conservation Framework, and in association the British Columbia Conservation Data Centre
- The British Columbia *Weed Control Act*
- The British Columbia *Forest and Range Practices Act*.

The *Species at Risk Act* (SARA) provides protection for selected plant species on federal lands (Government of Canada 2011). Based on a review of Schedule 1 of SARA, no federally-listed plants occur in the Prince Rupert area. However, in the spirit of the SARA safety net provision, provincially designated Red- and Blue-listed species are considered rare plants in this assessment, and provincially designated Red- and Blue-listed vegetation communities are considered ecological communities of conservation concern.

The objective of the Federal Policy on Wetland Conservation is to “promote the conservation of Canada's wetlands to sustain their ecological and socio-economic functions, now and in the future” (Government of Canada 1991). It states that the federal government will strive to achieve the goal of no net loss of wetland functions on all federal lands and waters.

The British Columbia Conservation Framework (Ministry of Environment 2009) sets objectives for the preservation of biodiversity by helping to coordinate and align conservation efforts across government and non-government sectors. The BC Conservation Framework is built with data from the BC Conservation Data Centre (CDC), and incorporates existing provincial and federal species listings.

The BC *Weed Control Act* and its associated Regulation (Government of British Columbia 1996, 2011) are the regulatory tools used to control invasive vascular plants on provincial Crown land in BC. The Act requires ‘occupiers of land’ to avoid establishment or dispersal of noxious weeds, which are defined in the Regulation.

The BC *Forest and Range Practices Act* and its regulations set the requirements for planning, road building, logging, reforestation and grazing for forest and range licensees in the province. These requirements for forest and range activities are used here as guidelines for non-forest and range activities affecting vegetation resources, such as old forest descriptions and targets.

PRPA has earmarked Ridley Island for major industrial development in the future (PRPA 2011).

10.1.2 Key Issues

Vegetation resources were selected as a VEC because of their contribution to biological diversity, socio-economic and cultural importance, and sensitivity to Project activities.

The key effect associated with these activities includes the loss of vegetation resources or resource function. Potential Project effects on individual KIs as listed below are assessed in detail in Section 10.3:

- Loss of rare vascular plants
- Loss of ecological communities of conservation concern
- Loss of old forest
- Loss of wetland function
- Loss of riparian areas
- Loss of traditional use plants.

Potential effects on vegetation resources were assessed following the approach described in Section 3. Table 10-1 presents a summary of the potential environmental effects resulting from interactions between the Project and vegetation resources. Potential interactions identified in Table 3-4 but not carried forward in this assessment (i.e., ranked as a '1') include:

- Temporary Construction Infrastructure (trailers, power, sanitary facilities, etc.)
- Rail Loop Construction
- Onshore Terminal Construction (receiving, storage, reclaim and shiploading facilities, site services)
- 69 kV Transmission Line Construction
- Installation of Canpotex Rail Tracks
- Access Road and Overpass Construction
- Waste Management (Sewage, Stormwater and Wastewater)
- Infrastructure Maintenance.

Site preparation activities involve complete vegetation removal within the Project footprint, which means that subsequent construction and operational activities within the Project footprint will not have further direct effects on vegetation resources and are not assessed. Indirect effects such as weed introductions or changes in moisture and nutrient regime will be minimized through construction techniques and a weed control plan that will be developed as part of the EMP.

The Project lifespan is likely to exceed 50 years; however, the eventual decommissioning would have a positive effect on vegetation resources as the site would be allowed to return to natural conditions following the removal of Project infrastructure. Consequently, this assessment does not discuss effects from decommissioning activities and focuses only on potential Project effects arising from construction (i.e., site preparation). Activities to be conducted during decommissioning will comply with standards in effect at that time.

Construction techniques may include the use of berms to direct runoff away from sensitive plant communities and maintain hydrological regimes of adjacent ecosystems, as well as the installation of silt fences to remove suspended solids before runoff water leaves the Project site.

Waste management will involve use of an on-site settling pond and ocean disposal, and will not affect vegetation resources. Infrastructure maintenance will occur after vegetation clearing has already occurred; it will therefore have negligible impacts on vegetation resources.

Through these actions, based on professional judgment, the effects on vegetation resources from the above will be nominal and would not be considered significant.

The effects of Potential Accidents and Malfunctions on vegetation resources are discussed in Section 19 and will not be considered in this section.

Table 10-1: Potential Environmental Effects to Vegetation Resources Associated with the Project

Project Activities and Physical Works	Potential Effects on Vegetation Resources					
	Loss of rare vascular plants	Loss of Ecological Communities of Conservation Concern	Loss of old forest	Loss of wetland function	Loss of riparian area	Loss of traditional use plants
Construction and Commissioning						
Site Preparation (Clearing and Grubbing, Site Grading)	✓	✓	✓	✓	✓	✓
Interaction of Other Projects and Activities in the Boundary for Assessment (potential for cumulative effects; see rankings below)						
Ridley Terminals Inc.	2	2	2	2	2	2
Prince Rupert Grain Ltd	2	2	2	2	2	2
Ridley Island Log Sort (Not Operational)	2	2	2	2	2	2
HPI Wood Pellet Facility (Not Operational)	2	2	2	2	2	2
China Paper Group Pulp Mill (Not Operational)	2	2	2	2	2	2
PRPA Land Use Plan	2	2	2	2	2	2

NOTES:

Project Environmental Effects

Only Project – Environment interactions ranked as 2 in Table 3-4 are carried forward to this Table.

✓ Indicates that an activity is likely to contribute to the environmental effect.

Cumulative Environmental Effects

Cumulative environmental effects were ranked as follows:

0 = Project environmental effects do not act cumulatively with those of other Projects and Activities

1 = Project environmental effects act cumulatively with those of other Project and Activities, but are unlikely to result in significant cumulative environmental effects OR Project environmental effects act cumulatively with existing significant levels of cumulative environmental effects but will not measurably change the state of the VEC

2 = Project environmental effects act cumulatively with those of other project and activities, and may result in significant cumulative environmental effects OR Project environmental effects act cumulatively with existing significant levels of cumulative environmental effects and may measurably change the state of the VEC

10.1.3 Selection of Measurable Parameters

The vegetation resources selected for this assessment have intrinsic ecological or social value and are sensitive to the Project activities. Collectively, the condition of the vegetation resources is representative of the overall health and functional integrity of ecological systems and biodiversity within the Project area. The measurable parameters listed in Table 10-2 were selected to aid with quantitative and qualitative measurement of potential Project and cumulative effects on vegetation resources.

Table 10-2: Measurable Parameters for Vegetation Resources

Project Effect	Measurable Parameter(s) for the Effect	Rationale for Selection of Measurable Parameter
Loss of rare vascular plants	Loss of known occurrences of rare vascular plants Introduction of invasive species or weed species	Loss of individual rare vascular plants may negatively affect population sustainability and biodiversity
Loss of ecological communities of conservation concern	Change in spatial extent of ecological communities of conservation concern	Loss of ecological communities of conservation concern decreases biodiversity and habitat types available to wildlife
Loss of old forest	Change in spatial extent of old forest	Loss of old forest decreases biodiversity and habitat available to old forest-dependent wildlife
Loss of wetland function	Change in spatial extent of wetlands Change in wetland function	Wetlands provide a myriad of beneficial services, including habitat for rare plants and animals
Loss of riparian area	Change in spatial extent of riparian areas	Riparian areas protect the integrity of wetlands, waterbodies and streams
Loss of traditional use plants	Loss of known occurrences of accessible traditional use plants Introduction of invasive species or weeds	Treaty rights include the right to collect traditional use plants

10.1.4 Characterization of Residual Effects

Residual effects are those that remain after the application of mitigations. They are characterized using the criteria described in Table 10-3.

Table 10-3: Characterization Criteria for Residual Effects to Vegetation Resources

Criterion	Description
Direction	**Positive:** improvement compared to baseline status
	Neutral: no change compared to baseline status
	Adverse: negative change compared to baseline status
Magnitude	**Low:** alteration, but not elimination, of the abundance of native species or communities. However, no rare species, communities or wetland function will be lost
	Moderate: elimination of some native species or communities, or alteration (but not elimination) of rare plant populations or ecological communities; wetland function will not be lost
	High: elimination of rare species or communities, or any alteration of wetland function
Geographical Extent	**Site-specific:** limited to the Project footprint
	Local: limited to Ridley Island
	Regional: extending beyond Ridley Island

Criterion	Description
Frequency	**Once:** effect occurs once
	Rarely: effect occurs occasionally (e.g., monthly)
	Frequently: effect occurs regularly (e.g., daily)
Duration	**Short-term:** measurable for less than one month
	Medium-term: measurable for more than one month but less than two years
	Long-term: measurable for the life of the Project
Reversibility	**Reversible:** effects will cease during or after the Project is complete
	Irreversible: effects will persist after the life of the Project
Ecological Context	**Disturbed:** effect takes place within an area with human activity. Area has been substantially previously disturbed by human development or human development is still present
	Undisturbed: effect takes place within an area that is relatively unaffected or not adversely affected by human development

10.1.5 Standards or Thresholds for Determining Significance

With the exception of wetlands, there is an absence of federally set standards or thresholds for determining the significance of effects on vegetation resources. As such, recommendations from relevant policy, guidance documents and literature are used to determine the potential of a project to compromise the sustainability of vegetation resources, and thus the significance of effects on vegetation resources. For wetlands, the Federal Policy on Wetland Conservation is followed. Standards for determining significance of each KI are described below.

For rare plants, the Alberta Native Plant Council (ANPC 2006) recommends the removal of no more than one in 50 rare plants to maintain the biological integrity of a population. Therefore residual effects on rare plants are considered significant if they result in the loss of 2% of individuals within a population of Red-listed plants in the regional assessment area (RAA; as defined in Section 3.2.2). For Blue-listed plants residual effects are significant if more than 10% of the individuals within a population are removed.

For ecological communities of conservation concern, the Central and North Coast Order (CNCO) (Ministry of Agriculture and Lands 2009) contains objectives for retention of Red- and Blue-listed plant communities on provincial Crown land. It outlines that rare plant communities must be protected during primary forest activities, but if there are no practical alternatives for infrastructure or road access then up to 5% of a Red-listed or 30% of a Blue-listed community may be disturbed. Therefore, residual effects to ecological communities of conservation concern are considered significant if they lead to the loss of more than 5% of a Red-listed community or 30% of a Blue-listed community in the regional assessment area (RAA; as defined in Section 3.2.2). Note that the CNCO defines Blue- and Red-listed plant communities on its Schedules 5 and 6, whereas the definition used in this assessment is based on the most current listings provided by the BC Conservation Data Centre.

The CNCO outlines objectives for retention of old forest on provincial Crown land in the Kaien landscape unit, in which the Project occurs (Ministry of Agriculture and Lands 2009). The CNCO recommends retention targets for modal, rare, and very rare units as well as an overall retention target. In the CWHvh2, it recommends the retention of between 59% and 63% of "medium" spruce site series surrogates and "good" western redcedar and spruce leading site series surrogates. It also recommends that 30% of old forest in the Kaien landscape unit be retained. Therefore, residual effects to old forest are considered significant if they: 1) result in the loss of more than 40% of these specifically identified modal, rare or very rare units, and 2) overall, result in the loss of more than 70% of the old forest in the RAA.

The Federal Policy on Wetland Conservation (Government of Canada 1991) has the goal of no net loss of wetland functions on all federal lands and waters. The LAA is entirely federal Crown land, so effects to wetlands are considered significant if they lead to the net loss of any wetland function.

The CNCO outlines retention guidelines for riparian forests, providing requirements that primary forest activities must maintain 70% of functional riparian forest adjacent to S1 to S3 streams; lakes, fens and marshes greater than 1.0 ha; and forested swamps greater than 0.25 ha (Ministry of Agriculture and Lands 2009). Following guidance from the CNCO, residual effects to riparian areas are considered significant if they result in the loss of more than 30% of riparian areas in the RAA.

Residual effects to traditional use plants are considered significant if they eliminate the ability of First Nations to access traditional use species regionally.

10.2 Baseline Conditions

Ridley Island lies entirely within the Very Wet Hypermaritime subzone of the Coastal Western Hemlock (CWHvh2) biogeoclimatic (BGC) variant. This subzone variant's climate is cool and very mild with substantial rainfall and fog, but very little snow (Banner *et al.* 1993a). It is dominated by bog ecological communities in the interior of the island and forested ecological communities at the outer edges. Ridley Island has been earmarked for major industrial development in PRPA's Port of Prince Rupert 2020 Land Use Management Plan (PRPA 2011). There are a number of existing developments on the island, including Prince Rupert Grain Ltd., Ridley Terminals Inc., and the CN rail lines. There is an existing ring road around the outer edge of the island.

Baseline vegetation conditions for the Project have been described using the following information sources:

- Literature review, in particular the Ridley Island Master Development Plan (Jacques Whitford AXYS [JWA] 2008)
- The SARA public registry
- The BC CDC website
- Ecological community mapping (via Terrestrial Ecosystem Mapping [TEM])
- Field studies.

Vegetation communities on Ridley Island are generally characterized by low scrubby coniferous trees and ericaceous shrubs with a diverse suite of herbaceous species and peat mosses. The bog ecological communities range from pine-cedar treed bogs to open bogs dominated by low-growing shrubs like Labrador tea and sweet gale intermixed with sedges, rushes and high covers of peat mosses. The forested ecological communities have open canopies of low productivity species such as western hemlock, western redcedar, yellow-cedar and shore pine with low shrub and herb cover. Open canopy forested ecological communities on the island generally have a continuous carpet of feather mosses; however, dense stands of second-growth coniferous forest also occur and typically have relatively low covers of shrubs, herbs, and mosses.

Twenty one ecosystem units were mapped on Ridley Island, using map unit codes with equivalencies to site series (Banner *et al.* 1993a) and wetland (Mackenzie and Moran 2004) codes. The ecosystem units are described in detail in Section 10.7, and summarized in Table 10.4. The most common ecosystem unit on Ridley Island is the western redcedar – western hemlock/salal (HS) unit which covers 151.7 ha, followed by the shore pine – yellow-cedar/Sphagnum (LS) unit which covers 142.0 ha. Previously disturbed sites (including industrial developments, exposed soil and roads) cover 116 ha of Ridley Island. See Figure 10.1 for the TEM mapping of the LAA.

Table 10-4: Ridley Island Ecosystem Mapping Summary

Name	Map Unit Code	Equivalent Site Series Code (and Wetland Code)	Area in LAA (ha)	Area in Project Footprint (ha)
Yellow pond-lily/buckbean bog pond	BP	00	10.8	2.2
Lyngby's sedge/spike rush tidal mudflat	CE	00 (Em01)	4.1	0
Sitka sedge/peat mosses	FS	00 (Wf51)	3.2	1.1
Western hemlock – Sitka spruce/lanky moss	HM	04	13.6	1.6
Western redcedar – western hemlock/salal	HS	01	151.7	36.0
Common juniper/tufted clubrush/hoary rock moss	JR	32 (Wb52)	0.5	0.5
Shore pine – yellow-cedar/*Sphagnum*	LS	12 (Wb53)	142.0	39.0
Western redcedar – Sitka spruce/skunk cabbage	RC	13 (Ws54)	36.7	13.7
Western redcedar – Sitka spruce/sword fern	RF	05	1.6	0.9
Sitka spruce/Pacific crab apple	SC	19	5.8	1.1
Shore pine/black crowberry/tough peat moss	TS	31 (Wb51)	42.7	10.9
Coal terminal	CA	00	60.3	5.1
Exposed soil	ES	00	8.1	1.6
Grain terminal	GR	00	32.3	2.2
Gravel pit	GP	00	4.1	0.2
Ocean	OC	00	2.8	0
Pond	PD	00	3.7	0.4

Name	Map Unit Code	Equivalent Site Series Code (and Wetland Code)	Area in LAA (ha)	Area in Project Footprint (ha)
Road surface	RZ	00	8.8	3.4
Shallow open water	OW	00	7.3	1.3
Sulphur tanks	SU	00	1.5	0.5
Urban/suburban	UR	00	1.1	0.1
Total			**542**	**122**

10.2.1 Rare Vascular Plants

For the purpose of this assessment and because no SARA-listed species were identified within the LAA, rare plants are vascular plant species, subspecies or varieties included on the BC CDC's Red or Blue lists.

The island does not support any plant species listed on SARA. Two provincially Blue-listed plants have been recorded on Ridley Island (JWA 2008):

- Alaska holly fern (*Polystichum setigerum*), found in a patch of dense second-growth forest along the central west coast shoreline of the island
- Gmelin's sedge (*Carex gmelinii*) located on shoreline bluffs at the southern west coast of the island.

See Figure 10.2 for known locations of rare plant occurrences.

10.2.1.1 Alaska Holly Fern

Alaska holly fern (*Polystichum setigerum*, K.B. Presl) is a deciduous or overwintering perennial fern that grows from a short, stout rhizome. It grows in moist, shady forests, on rock outcrops and lava flows in lowland and montane areas (Klinkenberg 2011). One occurrence of Alaska holly fern was observed in a well shaded alder stand on a moderately steep slope along the western shoreline of Ridley Island, 25 m from the Project footprint (JWA 2008). This Blue-listed species is considered *imperiled to vulnerable* in BC and *vulnerable* globally with a conservation status rank of S2S3/G3 (BC CDC 2011).

10.2.1.2 Gmelin's Sedge

Gmelin's sedge (*Carex gmelinii,* Hook. & Arn.) is a perennial herb that grows in saline marshes, exposed bluffs and low-lying meadows. Its flowering stems grow 30 to 50 cm tall, exceeding the narrow, rolled-under leaves (Klinkenberg 2011). One clump of Gmelin's sedge was found on a rocky shoreline bluff at the south end of the island (JWA 2008). This Blue-listed species is *imperiled to vulnerable* in BC and *apparently secure to secure* globally with a conservation status rank of S2S3/G4G5 (BC CDC 2011).

10.2.2 Ecological Communities of Conservation Concern

Ecological communities of conservation concern are plant associations included on the BC CDC's Red or Blue lists. They are plant communities that have restricted distribution or require special management within BC. For example, they may be sensitive and important ecosystems due to the ecological goods and services they provide as well as their susceptibility to human impacts.

Five of the ecosystem units mapped on Ridley Island support ecological communities of conservation concern, including one Red-listed community and four Blue-listed communities (BC CDC 2011). These ecosystem units cover 61 ha of Ridley Island and 18 ha of the Project footprint, as summarized in Table 10-5 and shown in Figure 10.2.

Vulnerability ratings have been assigned to forested ecological communities of conservation concern based on structural stage (stand age), using an approach consistent with the BC CDC rating criteria (BC CDC 2004). Structural stage gives an indication of successional development of the community. Late seral and climax plant communities are most vulnerable, as reflected in the following ratings:

- Very highly vulnerable (VHV) = Structural Stage 7 (i.e., old forests)
- Highly vulnerable (HV) = Structural Stage 6 (i.e., mature forests)
- Moderately vulnerable (MV) = Structural Stage 5 (i.e., young forests)
- Not Intrinsically Vulnerable (NIV) = Structural Stage 2, 3 or 4 (i.e., herbaceous, shrubby or pole/sapling).

The Red-listed Sitka sedge/peat moss community is considered Very Highly Vulnerable despite its structural stage of 2, because this is a naturally herbaceous community at climax.

Table 10-5: Ridley Island Ecological Communities of Conservation Concern

Name	Map Unit Code	Site Series (Wetland Code)	Structural Stage	Vulnerability Rating[1]	Area (ha)	
					LAA	Project Footprint
Red-listed						
Sitka sedge/peat mosses	FS	00 (Wf51)	2	VHV	3.2	1.1
Blue-listed						
Western hemlock – Sitka spruce/lanky moss	HM	04	6	HV	8.0	0
			7	VHV	5.6	1.6
Western redcedar – Sitka spruce/skunk cabbage	RC	13 (Ws54)	4	NIV	2.2	1.2
			6	HV	8.1	0.8
			7	VHV	26.4	11.8
Western redcedar – Sitka spruce/sword fern	RF	05	4	NIV	1.0	0.7
			7	VHV	0.6	0.2

Name	Map Unit Code	Site Series (Wetland Code)	Structural Stage	Vulnerability Rating[1]	Area (ha)	
					LAA	Project Footprint
Sitka spruce/Pacific crab apple	SC	19	4	NIV	1.4	0.9
			6	HV	1.4	0.2
			7	VHV	3.0	0
Total					**61**	**18**

NOTES:
[1] VHV = Very Highly Vulnerable
HV = Highly Vulnerable
NIV = Not Intrinsically Vulnerable

10.2.2.1 Sitka Sedge – Peat Moss (Map code FS)

This Red-listed community is an uncommon fen of small areal extent (Banner *et al.* 1993a). This community occurs in low elevation coastal areas characterized by wet drainage channels or hollows in sloping peatlands with gradually flowing surface water. This ecological community was found primarily in the central region of Ridley Island. This ecosystem occurs in 35 ecosections in the province of British Columbia; however, it is considered *imperiled* provincially and globally, with a conservation status rank of S2/G2 (BC CDC 2011).

10.2.2.2 Western Hemlock – Sitka Spruce/Lanky Moss (Map code HM)

This Blue-listed community occurs on moderate slopes above or below mesic forests where nutrient availability and drainage conditions are improved (BC CDC 2011, Banner *et al.* 1993a). This ecological community was found in forested areas along the western portion of the island in combination with the common western redcedar – western hemlock/salal ecosystem (site series CWHvh2/01; HS map unit). It is considered *vulnerable* provincially and is *unranked* globally, with a conservation status rank of S3/GNR.

10.2.2.3 Western Redcedar – Sitka Spruce/Sword Fern (Map code RF)

This Blue-listed community occurs in small patches in association with shallow or exposed base-rich metamorphic bedrock where nutrients are more readily available (Banner *et al.* 1993a). This ecological community occurs primarily in forested areas found mainly on the west coast of Ridley Island and in combination with common western redcedar – western hemlock/salal (CWHvh2/01; HS map unit) mesic forests. This Blue-listed community is considered *imperiled or vulnerable* provincially (S2S3) and *unranked* globally (GNR) (BC CDC 2011).

10.2.2.4 Western Redcedar – Sitka Spruce/Skunk Cabbage (Map code RC)

This Blue-listed forest only occurs in very wet lower slopes or depressional areas that receive mineral-rich seepage (Banner *et al.* 1993a). This ecological community was found in forested areas throughout the island in combination with western redcedar – western hemlock/salal (CWHvh2/01;

HS map unit) mesic forests. This Blue-listed community is considered *vulnerable with uncertainty* both provincially and globally, with a conservation status rank of S3?/G3? (BC CDC 2011).

10.2.2.5 Sitka Spruce/Pacific Crab Apple (Map Code SC)

This Blue-listed shoreline forest occurs as a narrow fringe between upland forest and lower tidal communities on shallow organic soils and bluffs (Banner *et al.* 1993a). It is vulnerable because it occupies specific shoreline conditions. This ecological community was found in forested areas along the shoreline polygons of Ridley Island. It is considered *vulnerable* provincially (S3) and is *unranked* globally (GNR) (BC CDC 2011).

10.2.3 Old Forest

In the Coastal Western Hemlock (CWH) zone, old forest is defined as structurally diverse stands older than 250 years (Luttmerding *et al.* 1990). Old forest is identified as structural stage 7 in terrestrial ecosystem mapping (TEM) and age class 9 in vegetation resources inventory (VRI) mapping (MoF and MOELP 1998).

Old forest was identified through vegetation mapping and field work. Equivalent site series surrogates were identified by comparing tree species to site productivity information and range of site index by site series in the CWHvh2 (Ministry of Forests and Range, Internet site 2011; Banner *et al.* 1993b). Old forest covers 93 ha within the LAA and 33 ha within the Project footprint, as summarized in Table 10-6 and on Figure 10.3.

Table 10-6: Ridley Island Old Forest

Name	Map Unit Code	Site Series (Wetland Code)	Equivalent Site Series Surrogate	Area in LAA (ha)	Area in Project Footprint (ha)
Western hemlock – Sitka spruce/lanky moss	HM	CWHvh2/04	Ss – Good; Cw Med	5.6	1.6
Western redcedar/western hemlock/salal	HS	CWHvh2/01	Cw Med	56.1	18.2
Shore pine – Yellow-cedar – Tufted clubrush bog	LS	CWHvh2/12 (Wb53)	N/A	1.5	1.3
Western redcedar – Sitka spruce/skunk cabbage	RC	CWHvh2/13 (Ws54)	N/A	26.4	11.8
Western redcedar – Sitka spruce/sword fern	RF	CWHvh2/05	Ss Good; Cw Med	0.6	0.2
Sitka spruce/Pacific crab apple	SC	CWHvh2/19	N/A	3.0	0
Total				**93**	**33**

10.2.4 Wetlands

Wetlands include forested and non-forested ecosystems that are saturated with water long enough to develop hydric soils and to support hydrophytic vegetation (National Wetlands Working Group [NWWG] 1997). Wetland functions include the ecological functions outlined in the Federal Policy on Wetland Conservation (Government of Canada 1991).

10.2.4.1 Wetland Classification

Wetlands in the LAA are classified using the Canadian Wetland Classification System (CWCS) (NWWG 1997). The CWCS defines wetlands as "land that is saturated with water long enough to promote wetland or aquatic processes as indicated by poorly drained soils, hydrophytic vegetation, and various kinds of biological activity which are adapted to a wet environment" (NWWG 1988).

The CWCS uses a hierarchical system that classifies wetlands into three levels: 1) classes; 2) forms; and 3) types. The classes reflect the overall genetic origin of the wetland ecosystem and the nature of the wetland environment. Forms are classified based on surface morphology, surface pattern, water type, and the morphological characteristics of underlying soil. Types are subdivisions of wetland forms based on the vegetation community. Wetlands in the LAA were classified to the level of wetland form. The five classes of wetlands in the CWCS are: 1) bog, 2) fen, 3) marsh, 4) swamp, and 5) shallow water.

The map unit codes from the Ridley Island ecosystem mapping were classified into the five wetland classes of the CWCS, and further classified into wetland forms. See Table 10.4 above for the relationship between these map unit codes and site series (Banner *et al.* 1993a) and BC wetland (Mackenzie and Moran 2004) codes. Representatives of four of the five wetland classes were found in the LAA. The exception is shallow water, which was not found on Ridley Island, as explained below (see Section 10.2.4.1: 'Shallow Water' below). Five wetland forms were found in the LAA, four of these were found in the Project footprint, as summarized in Table 10-7. Figure 10.4 shows the distribution of wetlands in the LAA.

Table 10-7: Ridley Island Wetlands Summary

Wetland Class	Wetland Form	Map Unit Codes	Area on Ridley Island (ha)	Area in Project Footprint (ha)
Bog	Slope bog	BP, JR, LS, TS	196.0	52.6
Fen	Riparian fen	FS	3.2	1.1
Marsh	Estuarine marsh	CE	4.1	0
Swamp[1]	Slope swamp	RC	36.7	13.7
	Tidal swamp	SC	5.8	1.1
Total			**246**	**69**

NOTES:
[1] Lewis (2007) indicates that some swamps in coastal British Columbia defined by Mackenzie and Moran (2004), including map code RC (Ws54), are transitions between upland and wetland, rather than being genuine wetlands, but to be conservative they included here as wetlands (due to their typically saturated, poorly drained, non-aerated soils)

A brief discussion of the five wetland classes and their occurrence in the LAA is provided in the ensuing paragraphs.

Bogs

Bogs are wetlands characterized by the accumulation of peat, most frequently dominated by *Sphagnum* mosses with tree, shrub, or treeless vegetation cover (NWWG 1997). They receive water almost exclusively from precipitation, leading to poor nutrient conditions. Although bogs are locally common on the Pacific coast, these coastal bogs are continentally and globally rare (Pojar 2002). Similar coastal bogs occur elsewhere only in Atlantic coastal Europe, specifically in hypermaritime parts of the United Kingdom and Scandinavia.

Slope Bogs

Slope bogs are a common wetland form on the north coast of British Columbia (Banner *et al.* 1988). They occur in areas of high rainfall on sloping terrain (NWWG 1997). Their water sources are precipitation and drainage from adjacent peatlands, and as a result are nutrient poor. High precipitation in the north coast means that peat depths often exceed 1 m in depth. Nutrient-poor *Sphagnum spp.*-dominated slope bogs are the dominant wetland type in the study area. The slope bog wetland form is represented by four ecological communities on Ridley Island:

- Shore pine – black crowberry – tough peat moss CWHvh2/31 (Wb51); ecosystem map code = TS
- Common juniper – tufted clubrush – hoary rock moss CWHvh2/32 (Wb52); map code = JR
- Shore pine – yellow-cedar – Sphagnum CWHvh2/12 (Wb53); map code = LS
- Yellow pond-lily – buckbean bog pond CWHvh2/31 (Wb51); map code = BP.

For descriptions of these ecological communities see Section 10.7.

Fens

Fens are peatlands with a fluctuating water table (NWWG 1997). Their waters are relatively rich in dissolved minerals because groundwater and surface water movement is common. They are characterized by an accumulation of peat, which is commonly formed from sedges and brown mosses.

Riparian Fens

Riparian fens, as observed in the LAA, are the primary fen form occurring at low elevations on the north coast of British Columbia (Banner *et al.* 1988). Regionally, they are infrequent and localized along lake margins; in the LAA they occur in the central boggy portions of Ridley Island adjacent to shallow open water bodies and bog ponds. Riparian fen is represented by one ecological community on Ridley Island: the Sitka sedge/peat moss CWHvh2/00 (Wf51) ecological community.

Marshes

Marshes are wetlands with shallow, fluctuating water level and mineral soils (NWWG 1997). They receive water from the surrounding catchment area as runoff, stream inflow, precipitation, storm surges, groundwater discharge, longshore currents and tidal action. Vegetation is dominated by graminoids, shrubs, forbs or emergent plants.

Estuarine Marshes

Estuarine marshes are confined to intertidal and supratidal zones of estuaries. Water levels in estuarine marshes are somewhat subject to tidal changes. Waters are brackish to fresh, due to tidal and riverine inputs. The estuarine marsh on Ridley Island is in an area of industry-altered estuarine mudflat at the south end of the island. This area was formerly known as Mudflat Bay. In the 1980s, two major rock berms and two smaller berms were constructed to enclose Mudflat Bay. This area was used as a settling pond for material dredged for the construction of the adjacent grain and coal sites. Since then the area has been characterized by poor water quality and limited to no connectivity with the marine environment (JWA 2008). The estuarine marsh wetland is represented by one ecological community in the LAA: the Lyngby's sedge/spike rush tidal mudflat CWHvh2/00 (Em01) ecological community.

Swamps

Swamps are forested or wooded wetlands that are characterized by trees or tall shrubs and are influenced by nutrient rich groundwater and either mineral or organic soils (NWWG 1997). Swamps are less wet than marshes, fens and open bogs; drier treed swamps transition into upland forest (NWWG 1997).

Slope Swamps

Slope swamps have a noticeable gradient from the highest point sloping down to the lowest point in the feature. In the LAA, slope swamps occur in the transition between slope bogs and upland forest. They are generally located on the outer edge of Ridley Island, surrounding the central slope bog complex. Slope swamps in the LAA are characterized by one ecological community: the western redcedar – Sitka spruce/skunk cabbage CWHvh2/13 (Ws54) ecological community. This community is transitional between swamp and upland, representing a mix of forested swamp and poorly drained upland forest rather than being entirely wetland (Lewis 2007) but for a conservative approach is considered wetland in this assessment.

Tidal Swamps

Tidal swamps develop in the zone of influence of tides, at the highest reach of tides and wave influence during storms (NWWG 1997). Forested tidal swamps exist where there is a minor influence of high tides, but not enough to kill the trees. The tidal swamp in the LAA consists of the Sitka spruce/Pacific crabapple CWHvh2/19 ecological community. This community is characterized by gleysolic soils and typically occurs in brackish sloughs and estuaries behind sedge marshes (Banner *et al.* 1993a).

Shallow Water

Shallow water wetlands are transitional between those that are saturated or seasonally wet (i.e., bog, fen, marsh and swamp) and permanent, deep water bodies (e.g., lakes) (NWWG 1997). They have standing or flowing water less than 2 m deep in mid-summer. Open water occupies more than 75% of the surface area. The pond map code (PD) is defined as a small body of water greater than 2 m deep, so is not included under the definition of a shallow water wetland.

The shallow water wetland class excludes artificial water bodies where water regimes are manipulated, such as reservoirs, impoundments and dugouts (NWWG 1997). The muskeg disposal pond and sediment control pond on the southeast end of Ridley Island were created by isolating Mudflat Bay from Porpoise Channel.

Mudflat Bay at the south end of Ridley Island was used as a disposal site during previous grain and coal terminal developments. As discussed above under *Estuarine Marshes,* this area was used as a settling pond for dredged materials. It was diked with rock berms to remove marine connectivity and divided into northern and southern sections. The northern portion consists of a constructed muskeg disposal pond and the southern portion a sediment control pond. These constructed waste treatment ponds are water bodies with artificially manipulated water regimes. Therefore, the open water (map codes OW and OC) within the muskeg disposal pond and sediment control pond fall outside the focus of the CWCS, are not considered Shallow Water wetland, and are not included in this assessment.

10.2.4.2 Wetland Function

Wetland function encompasses all the natural processes associated with wetlands, including physical, chemical and biological functions, as well as the derivation of benefits these processes may provide to humans (Lynch-Stewart *et al.* 1996).

Wetland functions in the LAA were broadly categorized as follows:

- Hydrological
- Climate
- Biogeochemical
- Habitat.

The paragraphs below provide descriptions of these hydrological functions, and an evaluation of the functions provided by the wetland types that occur in the LAA.

Hydrological Function

Hydrological function is the capacity of a wetland to store, moderate, and release water in a watershed (i.e., for groundwater recharge/discharge, flood flow alteration, sediment stabilization, and the maintenance of water quality). This is important in order to maintain human and ecological life support systems, protect infrastructure, and enhance social values. The function of a wetland is driven by its water balance or the quantity and movement of water through a wetland system (Bond *et al.* 1992).

Ridley Island wetlands are characterized by high densities of absorbent peat-forming moss species (i.e., sphagnum mosses) and decomposed sedges associated with bog ecological communities, interspersed with small areas of surface water movement (i.e., fens). The upper layers of peat in combination with sphagnum mosses contribute to horizontal flow which begins at the raised centre of the island, flows to the bog margins, and continues to outflow gullies throughout the forested areas. Water balance in bogs is governed by precipitation, surface water inflow/outflow, groundwater inflow/outflow, and evapotranspiration (Rydin and Jeglum 2006). Water levels are generally stable (i.e., do not fluctuate substantially with precipitation events).

A number of issues related to the hydrological function of Ridley Island wetlands have been examined including flood protection, erosion control, flow augmentation, drinking water supply and reduction of tidal forces.

- Ridley Island does not supply water for regional drinking water or usable surface water for residents or industry, nor does it provide water storage for agriculture purposes.
- The wetlands provide negligible local flood protection benefits. Slow surface and groundwater movement is overwhelmed by the addition of precipitation to the water table. Therefore, surface water and groundwater are regulated more by precipitation influences rather than in-ground movement.
- Erosion control is maintained in a similar way. High volumes of precipitation are absorbed by the bogs after summer months when the water balance is low. During the fall, winter and spring, the bogs fill-up from the precipitation and flow is mostly distributed to undefined channels radiating from the centre of the island to the perimeter. Surface water flow is therefore mediated by the absorbent peat, avoiding large peak flow events which could otherwise cause surface soil erosion.
- Shore fens have the capacity to provide shoreline erosion control through dense, energy dissipating vegetation with deeply knitted root masses. The open pools of water in the bog complexes are small and isolated and are therefore not expected to exert high levels of erosive force on adjacent vegetation.
- The wetland area does not provide flow augmentation to users; however, the area slated for development includes the upper elevation of the main slope bog watershed on Ridley Island. The island has two isolated slope bog watersheds, a large one in the centre of the island and another subdominant slope bog at the southern end of the island that will not be affected by the Project. Both systems have a gradual gradient from the upper slope bogs toward the coast.
- The wetlands potentially affected by the Project do not play a role in reducing tidal impacts as they are situated within the island's interior.

Climate Function

By storing substantial volumes of water at or near the ground surface, large wetlands are able to moderate the local climate through the high latent heat capacity of the water, the albedo of the wetland surface, and the high rates of evapotranspiration associated with vegetation. These large scale, wetlands, or landscapes dominated by wetlands, may provide favourable climates for agriculture, as they influence rain patterns (Carter 1997). Although poorly quantified in the literature to date, the effects that urban wetlands may have in dissipating "urban heat island effects" have also been recognized (Bolund and Hunhammar 1999).

However, the wetland communities on Ridley Island are located on an undeveloped marine island influenced by coastal climates. They are unlikely to provide any measurable dampening effect on micro-climate in the context of the surrounding ocean and wind currents.

Biogeochemical Function

Biogeochemical function refers to the biological, geological and chemical processes and reactions that govern the composition of the natural environment as it relates to the recycling chemistry between plants, animals and the earth's sediments.

The wetland ecological communities on Ridley Island:

- Store large amounts of carbon. Removal of bog surface area will reduce the ability of the Ridley Island wetland complex to sequester and store carbon.
- Are pH depressed wetlands with low redox potential, and little interaction with surface water. As a result, these wetlands have a low potential, chemically, for oxidizing or precipitating nutrients, hydrocarbons and other contaminants.
- May export soluble organic carbon as food chain support to down-gradient watercourses. They do not provide for the containment of surface water toxicants.
- Do not play a substantial role in stabilizing sediment flow as the gradient and substrate have very low mineral soil quantities.
- Are generally nutrient poor and therefore do not contain high nutrient availability for transfer to wildlife, such as salmon or grizzly bear.

Habitat Function

Habitat function refers to the manner in which a wetland contributes to biological productivity and diversity.

Habitat functions provided by wetlands on Ridley Island include the following:

- Foraging, nesting, and staging habitat for migratory birds (including raptors, waterfowl, shorebirds, and songbirds) provided by the sedge fens in the study area.
- Seasonal foraging habitat for mammals (including black bear, mule deer, mink, bats, and small rodents).
- Habitat for amphibians, including confirmed observations of western toads, rough-skinned newts, and northwestern salamander (Stantec 2011). Potential for long-toed salamander, wood frog, and Pacific tree frog (Fisher and Brooks 2007).
- No habitat for sport or commercial fish provided by the wetlands on Ridley Island, as summarized in Section 12 (Freshwater Aquatics).
- Contribute to habitat diversity, as indicated by the presence of three ecological communities of conservation concern that are wetlands, including a Red-listed riparian fen, a Blue-listed slope swamp, and a Blue-listed tidal swamp. See Section 10.1.4 for descriptions of these communities.

10.2.5 Riparian Areas

Riparian areas are defined as areas adjacent to streams, lakes and wetlands that are wet enough or inundated frequently enough to develop and support natural vegetative cover distinct from the vegetation in neighbouring freely-drained upland sites (Stevens *et al.* 1995). Riparian areas are structurally complex and provide conditions for a diversity of plants and animals. Riparian areas depend on adjacent terrestrial habitats to support a broad array of ecological functions including, large organic debris input, root systems for bank stability, and overhanging vegetation to moderate temperature. For the purpose of this assessment, riparian areas were defined by applying a 30 m buffer to the shoreline of Ridley Island, terrain resource information management (TRIM) water courses and water bodies, and mapped wetlands (excluding bogs), following Stevens *et al.* (1995). Bogs are excluded because they receive water exclusively from precipitation and are virtually unaffected by runoff waters or groundwater from surrounding areas (NWWG 1997). Riparian areas protect the land that provides water to wetlands, whereas bogs are not dependent on terrestrial sources for their water.

The total spatial extent of riparian areas on Ridley Island is approximately 200 ha, with 47 ha in the Project footprint, as shown in Figure 10.5.

10.2.6 Traditional Use Plants

For the purpose of this assessment, traditional use plants include vascular species identified as important to the First Nations affected by the Project, as identified by Ames (2005), Butler *et al.* (2007), Butler *et al.* (2010), Compton (1993), People of Port Simpson and School District No. 52 (1983), McDonald and Inglis (1981), McDonald (2003), Menzies (2006), Menzies (2008), Turner and Marsden (2000) and Turner (2005).

The five First Nations that share an interest in the proposed Project are:

1. Allied Tribes of Lax kw'alaams
2. Gitxaala Nation (Kitkatla)
3. Kiselas First Nation
4. Kitsumkalum First Nation
5. Metlakatla First Nation.

These five Nations will be collectively referred to as the Tsimshian Nation for this assessment.

The vegetation on Ridley Island consists of trees, shrubs, herbs and ferns, some of which are used by the Tsimshian Nation for food or medicinal purposes. Table 10-8 lists the plants traditionally used by the Tsimshian Nations that have been recorded on Ridley Island.

Table 10-8: Traditional Use Plants on Ridley Island

Common Name	Scientific Name
Bracken fern	*Pteridium aquilinum*
Bunchberry	*Cornus canadensis*
Cloud berry	*Rubus chamaemorus*
Common juniper	*Juniper communis*
Crowberry	*Empetrum nigrum*
Devil's club	*Oplopanax horridus*
Elderberry	*Sambucus racemosa*
Labrador tea	*Ledum groenlandicum*
Licorice fern	*Polypodium glacerrhiza*
Mountain ash	*Sorbus* spp.
Red alder	*Alnus rubra*
Salal	*Gaultheria shallon*
Salmonberry	*Rubus spectabilis*
Shore pine	*Pinus contorta* var. *contorta*
Sitka spruce	*Picea sitchensis*
Skunk cabbage	*Lysichiton americanus*
Sword fern	*Polystichum munitum*
Western hemlock	*Tsuga heterophylla*
Western redcedar	*Thuja plicata*
Wild crab apple	*Malus fusca*
Yellow-cedar	*Chamaecyparis nootkatensis*

SOURCES: Ames (2005), Butler *et al.* (2007), Butler *et al.* (2010), Compton (1993), People of Port Simpson and School District No. 52 (1983), McDonald and Inglis (1981), McDonald (2003), Menzies (2006), Menzies (2008), Turner and Marsden (2000), Turner (2005)

These traditional use plant species are common on Ridley Island, in the Kaien landscape unit, and on the coast of British Columbia generally, and often are the dominant plant species in ecological communities.

10.3 Effects Assessment

10.3.1 Effects Analysis Methods

Two temporal boundaries are used for the assessment of potential environmental effects on vegetation resources. These include:

- **Baseline Scenario**—The baseline scenario represents vegetation conditions as of 2010, prior to any Project-related developments. The baseline conditions for vegetation resources incorporate the environmental effects of existing human-caused disturbances, including roads, rail lines, industrial facilities and logging.

- **Maximum Disturbance Scenario**—The maximum disturbance scenario represents vegetation conditions during the Construction phase. The maximum disturbance scenario is intended to represent the "worst case" for use in the vegetation effects assessment.

Spatially, the significance thresholds for the KIs are based on the RAA; however, the maximum disturbance scenario first determined the direct loss of KIs in the Project footprint. Because quantitative data is available for the LAA (such as available TEM data and field survey data), effects are compared to significance thresholds first at this scale. If thresholds are exceeded, then the effects are examined qualitatively (and quantitatively when reliable data exists) in the context of the RAA. The assessment used spatial analysis of TEM and field data to assess the potential effects of the Project on each vegetation resource. The baseline scenario quantified or qualified existing baseline conditions for vegetation resources on Ridley Island.

10.3.2 Loss of Rare Vascular Plants

10.3.2.1 Potential Effects

Two provincially Blue-listed rare vascular plants have been recorded on Ridley Island. One occurrence of Alaska holly fern (*Polystichum setigerum*) was found approximately 25 m from the edge of the Project footprint, near the shoreline of the island. One occurrence of Gmelin's sedge (*Carex gmelinii*) was located 1 km outside of the Project footprint. See Figure 10.2 for locations of rare plant occurrences. There are no known occurrences of rare vascular plants within the Project footprint; therefore, construction and commissioning work for the Project will not lead to direct loss of the observed rare plants.

10.3.2.2 Mitigation

No specific mitigation is planned for rare vascular plants as there will be no direct effects on rare plants due to the Project. Indirect effects through changes to abiotic conditions will be minimized through drainage and erosion control as outlined in the EMP. These techniques may include the construction of berms to direct runoff and maintain hydrological regimes of communities supporting rare plants, as well as the installation of silt fences to remove suspended solids before runoff water leaves the Project site. A weed control plan will be developed to minimize establishment of non-native invasive species that could compete with native species.

10.3.2.3 Residual Effects

Residual effects to rare vascular plants are expected to be neutral (i.e., there will be no change as compared to the baseline condition).

10.3.2.4 Determination of Significance

The known occurrences of rare vascular plants will not be disturbed by the Project, therefore, effects of the Project on rare plants are considered not significant.

10.3.3 Loss of Ecological Communities of Conservation Concern

10.3.3.1 Potential Effects

Five provincially Red- or Blue-listed ecological communities are found on Ridley Island. A quantification of the direct effects to ecological communities of conservation concern in the LAA is presented in Table 10-9. Figure 10.2 shows the distribution of ecological communities of conservation concern in the LAA and Project footprint. Quantitative information on the distribution of ecological communities of conservation concern is not available in the RAA. Significance of potential effects to ecological communities of conservation concern is determined based on regional thresholds; if effects exceed these thresholds locally (i.e., within the LAA), then the effect is examined in a regional context.

Direct effects will lead to the loss of 1.1 ha (33.9%) of the *Very Highly Vulnerable* Red-listed ecosystems in the LAA and 14.6 ha (27.4%) of the *Very Highly* or *Highly Vulnerable* Blue-listed ecosystems in the LAA. The Project will also lead to the loss of 2.7 ha (59.0%) of *Not Intrinsically Vulnerable* Blue-listed ecosystems on Ridley Island which are not considered in this assessment. Refer to Section 10.2.2 for more detail on the role of succession in the determination of ecosystem vulnerability.

Table 10-9: Direct Effects to Ecological Communities of Conservation Concern

Name	Map Code	Type	Vulnerability Rating[1]	Baseline	Maximum Disturbance	
				LAA (ha)	Area in Project Footprint (ha)	Change from Baseline (%)[2]
Red-listed						
Sitka sedge/peat mosses	FS	Wetland	VHV	3.2	1.1	-33.9
Blue-listed						
Western hemlock – Sitka spruce/lanky moss	HM	Upland	HV	8.0	0	0
			VHV	5.6	1.6	-27.9
Western redcedar – Sitka spruce/skunk cabbage	RC	Wetland	HV	8.1	0.8	-9.3
			VHV	26.4	11.8	-44.6
Western redcedar – Sitka spruce/sword fern	RF	Upland	VHV	0.6	0.2	-37.3
Sitka spruce/Pacific crab apple	SC	Wetland	HV	1.4	0.2	-16.2
			VHV	3.0	0	0
Total				**56.4**	**15.6**	**-28**

NOTES:
[1] VHV = Very Highly Vulnerable; HV = Highly Vulnerable
[2] Differences between percent calculations and areas are due to significant digits and rounding

10.3.3.2 Mitigation

Indirect effects to ecological communities of conservation concern will be limited through drainage and erosion controls to maintain the hydrological regime, as outlined in the EMP. These techniques may include the construction of berms to direct runoff away from sensitive plant communities and maintain hydrological regimes of adjacent rare ecosystems, as well as the installation of silt fences to remove suspended solids before runoff water leaves the Project footprint.

Direct effects to the three ecological communities of conservation concern that are wetlands will be mitigated through development of a wetland compensation plan, as outlined in Section 10.3.5.2 below.

10.3.3.3 Residual Effects

Residual effects on the wetland communities of conservation concern will include the loss of 1.1 ha (33.9%) of Red-listed *Very Highly Vulnerable* FS map code, 12.5 ha (36.3%) of Blue-listed *Highly and Very Highly Vulnerable* map code RC and 0.2 ha (5.3%) of *Highly* and *Very Highly Vulnerable* Blue-listed map code SC. The Red-listed FS community and the Blue-listed RC community surpass the thresholds at the local level. However, given that these, and the SC community are wetlands, their loss will be offset through the development and implementation of the wetland compensation plan as outlined in Section 10.3.5. The residual effects will therefore be neutral because of the development of a wetland compensation plan.

For the *upland* communities of ecological concern, residual effects on these Blue-listed communities include the loss of 0.2 ha (37.3%) of *Very Highly Vulnerable* RF map code and 1.6 ha (11.4%) of *Highly* and *Very Highly Vulnerable* HM map code from Ridley Island.

Although the effect to the RF ecosystem surpasses the 30% Blue-listed threshold within the LAA, it is expected that the regional loss within the Kaien Landscape Unit is far below this threshold. For example, although the regional distribution of these rare communities is unknown, there are 2.4 ha of *Highly Vulnerable* RF map code near the Fairview Project that are unaffected by that project (Stantec 2009). This means that, very conservatively, the regional loss of 0.2 ha of the Blue-listed *Highly* and *Very Highly Vulnerable* RF community due to the Project is at most 8%, considering a baseline of at least 3.0 ha exists in the region.

Overall, residual effects on ecological communities of conservation concern will be adverse, moderate, site-specific, occur once, be long term and irreversible.

10.3.3.4 Determination of Significance

Effects of the Project on the Red-listed ecological community of conservation concern are considered not significant as they will be mitigated as described in Section 10.3.5.2. Effects of the Project on the Blue-listed ecological communities of conservation concern are considered not significant as they will either be mitigated as described in Section 10.3.5.2 for wetland communities and for upland communities they are expected to easily fall within thresholds as described by the CNCO guidelines (Ministry of Agriculture and Lands 2009).

10.3.4 Loss of Old Forest

10.3.4.1 Potential Effects

Old forest (structural stage 7) covers approximately 93 ha of Ridley Island at baseline. Overall, under the maximum disturbance scenario, 64% of the old forest will remain on Ridley Island, as summarized in Table 10-10 and shown on Figure 10.3.

For individual ecosystem units within the Project LAA, all of the CNCO identified modal, rare, or very rare old forest ecosystems will be retained above the stated 60% threshold. Further, as identified in Section 10.1.5, other non-CNCO identified units need to have at least 30% of their area within the RAA retained. Even within the LAA, all of the remaining old forest ecosystems are within this threshold except for the Shore pine – Yellow-cedar – Tufted clubrush bog ecosystem which exceeds this guideline within the LAA. However, although no current mapping exists for the Kaien Landscape Unit, it is expected that regionally this old forest ecosystem will also surpass the target of 30% retention over the landscape unit (which is consistent with existing guidelines).

Table 10-10: Direct Effects to Old Forest

Community Name	Map Code	Equivalent Site Series Surrogate	Baseline	Maximum Disturbance	
			Area in LAA (ha)	Area in Project Footprint (ha)	Change from Baseline (%)
Western hemlock – Sitka spruce/lanky moss	HM	Ss Good; Cw Med	5.6	1.6	-28.6
Western redcedar – western hemlock/salal	HS	Cw Med	56.1	18.2	-32.4
Shore pine – Yellow-cedar – Tufted clubrush bog	LS	N/A	1.5	1.3	-86.7
Western redcedar – Sitka spruce/skunk cabbage	RC	N/A	26.4	11.8	-44.7
Western redcedar – Sitka spruce/sword fern	RF	Ss Good; Cw Med	0.6	0.2	-33.3
Sitka spruce/Pacific crab apple	SC	N/A	3.0	0	0
Total			**93**	**33**	**-36**

10.3.4.2 Mitigation

The potential loss of old forest ecosystems was minimized through Project design. No additional mitigation for old forest is proposed.

10.3.4.3 Residual Effects

The residual effects to old forest as a result of direct loss are expected to be adverse in direction, low in magnitude, site-specific in extent, long term, and will occur only once. They will be reversible, as areas of mature forest (structural stage 6) within the LAA will become old forest (structural stage 7). There is a high level of certainty in this outcome.

10.3.4.4 Determination of Significance

Direct effects from the Project will lead to a loss of 36% (i.e. retention of 64%) of the old forest in the LAA, well within recommendations by the CNCO for the overall retention of 30% of old forest in the landscape unit (Ministry of Agriculture and Lands 2009). As such, the effects of the Project to old forest are considered not significant.

10.3.5 Loss of Wetland Function

10.3.5.1 Potential Effects

The total area of wetland that occurs within the Project footprint is 69 ha. Figure 10.4 shows the distribution of wetlands in the LAA and in the Project footprint. Site preparation work for the proposed Project will include clearing of vegetation, topsoil salvage, backfilling, blasting and grading. Environmental changes to adjacent forest and wetland habitat (outside of the footprint of direct effects) may include higher ground temperatures and reduced infiltration due to a replacement of the current vegetation cover with man-made surfaces (asphalt, gravel, buildings, etc.), and localized changes in groundwater movement due to alterations to the current topography. These environmental changes may adversely affect the functions of wetland communities.

10.3.5.2 Mitigation

When wetland areas cannot be avoided, mitigation techniques as detailed in the EMP will be implemented. These are primarily focused on drainage and erosion control techniques designed to maintain the hydrological regime of wetland areas bordering the Project footprint. These techniques may include the construction of berms to direct runoff or maintain hydrological regimes of adjacent wetland ecosystems, and the installation of silt fences to remove suspended solids before runoff water leaves the Project site.

Where avoidance of wetlands is not possible and other mitigation techniques are not practical, wetland function may be lost. An assessment of the Ridley Island wetlands indicated that the primary functions and services provided by these wetlands are:

- Atmospheric carbon sequestration and long term storage (>1,000 years) in peat and woody vegetation
- Support of the food chain in down gradient aquatic habitat through the export of dissolved organic carbon
- Habitat, most notably:
    - Foraging, nesting, and staging habitat for migratory birds (including raptors, waterfowl, shorebirds, and songbirds) provided by the sedge fens in the study area.
    - Habitat for herpetiles, such as western toads, rough-skinned newts, and Pacific salamander, all of which have been observed on Ridley Island (Stantec 2011).
    - Supporting three ecological communities of conservation concern, including a Red-listed fen, and two Blue-listed swamps.

To effectively mitigate the effects of the Project on wetlands, these functions will be compensated through development of a wetland compensation plan developed in consultation with CWS. Several options are available to offset losses of wetland function in areas outside the RAA. These include:

- Funding to organizations whose mandates are consistent with enhancement, preservation, restoration and creation of wetland habitat (e.g., Ducks Unlimited Canada)
- Funding to organizations whose mandate is to specifically provide one or more of the identified functions provided by wetlands affected by the Project (e.g., Pacific Carbon Trust)
- Enhancement of unaffected wetland areas to better provide these functions
- Preservation of wetland areas that provide these functions that may be at risk of future development through securement of property and/or land use covenants
- Restoration of degraded wetland areas with the potential to provide these functions
- Creation of wetland areas with design goals to provide these functions.

The proposed compensation plans will include, at a minimum:

- A conceptual plan
- Specific goals for the Project and an outline of how they will offset the functions of wetlands affected by the Project (e.g., sequestration of carbon or meeting habitat requirements of one or more identified species)
- An implementation plan, including schedule and construction phase environmental protection, if necessary
- An adaptive management plan, specifying potential risks, how the risks will be identified and managed or resolved to achieve Project goals.

10.3.5.3 Residual Effects

With the implementation of mitigation and compensation measures, the residual effects to wetland function as a result the Project are expected to be neutral.

10.3.5.4 Determination of Significance

Given that a wetland compensation plan will be developed as per discussions with EC, the predicted effects to wetland function are determined to be not significant.

10.3.6 Loss of Riparian Areas

10.3.6.1 Potential Effects

Construction of the Project will result in a loss of approximately 47 ha of riparian area from Ridley Island. Figure 10.5 shows the distribution of riparian areas in the LAA and Project footprint.

10.3.6.2 Mitigation

Where the identified riparian communities cannot be avoided, mitigation techniques as detailed in the EMP will be implemented; these include drainage and erosion control to maintain the hydrological regime. These techniques may include the construction of berms to direct runoff away from sensitive riparian communities, or maintain hydrological regimes of adjacent ecosystems, and the installation of silt fences to remove suspended solids before runoff water leaves the Project site. These measures will also mitigate effects to riparian communities that could indirectly affect wetland function.

10.3.6.3 Residual Effects

The residual effect after mitigation is the loss of 47 ha (23%) of the riparian area on Ridley Island. This effect is adverse in direction, low in magnitude, site-specific in extent, long-term, will occur only once and will be reversible. There is a high level of certainty in this outcome.

10.3.6.4 Determination of Significance

Effects to riparian areas are not significant as they conform to the recommendation by the CNCO for the loss of no more than 30% of riparian area (Ministry of Agriculture and Lands 2009).

10.3.7 Loss of Traditional Use Plants

10.3.7.1 Potential Effects

Clearing of vegetation will lead to the loss of traditional use plants in the Project footprint. Access to the species listed in Table 10-8 that are present in the Project footprint will be lost. Distribution of these plants in the Project footprint is unknown, but these species are common regionally and provincially.

10.3.7.2 Mitigation

In developing a wetland compensation plan, as outlined in Section 10.3.5.2, traditional use plant species will be used for plantings where possible and practicable.

10.3.7.3 Residual Effects

The residual effects to traditional use plants as a result of direct loss are expected to be adverse in direction, low in magnitude, site-specific in extent, long term, and will occur only once, and will be irreversible. There is a high level of certainty in this prediction.

10.3.7.4 Determination of Significance

Considering the highly common nature of the traditional use plants that occur on Ridley Island, the availability of these plants regionally, as well as the incorporation of traditional use plants into the wetland compensation plan where possible, the effects to traditional use plants are determined to be not significant.

10.4 Combined Effects and Overall Significance Determination

Table 10-11 summarizes the overall significance determination of Project effects on vegetation resources. With the implementation of proposed mitigation measures, the residual effects to vegetation resources will be adverse in direction, low to moderate in magnitude, site-specific, occur once, long-term, irreversible, and occur within an undisturbed ecological context. After application of mitigation and wetland compensation, residual effects to vegetation resources are determined to be not significant.

Table 10-11: Summary of Project Residual Effects on Vegetation Resources

Residual Effect	Characterization of Residual Effects								Recommended Follow-up or Monitoring
	Direction	Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological Context	Significance	
Rare plants	N	–	–	–	–	–	U	N	
Ecological Communities of Conservation Concern	A	M	S	O	L	I	U	N	Wetland compensation plan
Old forest	A	L	S	O	L	R	U	N	
Wetland function	N	–	–	–	–	–	U	N	Wetland compensation plan
Riparian	A	L	S	O	L	I	U	N	
Traditional use plants	A	L	S	O	L	R	D	N	Incorporate traditional use plants into wetland compensation plan where feasible.
Combined	**A**	**L**	**S**	**O**	**L**	**I**	**U**	**N**	

NOTES:
See Table 10-3 for characterization criteria for residual effects to vegetation resources.
Direction: P=Positive; N=Neutral; A=Adverse
Magnitude: L=Low; M=Moderate; H-High
Geographic Extent: S=Site-specific; L=Local; R=Regional
Frequency: O=Once; R=Rarely; F=Frequently
Duration: S=Short-term; M=Medium-term; L=Long-term
Reversibility: R=Reversible; I=Irreversible
Ecological Context: D=Disturbed; U=Undisturbed

10.5 Cumulative Effects Assessment

Cumulative effects to vegetation resources are assessed by first determining if the Project is likely to have an adverse residual effect on a vegetation resource and then determining if other projects or activities also potentially adversely affect the same vegetation resource. When the effects of a Project act in combination with the effects of other projects or activities, a cumulative effect may result. A cumulative effects assessment determines if there is a reasonable expectation that a Project's contribution to cumulative effects will compromise the sustainability of the resource regionally.

The Project will have the following adverse residual effects on vegetation resources:

- Loss of 1.8 ha of Blue-listed upland communities
- Loss of 33 ha of old forest
- Loss of 47 ha of riparian area
- Loss of some common traditional use plants.

These residual effects on vegetation resources may act cumulatively with the effects of other projects and activities in the area. In 2011, the PRPA prepared the Port of Prince Rupert 2020 Land Use Management Plan, in which Ridley Island was earmarked for major industrial development; therefore further development of Ridley Island is anticipated (PRPA 2011). However, there is no reasonable expectation that the Project's contribution to cumulative effects will compromise the sustainability of the above resources regionally.

Based on the expectation that the Project's contribution to cumulative effects will not have a significant effect on the sustainability of vegetation resources, a quantitative cumulative effects assessment was not completed for vegetation resources.

10.6 Follow-up Program

The wetland compensation plan will include a detailed monitoring plan to confirm the achievement of Project goals (e.g., seasonal carbon balance or herpetile surveys).

10.7 Ecological Community Descriptions

See Figure 10.1 for ecological community mapping in the LAA, and below for descriptions of the mapped ecological communities.

Map Code: BP

Yellow pond-lily – Buckbean bog pond (CWHvh2/00)

Bog ponds are permanently flooded pools of still or slow moving water with more than 10% emergent vegetation. Yellow pond-lily and buckbean dominate the open water areas of the bog ponds, but associated plants can vary depending on water movement. Bog ponds are distinguished from fens by their poor nutrient status, stagnant water, and the fact that the lack of sedges at the edge of the open water areas. The degraded peat bog pond areas are surrounded with Sphagnum moss and typical bog plants such as tufted clubrush, white beak rush, and sundews. These ecological communities are important for wildlife such as sandhill cranes, as they provide high densities of invertebrate prey, nesting platforms, and abundant shelter.

Map Code: CE

Lyngby's sedge – Common spike-rush estuarine mudflat (CWHvh2/00, Em01)

This map code was created specifically for the Project to represent the industry-altered estuarine mudflat ecological community at the south end of the island. This nutrient rich area is dominated by Lyngby's sedge and common spike-rush with co-dominants such as widgeon-grass, marsh cinquefoil and toad rush. While this ecological community has been altered by the construction of a dike, culverts connect the tidal flow to the mudflats which has maintained ecological community structure and water bird habitat for the last 20 – 40 years. No occurrences of this ecological community occur within the Project Footprint.

Map Code: FS

Sitka sedge – Sphagnum fen (CWHvh2/33, Wf51)

These fens consist of open water surrounded by fringes of Sitka sedge and sweet gale. These nutrient poor fens (average pH levels around 4.5) have low plant diversity with some areas almost exclusively Sitka sedge with only one or two species of sphagnum. The FS unit is not common, but has high potential for foraging and nesting habitat for waterfowl.

Map Code: HM

CwHw – lanky moss (CWHvh2/04)

Lanky moss forests are productive sites that usually occur on substantial slopes adjacent to mesic forests. The HM site series is dominated by western hemlock and western redcedar. Shore pine and yellow-cedar are uncommon or absent from these sites. The HM ecosystem occurs on organic veneers over colluvium and is generally better drained than the zonal HS ecosystem. This ecosystem is Blue-listed by the CDC.

Map Code: HS

CwHw – salal (CWHvh2/01)

The HS ecosystem (the zonal site series) is the most common forested site series in the study area occurring along the outer edges of the dominant TS bog ecosystem. This mesic forest unit is dominated by western redcedar, western hemlock, and yellow-cedar with some shore pine and mountain hemlock on upper to lower slope positions. Shrub layers are characterized by salal, false azalea and red huckleberry. Herb layers include bunchberry and false-lily-of-the-valley, with minor amounts of skunk cabbage. Moderate covers of feathermosses and sphagnum moss occupy the moss layer. These forests occur on organic veneers over bedrock or organic veneers over morainal material. Soils are typically imperfectly drained Organic Folisols.

Map Code: JR

Common juniper – Tufted clubrush – Hoary rock-moss bog (CHWvh2/32, Wb52)

The JR bog ecological community is uncommon on Ridley Island and typically occurs as small patches distributed within the matrix of extensive TS bog. JR bogs are characterized by relatively shallow peat depths and higher percent covers of common juniper and hoary rock-moss (*Racomitrium lanuginosum*). Only two areas were observed that were large enough to be included in the terrestrial ecological community mapping.

Map Code: LS

Shore pine – Yellow-cedar – Tufted clubrush bog (CWHvh2/12, Wb53)

The LS bog ecological community is very common on Ridley Island. The shrub layer is typically dominated by shore pine, yellow-cedar, and western redcedar. Dwarf shrubs and herb layers are diverse and variable, with tufted club-rush, cottongrasses, sundews, and white beak-rush being most common. A well-developed moss layer occurs on these sites, including a variety of peat mosses and upland moss species.

Map Code: RC

CwSs – skunk cabbage (CWHvh2/13, Ws54)

CwSs – skunk cabbage forests can be distinguished from mesic forests by slope position, drainage, and relative cover of skunk cabbage. Skunk cabbage swamp forests are localized in lower slope positions, are poorly drained, and have a substantial cover of skunk cabbage. They are dominated by western redcedar and western hemlock. They occur on organic veneers and blankets over morainal or fluvial materials. This ecosystem is Blue-listed by the CDC.

Map Code: RF

CwHw – sword fern (CWHvh2/05)

Sword fern forests are found on substantial slopes and on generally more productive sites than the CWHvh2/01 HS unit. The sword fern ecosystem often develops in the presence of base-rich bedrock (Banner *et al.* 1993a). Several metamorphic cliff exposures occur upslope of the shoreline on Ridley Island and exhibit improved drainage and nutrient conditions. This site series can be distinguished from the 01 and 04 site series by high covers of sword fern and the lack of any substantial cover of salal. This ecosystem is Blue-listed by the CDC.

Map Code: SC

Sitka spruce/Pacific crab apple (CWHvh2/19)

Sitka spruce/Pacific crab apple shoreline forests occur as a fringe between upland forests and lower tidal ecosystems on the exposed coastline of Ridley Island. Canopy tree species include such as

Sitka spruce and western hemlock with an understory consisting of Pacific crab apple trees or tall shrubs. Other shrubs in this ecosystem that thrive in the increased light conditions include red huckleberry and salal.

Map Code: TS

Shore pine – Black crowberry – Tough peat-moss bog (CWHvh2/31, Wb51)

The TS bog ecological community is very common on Ridley Island and is easily identified from large scale colour aerial photography by the distinctive orange-brown colours of tough peat moss (*Sphagnum austinii*). Other common peat mosses include small red peat moss (*Sphagnum capillifolium*), brown-stemmed bog moss (*Sphagnum lindbergii*), and fat bog moss (*Sphagnum papillosum*). As the name of the ecological community indicates, shore pine and black crowberry are common shrub species, and are typically accompanied by yellow-cedar, western redcedar, sweet gale, Labrador tea, bog-rosemary, and western bog-laurel. Soils in TS bogs are typically Mesisols and Fibrisols with peat accumulations up to 5 m deep.

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10.9 Figures

Please see the following pages.

Client: Canpotex | PRINCE RUPERT PORT AUTHORITY

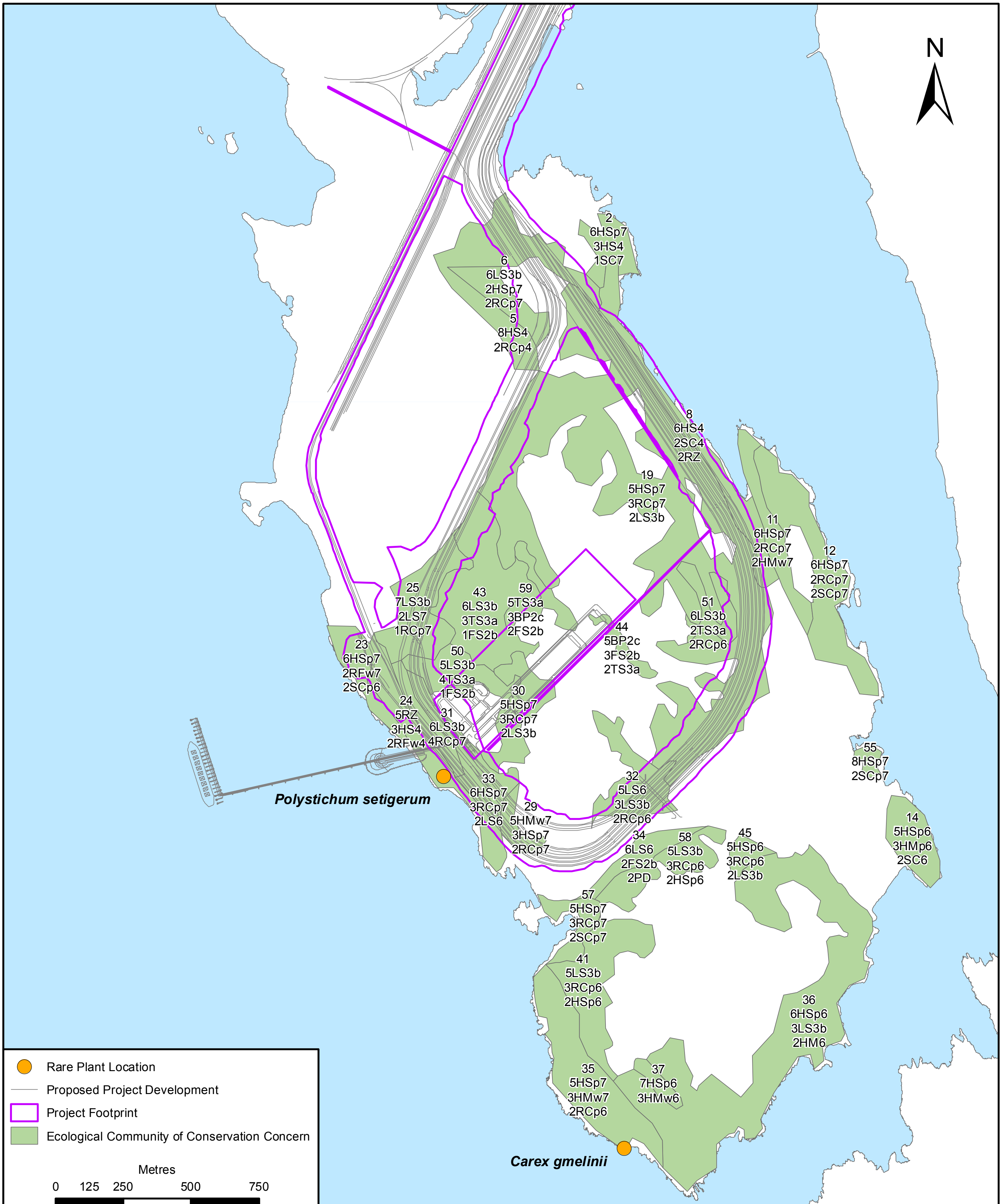
Data Sources: Province of British Columbia, Government of Canada

TEM Attribution in the LAA
PROJECT DESCRIPTION
RIDLEY ISLAND, BRITISH COLUMBIA

Job No.:	123110264
Scale:	1:18,500
Date:	14-Sep-11
Dwn. By:	RS
App'd By:	JM

Fig. No.: 10.1

Stantec



Client:

Canpotex

PRINCE RUPERT PORT AUTHORITY

Data Sources: Province of British Columbia, Government of Canada

Job No.:	123110264
Scale:	1:18,500
Date:	14-Sep-11
Dwn. By:	RS
App'd By:	JM

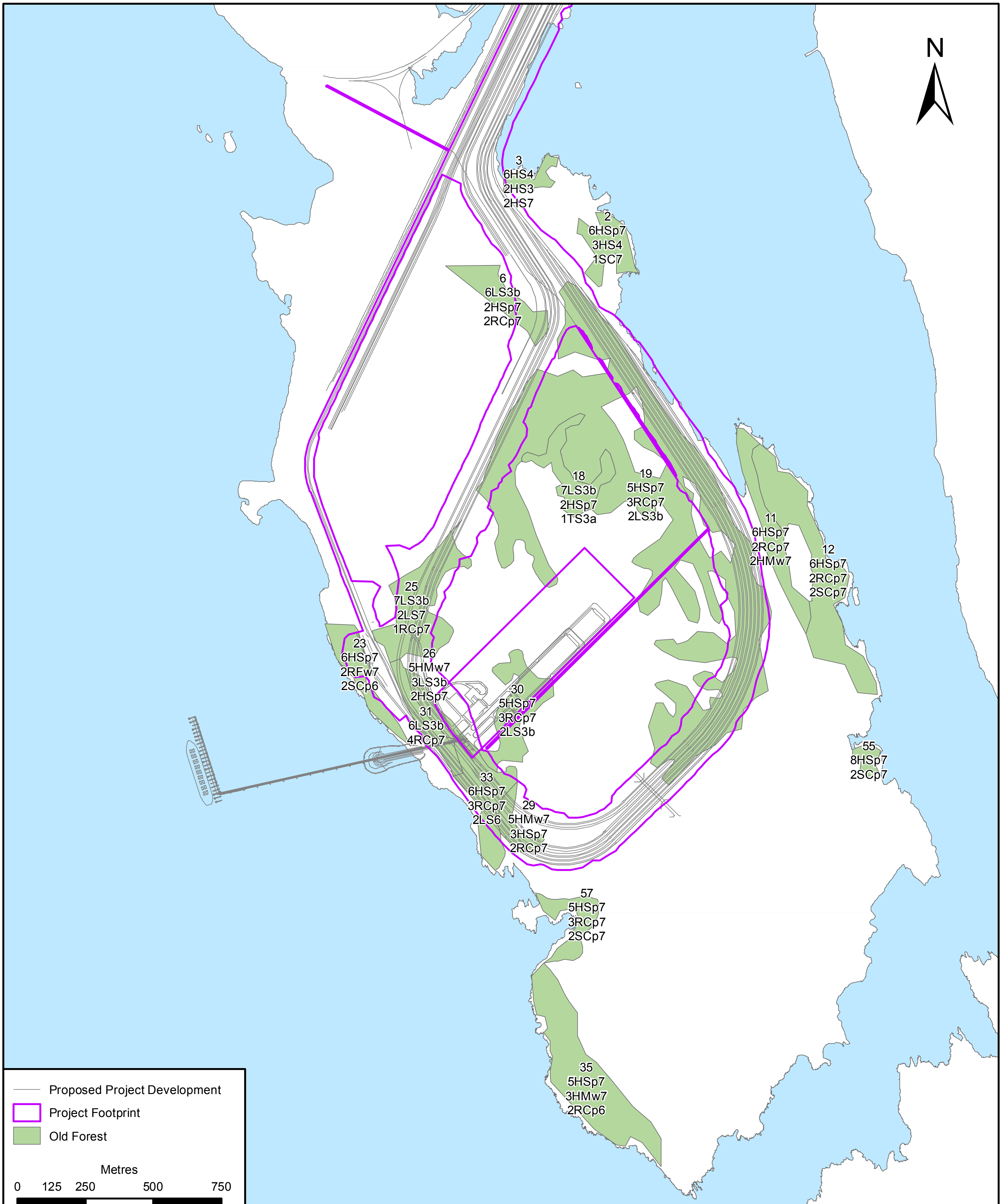
Fig. No.: 10.2

Stantec

Ecological Communities of Conservation Concern and Rare Plant Occurrences in the LAA

PROJECT DESCRIPTION

RIDLEY ISLAND, BRITISH COLUMBIA



Client:

Canpotex

PRINCE RUPERT PORT AUTHORITY

Data Sources: Province of British Columbia, Government of Canada

Old Forest in the LAA

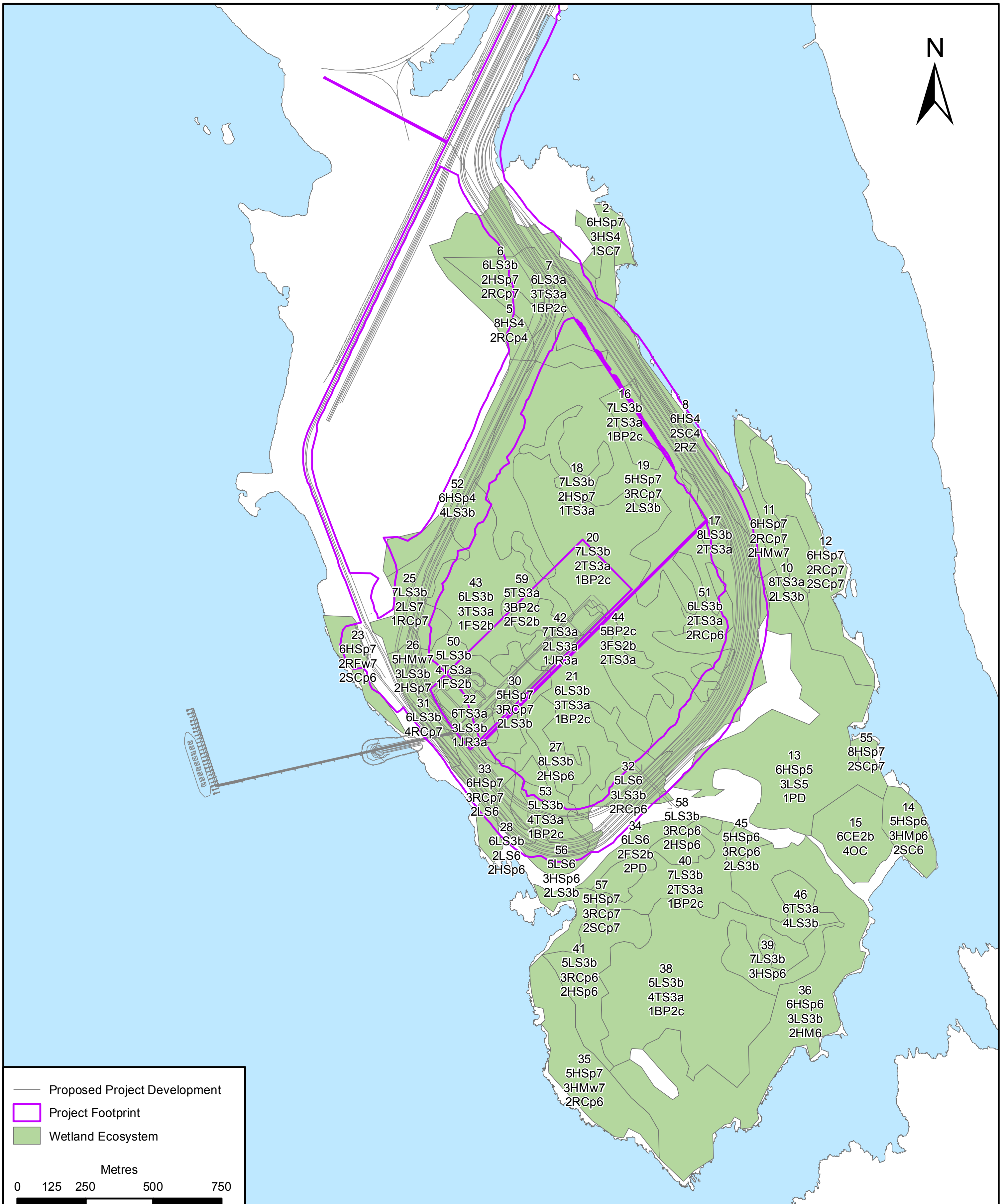
PROJECT DESCRIPTION

RIDLEY ISLAND, BRITISH COLUMBIA

Job No.:	123110264
Scale:	1:18,500
Date:	14-Sep-11
Dwn. By:	RS
App'd By:	JM

Fig. No.: 10.3

Stantec



Client:

Canpotex

PRINCE RUPERT PORT AUTHORITY

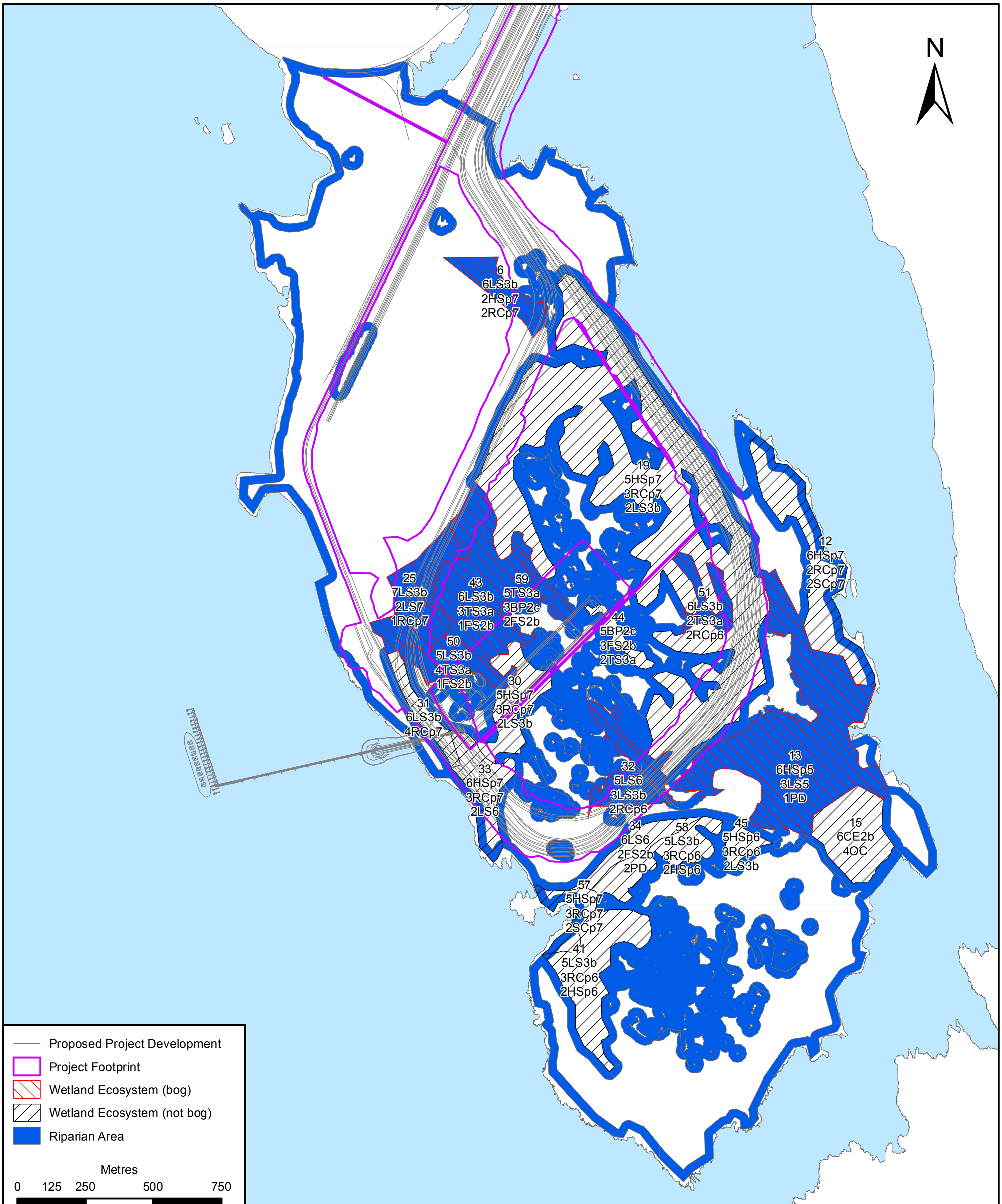
Data Sources: Province of British Columbia, Government of Canada

Wetlands in the LAA
PROJECT DESCRIPTION
RIDLEY ISLAND, BRITISH COLUMBIA

Job No.:	123110264
Scale:	1:18,500
Date:	14-Sep-11
Dwn. By:	RS
App'd By:	JM

Fig. No.:
10.4

Stantec



Client:

Canpotex

PRINCE RUPERT PORT AUTHORITY

Data Sources: Province of British Columbia, Government of Canada

Riparian Areas in the LAA
PROJECT DESCRIPTION
RIDLEY ISLAND, BRITISH COLUMBIA

Job No.:	123110264
Scale:	1:18,500
Date:	14-Sep-11
Dwn. By:	RS
App'd By:	JM

Fig. No.: 10.5

Stantec

11 WILDLIFE AND WILDLIFE HABITAT ASSESSMENT

11.1 Scope of Assessment

11.1.1 Regulatory/Policy Setting

Management of wildlife resources (including mammals, birds, and amphibians) on federal lands occurs primarily through the *Species at Risk Act* (SARA) and the *Migratory Birds Convention Act* (MBCA). These acts are administered through the Canadian Wildlife Service (CWS), a branch of Environment Canada.

Through the MBCA, federal biologists manage bird populations by regulating and restricting the harvest (or take) of individuals. The MBCA prohibits the disturbance, destruction or possession of migratory birds, and their nests, or eggs (MBCA section 5[9]) and prohibits the deposit of oil, oily waters and other substances harmful to migratory birds in any water or areas that they frequent (MBCA Section 5.1).

SARA came into effect in June 2003 to assist with the prevention of species-at-risk from becoming extinct and to aid in their recovery. It is also intended to manage species of Special Concern, to prevent them from becoming Threatened or Endangered. On federal lands, SARA protects species (and their residences) listed as Threatened or Endangered in Schedule 1. SARA requires that CWS prepare recovery plans for Threatened and Endangered species. Once a recovery plan is approved, it must be considered during any development or habitat alteration that may affect the species. For species listed as Special Concern, CWS must prepare a management plan that includes conservation measures for the species. While species (and their residence) listed as Endangered or Threatened and on Schedule 1 of SARA are protected, species of Special Concern are not.

11.1.2 Key Issues

The following key issues were identified through discussions with CWS and based on the professional judgment of the study team. The key issues are:

- Compliance with the MBCA with respect to the destruction of nests and nesting birds
- Compliance with the protection of species, and their residences, listed as Threatened or Endangered on Schedule 1 under SARA
- Management of species of Special Concern listed under SARA, consistent with Canada's policies related to biodiversity.

Consideration of potential Project effects on all wildlife species is critical, but it is impractical to consider every species individually. An effects based approach was used to assess the relevant potential effects of the Project on indicator species, or species groups. This assessment considers the potential effects of the Project on:

- SARA-listed species
- Nesting migratory birds
- Marine birds.

To assess effects on species-at-risk, marbled murrelet, northern goshawk, and western toad were chosen as indicator species. These species were selected because of their status under SARA and because of the potential for Project activities to interact with them. Each of these species is on Schedule 1 of SARA. Marbled murrelet and northern goshawk (*laingi* subspecies) are Threatened species and western toad is a species of Special Concern. Migratory nesting birds are of concern because many species of migratory birds (e.g., songbirds, woodpeckers, etc.) nest in a variety of habitats on Ridley Island. These species nest in the trees, shrubs, or on the ground throughout the island. Marine birds use the waters surrounding Ridley Island as foraging habitat. Species such as the marbled murrelet feed in the nearshore waters around Ridley Island. Many species of seaducks, seabirds, gulls and shorebirds use these waters year-round and are especially abundant in the winter.

Potential Project interactions with wildlife during the construction, operations, and decommissioning phases are identified in Table 3-4. The potential effects associated with these interactions are:

- Change in habitat availability
- Risk of mortality
- Alteration of movement.

Project activities that may cause these effects are identified in Table 11-1.

Table 11-1: Potential Environmental Effects to Wildlife and Wildlife Habitat Associated with the Project

Project Activities and Physical Works	Potential Environmental Effects		
	Change in Habitat Availability	Risk of Mortality	Alteration of Movement
Construction and Commissioning			
Temporary Construction Infrastructure (trailers, power, sanitary facilities, etc.)	✓		
Site Preparation (Clearing and Grubbing, Site Grading)	✓	✓	
Rail Loop Construction	✓		✓
Onshore Terminal Construction (receiving, storage, reclaim and shiploading facilities, site services)	✓		
69 kV transmission line Construction	✓		
Installation of Canpotex Rail Tracks	✓		
Access Road and Overpass Construction	✓		
Dredging			✓
Disposal at Sea			✓
Marine Facilities Construction (causeway, trestle and berth)			✓

Project Activities and Physical Works	Potential Environmental Effects		
	Change in Habitat Availability	Risk of Mortality	Alteration of Movement
Operations			
Potash Handling Operations (receiving, storage, reclaim and shiploading of potash)	✓		
Waste Management (Sewage, Stormwater and Wastewater)	✓	✓	
Arrival and Departure of Vessels			✓
Arrival and Departure of Trains		✓	
Interaction of Other Projects and Activities in the Boundary for Assessment (potential for cumulative effects; see rankings below)			
Ridley Terminals Inc.	2	1	1
Prince Rupert Grain Ltd	2	1	0
Ridley Island Log Sort (Not Operational)	2	0	0
HPI Wood Pellet Facility (Not Operational)	1	0	0
China Paper Group Pulp Mill (Not Operational)	1	0	0
Fairview Terminal (existing and II)	1	1	1
Quickload Terminals Prince Rupert Container Examination Facility	1	1	1
CN Aquatrain facility	1	1	1
BC Ferries and Cruise ship Terminal	1	0	1

Project Environmental Effects

Only Project – Environment interactions ranked as 2 in Table 3-4 are carried forward to this Table. A

✓ Indicates that an activity is likely to contribute to the environmental effect.

Cumulative Environmental Effects

Cumulative environmental effects were ranked as follows:

0 = Project environmental effects do not act cumulatively with those of other Projects and Activities

1 = Project environmental effects act cumulatively with those of other Project and Activities, but are unlikely to result in significant cumulative environmental effects **OR** Project environmental effects act cumulatively with existing significant levels of cumulative environmental effects but will not measurably change the state of the VEC

2 = Project environmental effects act cumulatively with those of other project and activities, and may result in significant cumulative environmental effects **OR** Project environmental effects act cumulatively with existing significant levels of cumulative environmental effects and may measurably change the state of the VEC

Potential interactions identified in Table 3-4 but not carried forward in the assessment include:

- Commissioning
- Infrastructure Maintenance
- Decommissioning activities including:
  - Removal of Site Infrastructure (potash handling system/buildings)
  - Waste Disposal and Site Clean-up.

Based on professional judgment and experience, the effects on wildlife from the above activities will be nominal, and would not be considered significant. Commissioning of the Project and infrastructure maintenance may interact with wildlife through disturbance and lead to avoidance of habitats. However, this disturbance would be small relative to the other Project activities and the potential effects are not likely to be significant. The Project lifespan is likely to exceed 50 years; however, the eventual decommissioning would have a positive effect on wildlife resources as the site would be allowed to return to natural conditions following the removal of Project infrastructure. Consequently, this assessment does not discuss effects from decommissioning activities and focuses only on potential Project effects arising from construction and operations (i.e., change in habitat availability, risk of mortality, and alteration of movement).

Change in habitat availability—The site preparation (clearing and grubbing, site grading) activities for the construction and operation of the Project will remove breeding, feeding and wintering habitat for wildlife for the lifetime of the Project. Furthermore, the noise and disturbance associated with construction activities (i.e., temporary construction infrastructure, rail loop construction, onshore terminal construction, 69 kv transmission line construction, installation of Canpotex rail tracks, and access road and overpass construction) and during operations (i.e., potash handling operations, road and rail traffic) can make adjacent habitats less suitable for wildlife.

Waste management activities resulting in the deposition of sediment in man-made ponds designated for waste disposal will likely reduce the habitat quality for wildlife species using the ponds, including species-at-risk (i.e., western toad).

Risk of mortality—There is a potential for mortality of some wildlife species, such as small mammals and amphibians, during vegetation clearing and grubbing. Small mammals and amphibians tend to take cover when exposed to noise and construction activity, making individuals vulnerable to heavy equipment. This activity is unlikely to affect populations of small mammals (given their widespread abundance); however there is potential for effects on amphibian species-at-risk, such as the western toad (considered in this effects assessment). Adult birds and large- and medium-sized mammals are unlikely to suffer direct mortality from clearing as they would flee the area. However, clearing could destroy bird nests and nestlings if it is conducted in the spring or summer. In addition, construction activities may cause birds in adjacent habitats to abandon their nests or cause increased mortality of eggs and hatchlings from exposure to cold or predators during temporary abandonment.

Waste management activities resulting in the deposition of sediment in man-made ponds designated for waste disposal may result in risk of mortality for amphibians (such as western toads). Deposition of waste or sediment has potential to destroy eggs and tadpoles of western toads if it occurs during their breeding period.

Increased road traffic during construction and arrival and departure of trains during Project operations may result in mortality of western toads crossing road or railway tracks when moving between terrestrial and aquatic habitats. Adult and juveniles toads may have difficulty crossing the rail tracks, therefore the presence of the tracks and their use by trains may lead to toad mortality.

Alteration of movement—Wildlife movements may be altered for a number of reasons. Project activities in the marine environment, including disposal at sea, marine facilities construction, the arrival and departure of vessels, and dredging activities may induce avoidance behaviour by marine birds, potentially interrupting their foraging activities. Project activities on Ridley Island are unlikely to disrupt movement patterns of most bird and mammal species. There is potential for the road and rail corridor to alter the movement of western toads as they migrate between inland terrestrial habitats and aquatic breeding habitat in the ponds on the south east corner of Ridley Island; however the potential effect on western toad is addressed under the assessment of effects of change in habitat availability and risk of mortality.

11.1.3 Selection of Measurable Parameters

A measurable parameter represents a feature that alone, or in combination with other measurable parameters, can provide management or scientific evidence of ecosystem quality, or reliable evidence of the trends or changes in quality. The following measurable parameters (Table 11-2) were selected to facilitate quantitative and qualitative measurement of potential Project and cumulative effects on wildlife resources.

To quantify the change in habitat availability, current habitat suitability (i.e., baseline) was considered for western toad, marbled murrelet, and northern goshawk. The baseline availability of preferred (high or moderately suitable) habitat within the LAA for each species was quantified to determine the extent of habitat loss relative to habitat in the area and potential population-level effects.

The effect of increased risk of mortality for wildlife is considered through potential effects on nesting birds and the western toad.

The Project effects on alteration of movement focus on marine birds. Project activities in the marine environment may affect feeding activities of marine birds. It is likely that marine birds would alter their habitat usage and feeding behaviour to avoid the noise and disturbance caused by these activities.

Table 11-2: Measurable Parameters for Wildlife Resources

Environmental Effect	Measurable Parameter(s) for the Environmental Effect	Rationale for Selection of the Measureable Parameter
Change in habitat availability	▪ Availability of habitat	▪ Loss of substantial amounts of habitat can negatively affect species population sustainability
Risk of mortality	▪ Identified risk of mortality to wildlife based on habitat availability, use and relative abundance	▪ Increased wildlife mortality can negatively affect species population sustainability
Alteration of movement	▪ Current use and connectivity of habitats	▪ Wildlife may alter movement patterns between and within habitats due to construction and operations activities and might avoid habitats close to those activities

11.1.4 Characterization of Residual Effects

Residual effects are assessed at the habitat and population level. Definitions of the terms used to characterize residual effects are provided in Table 11-3.

Table 11-3: Characterization Criteria for Residual Effects on Wildlife

Criterion	Description
Direction	**Positive:** condition is improving compared to baseline habitat or population status **Neutral:** no change compared to baseline habitat or population status **Adverse:** negative change compared to baseline habitat or population status
Magnitude	**Low:** effect is detectable but only on a few individuals (<0.5% of the population) **Moderate:** effect on many individuals (0.5 to 0.99% of the population) **High:** effect occurs at the population level (1% or more of the population)
Geographical Extent	**Site-specific:** limited to the site infrastructure (i.e., Project footprint) **Local:** limited to Ridley Island **Regional:** extending beyond Ridley Island
Frequency	**Once:** effect occurs once **Rarely:** effect occurs monthly **Continuous:** effect occurs daily
Duration	**Short-term:** measurable for less than one month **Medium-term:** measurable for more than one month but less than two years **Long-term:** measurable for the life of the Project **Permanent:** permanent or measured well beyond the life of the Project

Criterion	Description
Reversibility	**Reversible:** effects will cease during or after the Project is complete **Irreversible:** effects will persist after the life of the Project
Ecological Context	**Disturbed:** Area has been substantially previously disturbed by human development or human development is still present **Undisturbed:** Area relatively or not adversely affected by human activity
Likelihood	**Low:** Low probability of occurrence **Medium:** Medium probability of occurrence **High:** High probability of occurrence

11.1.5 Standards or Thresholds for Determining Significance

For this assessment an effect is considered significant when there is a moderate to high probability that the Project may affect the long-term viability of a local population (and not significant when this is not the case). Determining significance is most straightforward when there are clear thresholds in terms of the long-term viability of wildlife populations. Unfortunately, for most effects on wildlife, clear thresholds are not available. The assessment therefore is largely based on broadly applied thresholds used in conservation. Several international initiatives have applied a one percent population threshold to designate sites of conservation significance. To designate a Canadian Important Bird Area (Smart and Wilcox 2001), a Western Hemisphere Shorebird Reserve Network site (http://www.whsrn.org/network/sites.html), or a Ramsar Wetland of International Importance (http://www.ramsar.org/key_criteria.htm) the site must support at least 1% of the individuals of the population of interest – national, regional, or global.

- Changes in habitat availability will be significant if Project activities result in the loss of suitable habitat, such that at least 1% of individuals in the population of a selected indicator species are negatively affected.
- Risk of mortality will be considered significant if it affects at least one percent of individuals in the population of selected indicator species.
- Alteration of movement will be considered significant if it eliminates usage of the waters surrounding Ridley Island by sensitive marine birds (i.e., marbled murrelet).

11.2 Baseline Conditions

Ridley Island lies entirely within the Very Wet Hypermaritime subzone of the Coastal Western Hemlock (CWHvh2) biogeoclimatic variant and does not exceed 50 m above sea level in elevation. The vegetation on Ridley Island consists of low productivity forests surrounding a slope bog complex (see Section 10: Vegetation Resources for details). The waters around the island provide feeding habitat for marine birds including seaducks, seabirds, and gulls. A variety of wildlife species were recorded during baseline studies, including marbled murrelet, bald eagle, and western toad.

There is a large body of knowledge on bird species and their abundance in the Prince Rupert area. This has been collected by a number of volunteer-based programs where bird watchers census local birds. These data include 37 years of data on breeding birds collected through the North American Breeding Bird Survey (BBS) Kwinista route, 20 years of data on winter bird use collected through the Christmas Bird Count (CBC) on Digby Island (a 24 km diameter circle centered on the island), and over two years of data on marine bird use collected year-round through the BC Coastal Waterbirds Survey. These surveys are conducted annually by experienced observers using standardized scientific methods. The long-term data sets are complemented by several other programs including:

- eBird (casual sightings by bird watchers recorded year-round)
- Great Backyard Bird Count (4-day event in mid- to late-February)
- Project Feederwatch (November to April)
- BC Breeding Bird Atlas (records of breeding birds since 2008).

Data were also collected in the area for the environmental assessment for the Fairview Phase II Terminal Expansion project and on Ridley Island for the PRPA to support other planning initiatives in the area (PRPA Ridley Island Master Development Plan, Jacques Whitford AXYS, 2008a). These data include:

- Marine bird surveys:
  - Fairview Phase II Terminal Expansion – September 29 to October 1, 2006, April 30 to May 2, 2007; (including vessel and stationary shore counts)
  - PRPA Ridley Island Master Development Plan – April 4, April 24 to 27, and September 25 to 29, 2006.
- Breeding bird surveys:
  - Fairview Phase II Terminal Expansion – June 8 to 11, 2007
  - PRPA Ridley Island Master Development Plan – June 26 to 28, 2006.

These data provide a comprehensive overview of bird use in a variety of habitats over a wide area in the region and are provided in the Wildlife TDR. Surveys conducted specifically for the Project include:

- Wildlife Habitat Assessments (July 3 to 5 and July 31 to August 4, 2006)
- Western Toad surveys (July 29 to 31, 2009)
- Breeding Bird Surveys (June 2010)
- Marine Bird Surveys (June 2010, June 2011, and July 2011) including vessel and stationary shore counts.

The Project-specific data was collected over a shorter time period, during particular seasons, to provide a snapshot of detailed information on species use and their relative abundance in relation to the Project area. Marine bird data collected in the early summer supplement the CBC data collected in mid-winter, data collected for the Fairview Phase II Terminal Expansion, and the PRPA Ridley Island Master Development Plan, and provide data specific to the Project area. This assessment integrates the results of both the regional and Project-specific data to assess the potential effects on marine birds, nesting migratory birds, and bird species-at-risk.

Ridley Island contains pre-existing developments including: Prince Rupert Grain Ltd., Ridley Terminals Inc., Ridley Island Log Sort Inc., and the CN rail lines. There is an existing ring road around the outer edge of the island. The presence of these developments has influenced habitat quality and wildlife usage of the area. In 2011, the PRPA prepared the Port of Prince Rupert 2020 Land Use Management Plan, in which Ridley Island was earmarked for major industrial development; therefore further development of Ridley Island is expected (PRPA 2011).

11.2.1 Wildlife Species-at-Risk

Existing information on species-at-risk was collected from the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), the SARA public registry, and the BC Conservation Data Center (BC CDC). Of the wildlife that use habitats in the CWH zone of the Skeena Fort Nelson Forest District, and whose range and habitats overlap with the LAA, 12 are identified as SARA-listed species (Table 11-4). Ten of these species are on Schedule 1 of SARA (three are listed as Threatened and seven are Special Concern), one is listed on Schedule 3 (Keen's long-eared myotis), and one species (barn swallow) is listed as Threatened by COSEWIC, but is not yet listed on SARA.

Table 11-4: SARA-Listed Wildlife Species Potentially Occurring in the Region

Species Name	Scientific Name	SARA Status	Schedule
Birds			
Marbled Murrelet	*Brachyramphus marmoratus*	Threatened	Schedule 1
Ancient Murrelet	*Synthliboramphus antiques*	Special Concern	Schedule 1
Great Blue Heron, *fannini* subspecies	*Ardea herodias fannini*	Special Concern	Schedule 1
Northern Goshawk	*Accipiter gentilis laingi*	Threatened	Schedule 1
Peregrine Falcon	*Falco peregrinus pealei*	Special Concern	Schedule 1
Western Screech-Owl	*Megascops kennicotti kennicotti*	Special Concern	Schedule 1
Short-eared Owl	*Asio flammeus*	Special Concern	Schedule 1
Olive-sided Flycatcher	*Contopus cooperi*	Threatened	Schedule 1
Barn Swallow	*Hirundo rustica*	No Status (COSEWIC Threatened)	No Schedule
Mammals			
Keen's Long-eared Myotis	*Myotis keenii*	Data deficient	Schedule 3
Amphibians			
Coastal-tailed Frog	*Ascaphus truei*	Special Concern	Schedule 1
Western Toad	*Bufo boreas*	Special Concern	Schedule 1

SOURCE: BC CDC 2011

There is potential for Project effects on three of these species: marbled murrelet, northern goshawk, and western toad (see Section 11.1.2 for details). There may be suitable breeding habitat on Ridley Island for each of these species, and that habitat could be removed during construction of the Project. Marbled murrelet may alter their movement patterns to avoid marine construction activities and vessel traffic, and western toad is at risk of mortality during clearing and grubbing activities, sediment disposal at man-made ponds in the southeast corner of Ridley Island, and from road and rail traffic during operations.

The potential effects on these species are considered in detail below (see Section 11.3).

Though many of the remaining species have been recorded in the vicinity of Ridley Island (see the Wildlife TDR) there is low potential that the Project will affect individuals or their habitat. The paragraphs below provide a screening-level assessment of the potential effects on these species and provide a rationale for why they are not considered in further detail in the assessment.

Great blue heron and peregrine falcon are two species that have been observed feeding in the area, however there are no suitable nest sites for them on Ridley Island. Great blue herons nest in colonies in a variety of species of trees, including red alder, black cottonwood, bigleaf maple, Sitka spruce and Douglas-fir (COSEWIC 2008); however, no nests or colonies have been recorded on Ridley Island. Herons feed at shorelines, in fresh and saltwater marshes, along rivers and in grasslands (COSEWIC 2008) and have been observed foraging along the shores of Ridley Island. In the Prince Rupert area peregrine falcons typically nest on cliff ledges near seabird colonies, which are their primary source of food (COSEWIC 2007a). No seabird colonies are present close to Ridley Island and there is no cliff habitat for nesting. Given the lack of suitable nest sites for great blue heron and peregrine falcon the Project is unlikely to affect these species.

One observation of ancient murrelet was recorded in the waters near Ridley Island (within 2 km), according to the eBird database. No observations were recorded in any of the other data sources, including the Christmas Bird Count, the BC Coastal Waterbird Survey, the Great Backyard Bird Count or any of the baseline surveys conducted by Stantec. The only known breeding location for the ancient murrelet is on Haida Gwaii (i.e., the Queen Charlotte Islands; COSEWIC 2004). Small numbers of ancient murrelets may occasionally feed in the waters around Ridley Island, however these occurrences are rare. The Project is unlikely to affect ancient murrelets and any interaction would be limited to avoidance of the area during construction and avoidance of vessel traffic.

There are few records of western screech-owl along the north coast of British Columbia (COSEWIC 2002). Data collected from surveys completed in the Prince Rupert region confirmed the presence of one individual during 2004 Christmas Bird Counts. No western screech-owls were detected on Project-specific nocturnal call-playback surveys conducted on Ridley Island in 2011 (Wildlife TDR). Breeding habitat for the *kennicottii* subspecies includes riparian coniferous-dominated forests through northern parts of its range that include deciduous trees for roosting and nesting. Western screech-owls prefer forested habitats with open canopy. Though this type of habitat is present on Ridley Island, the forests have a dense forest understory, which is not preferred. Given the lack of preferred habitat, and since there are no records of western screech-owl on Ridley Island, there is low potential for the Project interact with this species.

There is little to no suitable feeding, roosting, or nesting habitat for short-eared owl on Ridley Island. Their foraging habitat is typically open field and wetland areas (BCMWLAP 2004), while roosting and nesting habitat includes undisturbed grass or shrub land adjacent to foraging sites; these habitats are common in agricultural areas. There were no records of short-eared owl on Project-specific baseline surveys conducted on Ridley Island (Wildlife TDR) or from regional survey data (Wildlife TDR); however, one foraging individual was observed on Ridley Island (Dez Shearing, pers. comm.). This species is considered an uncommon migrant through the Prince Rupert region and Ridley Island. Given the lack of suitable habitat for foraging, roosting, or nesting, there is low potential for the Project to interact with this species.

Olive-sided flycatcher was not detected during Project-specific baseline surveys on Ridley Island. The species does occur in the region and was detected on the North American breeding bird surveys conducted in Kwinista, approximately 80 km east of Prince Rupert. Olive-sided flycatcher typically use open habitats with snags for perching. These areas include forest clearings or edges near natural or man-made openings (e.g., wetlands or logged areas; COSEWIC 2007b). The forested habitats are usually old-growth or mid-successional coniferous or mixed-wood. There is little potential suitable habitat for olive-sided flycatcher on Ridley Island since tree snag density is low, and there are few open areas adjacent to snags for foraging. Given the lack of presence of the species on Ridley Island there is low potential for the Project to interact with this species.

There is suitable foraging and nesting habitat for barn swallow on Ridley Island. Barn swallow feed on aerial insects in open habitats and nests on artificial structures with protected ledges (COSEWIC 2011). Barn swallows forage near coastal bays, estuaries, marshes and forested areas such as those on Ridley Island. Regional records for barn swallow include: 40 individuals detected during the Kwinitsa breeding bird surveys, one during Ridley Island breeding bird surveys, and individual records on eBird and the BC Bird Atlas. Four individuals were recorded during baseline surveys conducted for the Project. No adverse effects of the Project are expected on this species as the Project has potential to increase both breeding and foraging opportunities for barn swallows by creating potential nesting habitat on building structures and increasing open spaces for foraging.

Keen's long-eared myotis (*Myotis keenii*) and the coastal tailed frog (*Ascaphus truei*) are both found in the Prince Rupert region; however, neither species is likely to occur on Ridley Island. Keen's long-eared myotis is found in mature to old-growth temperate coastal hemlock type forests (Firman *et al*. 1993), where tree cavities, rock crevices, and small caves are suspected typical summer roosting sites (Cannings *et al*. 1999). Caves >100 m in length and above 500 m elevation are known to be important winter hibernation sites (MWLAP 2004). There is little mature or old forest habitat in the LAA, and suitable winter roosting areas are not present on the island. Similarly, Ridley Island is within the distribution range of the coastal tailed frog. However, because the island lacks the fast-moving, cold streams, necessary to support their populations, there is no suitable habitat available (Matsuda *et al*. 2006). Given the lack of habitat for Keen's long-eared myotis and coastal tailed frog on Ridley Island, the Project is unlikely to interact with these species.

11.2.2 Habitat for Wildlife Species-at-Risk

Habitat suitability models were developed to characterize the abundance and availability of suitable habitat for indicator species. The habitat use requirements were selected for the following species based on the life requisite and season most likely to be affected by the Project.

- Marbled murrelet: Reproduction requirements during spring and summer
- Northern goshawk: Reproduction requirements during spring and summer
- Western toad:
    - Living requirements year round
    - Reproduction requirements.

For marbled murrelet and northern goshawk wildlife habitat assessments were completed by Stantec biologists between July 1 and August 4 2006, following methods outlined in the Field Manual for Describing Terrestrial Ecosystems (BC MELP 1998) and the British Columbia Wildlife Habitat Rating Standards (RIC 1999). Wildlife habitat suitability ratings were prescribed at each plot for the reproduction requirements for marbled murrelet and northern goshawk. Plots document the same characteristics as for Terrestrial Ecosystem Mapping (TEM; e.g., site, soil, and vegetation characteristics) and consider their value to wildlife species. Information collected on the plot is put into context with the adjacent wildlife habitats and features to establish the wildlife habitat rating. These surveys were used to ground truth the habitat models (see species accounts provided in the Wildlife TDR) that were used to determine habitat suitability for each species.

Habitat suitability for each indicator species was established using a four-class rating system according to methods outlined by the British Columbia Wildlife Habitat Rating Standards (BC MELP 1999). In the four-class system habitat suitability was ranked as nil, low, moderate or high. Suitable habitat includes habitats that were classed as moderate or high. Species accounts (see Wildlife TDR) describe the habitat life requisites that were assessed for each species. The wildlife habitat assessments and species accounts are used to model species habitat suitability based on TEM. The ratings are then paired with data from existing disturbances (roads, seismic lines, forestry etc.) which are each rated based on: 1) their zone of influence (ZOI); and 2) their disturbance coefficients (DC). Disturbance coefficients are applied to habitat units which are negatively influenced by adjacent anthropogenic features. For example, because predation of marbled murrelet nests is greater near edge habitats, features such as transmission lines will have a ZOI of 50 m within which habitat suitability for marbled murrelet is discounted by one rating. In this case, habitat located within 50 m of a transmission line would be discounted from high to moderately suitable habitat. The disturbance coefficients and zone of influence of each feature for each species are provided in detail in the Wildlife TDR.

Provincial habitat suitability models and species accounts have not been developed for western toad. However, several surveys conducted by Stantec biologists, and personal observations from operations staff (D. Shearing, Ridley Island Log Sort Ltd., September 2006) indicate that there is suitable western toad habitat available on Ridley Island for both breeding and living requirements.

Adult western toads can occur in a variety of habitats ranging from upland and wetland areas within forests, clearcuts, grasslands, avalanche slopes and subalpine meadows (Poll *et al*. 1984). They occur from the Rocky Mountains to the Pacific Coast, from sea level to 3,660 m (Jones 2000). Toads seem to prefer dense shrub cover where they are protected from desiccation and predation (Bartlet and Peterson 1994, Davis 2000). The habitat on Ridley Island provides forested and upland habitat suitable for the living requirements of western toads. Furthermore, transect and road surveys by Stantec biologists have recorded 63 adult western toads throughout the Island (Table 11-5). Given the presence of toads and their wide range of habitat requirements, all undeveloped terrestrial habitat in the LAA is considered highly suitable western toad habitat.

Table 11-5: Number of Western Toads Recorded on Ridley Island Amphibian Surveys

Survey Date	Number of Adults	Number of Toadlets	Reference
June 24 – 26, 2008	3	2	Jacques Whitford AXYS 2008a
September 9 – 11, 2008	18	0	Jacques Whitford AXYS 2008b
July 29 – 31, 2009	63	26	Wildlife TDR (Systematic Pond and Road Surveys)
May 16, 2011	103	0	Wildlife TDR (Incidental Observations)
TOTAL	**187**	**28**	

Western toads are explosive breeders, congregating along the shallow margins of lentic breeding sites such as ponds and lakes for one to two weeks each spring (Corkran and Thoms 2006). In midsummer, large aggregations of transforming tadpoles and toadlets gather around the banks of breeding ponds (Matsuda *et al*. 2006). After transformation, large numbers of toadlets can be seen dispersing upland. Though not confirmed, the ponds in the southeast corner of Ridley Island are thought to provide breeding habitat for western toads. These ponds are less acidic (pH is approximately 5.0) than other wetlands on the island and toadlets have been recorded on surveys in the vicinity of those wetlands (Table 11-5). Given the presence of toads and their breeding habitat requirements, the man-made ponds in the south east corner of the island are considered highly suitable habitat for western toads.

The results of the baseline models indicate that there is very little suitable habitat (8 ha, or 1.5% of the LAA, of moderately suitable habitat) for marbled murrelet on Ridley Island (Figure 11-1). There are 49 ha (9.1%) of suitable (high and moderately high suitability) nesting habitat for northern goshawk (Figure 11-2); 360.6 ha (67.0%) of terrestrial habitat to meet living requirements for adult western toads (Figure 11-3); and 24 ha (4.5%) of suitable breeding habitat for western toads. The amount of preferred habitat on Ridley Island for each species is summarized in Table 11-6.

Table 11-6: Amount of Suitable Habitat on Ridley Island for Indicator Species

Species	Life Requisite and Season	Area of Suitable Habitat at Baseline (ha)	Percent of the LAA (%)
Marbled Murrelet	Breeding requirements in spring and summer	8.1	1.5%
Northern Goshawk	Breeding requirements in spring and summer	49.0	9.1%
Western Toad	Living requirements in all seasons	360.6	67.0%
	Breeding requirements during spring	24.0	4.5%
Total Mapped Area of Ridley Island		**537.9**	

11.2.3 Nesting Birds

One hundred and sixty-six bird species have been recorded breeding in the Prince Rupert region (Radcliffe *et al*. 1994). Of those birds, there are potentially 65 species that may nest on Ridley Island (Jacques Whitford AXYS 2008a). Migratory birds nest in a wide range of habitats on Ridley Island. Migratory birds can be found nesting on shorelines, on the ground, in shrubs or trees, and even on man-made infrastructure.

Breeding bird surveys were conducted by Stantec biologists in June 2010 both early (June 10) and late (June 23 to 26) in the season, following methods outlined in the Inventory Methods for Forest and Grassland Songbirds (RISC 1999). Briefly, observers stand at a fixed location (point) and record the species of each songbird and woodpecker detected by sight or song. Surveys began half an hour before sunrise and continued until approximately 1000 hrs. Twenty-eight points were surveyed for 10 minutes each. The point count stations were located approximately 250 m apart and were focused on the Project footprint and the road and rail loop (see the Wildlife TDR).

Results from 2010 surveys included observations of 207 individuals of 28 species. The most common species included winter wren, Swainson’s thrush, Townsend’s warbler, and dark-eyed junco. Winter wren was detected at the most point count stations (10). Less common species included hermit thrush, northern flicker, Stellar’s jay, and yellow warbler. Barn swallow was the only listed-species (COSEWIC Threatened) recorded during breeding bird surveys.

In addition to migratory bird nests (protected by the MBCA) there are two bald eagle nests on Ridley Island. One nest is on the shoreline near the coal terminal and the other in the southeast corner of the island. Each nest is approximately 14 m above the ground in the canopy of a Sitka spruce *(Picea sitchensis*) and a western red cedar (*Thuja plicata*), respectively. Breeding activity has been observed at both nests as recently as June 2010 and the nests will be avoided by construction activities (see mitigation for risk of mortality in Section 11.3.3.2).

11.2.4 Marine Birds

There are 71 species of waterbirds whose range of occurrence overlaps with Ridley Island (Jacques Whitford AXYS 2008a). These include loons and grebes, waders, waterfowl, dabbling ducks, diving ducks, coots, cranes, shorebirds, and seabirds. Of these, 657 individuals of 21 species were recorded during surveys in June 2010, and June and July 2011.

The marine bird surveys were conducted based on Inventory Methods for Seabirds (RISC 1997). Two types of surveys were conducted: stationary counts and fixed-width vessel surveys. Stationary counts were conducted from six locations in 2010 and 2011. Each station was surveyed for 20 to 30 minutes using binoculars and a spotting scope. Birds within 600 m of the shoreline were identified and counted. Data were collected on vessel reconnaissance surveys to supplement the stationary counts. The vessel cruised approximately 300 to 600 m from the shore at five knots. Birds observed from both sides of the vessel were recorded. Weather and sea conditions at the time of both surveys were fair. The surveys were conducted along the coastline from the south end of Kaien Island, to Porpoise Channel, and to the north end of Porpoise Harbour (see Wildlife TDR).

The most abundant species recorded during the surveys in 2010 and 2011 were unidentified species of gulls (30%), bald eagle (15%), northwestern crow (15%), mew gull (15%), and marbled murrelet (4%). Federally listed species-at-risk observed during marine bird surveys included marbled murrelet (Threatened) and great blue heron (Special Concern). Christmas Bird Count data (2000 – 2008) from the western shore of Digby Island, near the Big Bay-Delusion Bay Important Bird Area, includes records of marbled murrelet in 2004 (six individuals), 2005 (eight), and 2008 (four).

11.3 Effects Assessment

11.3.1 Assessment Methods

Effects of the Project on wildlife resources were assessed using a habitat-based approach to estimate potential effects on each species. Using habitat suitability models, the available habitat for each indicator species was calculated (Section 11.2) and the effects from development of the Project were quantified. The modeling results were combined with data from field studies and information from the literature to predict the effects on wildlife resources.

The following documents were used to guide the assessment.

- Environment Canada. 2004. Environmental Assessment Best Management Practices Guide for Wildlife at Risk in Canada (http://www.ec.gc.ca/Publications/5407909E-10F6-4AFE-ACDF-75B9E820B4A1/CWSEAbestPracticeGuide2004.pdf).
- Environment Canada. Migratory Birds Environmental Assessment Guideline. Available from: (http://www.ec.gc.ca/Publications/890F4558-807A-4010-96A9-A3CC9CE34CC8/CWSmigratoryBirdsEAguide1998.pdf).
- Environment Canada and Parks Canada. 2010. Addressing *Species at Risk Act* Considerations under the *Canadian Environmental Assessment Act* for Species Under the Responsibility of the Minister responsible for Environment Canada and Parks Canada. pp. 73.

11.3.2 Change in Habitat Availability

11.3.2.1 Potential Effects

Habitat availability for all wildlife will be directly reduced by clearing of the Project footprint during construction. Habitat will be cleared for the storage buildings, terminal infrastructure, roads and railways. At full build out, 121 ha will be cleared of vegetation and this area will provide no wildlife habitat throughout the life of the Project. The area of suitable (i.e., moderate and highly suitable) habitat lost due to clearing is summarized in Table 11-7. This summary shows that the Project (including vegetation clearing and associated disturbance) will reduce the amount of suitable nesting habitat for northern goshawk, and both terrestrial and breeding habitat for western toad.

Table 11-7: Suitable Wildlife Habitat Lost Due to the Project

Species	Life Requisite and Season	Area of Suitable Habitat Lost (ha)	Percent of the LAA (%)
Marbled Murrelet	Breeding requirements in spring and summer	3.1	0.6%
Northern Goshawk	Breeding requirements in spring and summer	33.2	6.2%
Western Toad	Living requirements in all seasons	119.9	22.3%
	Breeding requirements during spring	4.15	0.7%
Total Mapped Area of Ridley Island		**537.9**	

Construction and operation of the Project will remove breeding, feeding and wintering habitat for wildlife for the lifetime of the facility. Habitat removal can lead to fragmentation, and can create edges, which improve access to interior habitats by predators. Furthermore, Project construction and operations may result in disturbance (and subsequent avoidance) of adjacent habitat. Site clearing will have direct and possible indirect effects on wildlife species-at-risk. Northern goshawks primarily nest in mature and old-growth coniferous stands with closed canopy and an open understory (Mahon *et al*. 2006; Campbell *et al*. 1990). The Project will result in a loss of 33.2 ha (6.2% of the LAA) of suitable habitat for northern goshawk (Figure 11-6); removal of this habitat would eliminate potential nesting opportunities for this species. Edge habitat will be created by vegetation clearing, and Northern goshawks often avoid edge habitat when choosing nest locations (Mahon *et al*. 2006; McLaren 2004).

Marbled murrelets nest in coniferous forests with large, old (>140 years) trees. They do not build a nest, but lay their single egg on a large limb covered with deep moss that acts as a platform for nesting (Burger 2002, DeGange 1996). Murrelets need tree cover above their nest but also need small gaps in the canopy for nest access (Burger 2002). There was a very small amount of moderately suitable nesting habitat identified for Marbled Murrelet on Ridley Island and very little of this will be affected by the Project (3.1 ha; see Figure 11-5).

There is both suitable aquatic breeding habitat and upland terrestrial habitats for western toad on Ridley Island. Western toads return to the same breeding location year after year (Matsuda *et al*. 2006). Degradation or contamination of their aquatic habitat could affect the breeding success of the population. After transforming from tadpoles, small toadlets disperse to upland terrestrial habitats to live for the rest of the year. Clearing of vegetation for site facilities will result in a loss of119.9 ha (22.3% of the LAA) of upland habitats (Figure 11-7) and 4.15 ha (0.7% of the LAA) of breeding habitat (Figure 11-8) for western toads for the life of the Project.

11.3.2.2 Mitigation

To minimize the change in habitat availability the following measures will be employed:

- **Project footprint clearing limits**—To the greatest extent possible, clearing, grading, construction, and temporary storage of materials will be limited to the Project site. Boundaries of the footprint will be clearly marked to indicate the limit of clearing.
- **Wetland compensation**—The wetland compensation program proposed for the Project (see Section 10.3.5.2 for details) will compensate for wetlands, and as a result, habitat used by western toads.

11.3.2.3 Residual Effects

Based on the habitat suitability modeling, Project effects on the change in availability of preferred habitat is adverse in direction, low in magnitude, and local in geographic extent (Table 11-7). Direct habitat removal will only occur once (i.e., during vegetation clearing), but will persist through the life of the port facilities. Habitat loss is reversible following reclamation; however, it would take up to 250 years for some of the habitat to regenerate to a similar state (see Section 10: Vegetation Resources for details).

As shown by the habitat suitability models and maps, there is very little suitable habitat for marbled murrelet (Figure 11-1) and northern goshawk (Figure 11-2) on Ridley Island. The habitat is fragmented and distributed in small patches due to pre-existing development on the island. Vegetation clearing and the potential disturbance from Project activities (i.e., the road and rail corridor) results in a loss of 3.12 ha of moderately suitable habitat (or 0.6% of the LAA) for marbled murrelet (Figure 11-5) and 33.2 ha of moderately suitable habitat (or 6.2% of the LAA) for northern goshawk (Figure 11-6). There was no highly suitable habitat on Ridley Island for either of these species. Though neither northern goshawk nor marbled murrelet have been recorded nesting on Ridley Island, the small amount of available suitable nesting habitat would only be sufficient to support a few breeding pairs of each species.

Northern goshawk (*laingi*) are territorial and on average, breeding pairs nest approximately 6.9 ± 0.7 km apart (McClaren 2004), limiting Ridley Island to support at most one breeding pair. The population estimate for northern goshawk is between 350 to 425 breeding pair (or approximately 700 to 850 individuals). The displacement of one breeding pair from Ridley Island would affect less than 0.3% of the population. Nesting density of marbled murrelet ranges from 0.11 to 0.86 nests per hectare (Burger 2002), resulting in potential displacement of 0.34 to 2.6 breeding pairs. The marbled murrelet population is estimated to be from 55,000 to 78,000 individuals (Marbled Murrelet Recovery Team 2011). The potential displacement of 2.6 breeding pairs (5.3 individuals) would affect less than 0.01% of the population.

Most of Ridley Island provides suitable terrestrial habitat for western toad (360.6 ha) and suitable breeding habitat (23.3 ha) is also available. The Project will directly remove 119.9 ha (or 22.3% of the LAA) of highly suitable terrestrial habitat (Figure 11-7) and 4.15 ha (or 0.77% of the LAA) of highly suitable breeding habitat (Figure 11-8). Western toad is listed as a species of Special Concern under SARA. While species (and their residence) listed as Endangered or Threatened and on Schedule 1 of SARA are protected, species of Special Concern are not. For these species CWS must prepare a management plan that includes conservation measures; however, for western toad, a plan has not yet been completed. The BC CDC (2011) estimates that the global population of western toads is between 100,000 and 1,000,000 individuals, and that they occupy an area of approximately 20,000 km^2 within their range. Based on that estimate, western toad density across the total range is between 0.05 and 0.5 toads per ha (5 and 50 toads per km^2), resulting in an estimate of between 27 and 270 western toads on Ridley Island. Up to 103 adult toads have been observed at any one time on Ridley Island (see Table 11-5) suggesting that their densities are relatively high. Displacement of 270 western toads as a result of the Project would affect up to 0.27% of the North American population. Given the high density of western toads observed on the Island this estimate is based on the upper range of the population density estimates (0.5 per ha) and the low range of the population estimate (100,000).

The wetland compensation program (see Section 10.3.5.2) will provide potential breeding and terrestrial habitat for western toads. This program will fully compensate for the potential loss of habitat for western toads and will therefor result in no adverse residual effects of loss of habitat for western toad.

11.3.2.4 Determination of Significance

The number of individuals displaced by habitat alteration for most wildlife species on Ridley Island is very small and will not affect their species population. For western toad, habitat availability on Ridley Island will be reduced; however, it is very small compared to the habitat available along the North Coast of BC and throughout their range in the province. Most importantly, the habitat compensation program will replace and protect terrestrial and breeding habitat for western toads, and will provide habitat for many other species of wildlife. Given the proposed wetland habitat compensation, with a moderate degree of confidence, the Project effect of change in habitat availability on wildlife is predicted to be not significant.

11.3.3 Risk of Mortality

11.3.3.1 Potential Effects

Vegetation clearing and grubbing and waste management activities are potential causes of wildlife mortality.

Adult birds and large and medium sized mammals are unlikely to suffer direct mortality from vegetation clearing as they would flee the area. However, clearing could destroy active bird nests and nestlings if it is conducted in the spring or early summer. In addition, construction activities may cause birds in adjacent habitats to abandon their nests or cause increased mortality of eggs and hatchlings from exposure to cold or predators during temporary abandonment.

The Migratory Birds Regulations of the *Migratory Birds Convention Act* (Sections 5 and 6[a]); prohibit the destruction of birds, their nests or eggs. Vegetation clearing presents the greatest risk of mortality to birds. Because their nests, eggs, and young are immobile, there is the potential for mortality if vegetation clearing occurs during the nesting season (April 1 to July 31). There are two active bald eagle nests on the island which will be avoided during construction. One is located in a spruce tree on the northwestern shoreline of the island and the other is in a cedar tree located in the southeastern corner of the island.

No dens were located in or adjacent to the proposed clearing zone; therefore, mortality to denning mammals is not expected from construction activities. There is a limited potential for mortality of some wildlife species, such as western toads, during vegetation clearing and grubbing. Amphibians tend to take cover when exposed to noise and construction activity, making individuals vulnerable to heavy equipment.

Waste management activities resulting in the deposition of sediment in man-made ponds designated for waste disposal may result in risk of mortality for amphibians (such as western toads). Deposition of waste or sediment has the potential to destroy eggs and tadpoles of western toads if it occurs during their breeding period (April to July). Toads migrate annually between terrestrial habitats and aquatic breeding habitats. Increased road traffic during construction and operations and rail traffic during Project operations may result in mortality of western toads crossing road or railway tracks when moving between terrestrial and aquatic habitats.

11.3.3.2 Mitigation

Mitigation measures to reduce the risk of mortality include:

- **Construction Schedule**—By clearing vegetation outside of the nesting season for birds (April 1 to July 31), mortality of birds, nests or eggs will be avoided in accordance with sections 5 and 6(a) of the Migratory Birds Regulations of the *Migratory Birds Convention Act*.
- **Nest Set-backs**—The two trees containing the bald eagle nests will be retained and a 50 m no-development and no-disturbance setback will be established around the trees. This exceeds the minimum setback recommended by BC MOE (2005) of 1.5 times the tree height (approximately a 35 m buffer).
- **Harassment**—Feeding and harassment of wildlife is prohibited.
- **Salvage and Relocation of Western Toads (Clearing and Grubbing Mortality)**—Prior to vegetation clearing and grubbing, there will be a search and salvage to remove western toads from the Project footprint to avoid mortality of individuals. Western toads will be salvaged when they are active (January to October) and will be relocated to an acceptable site as determined through consultation with Environment Canada.
- **Salvage and Relocation of Western Toads (Road and Rail Mortality)**—To avoid road and rail mortality, western toads will be salvaged and relocated during their migration between

terrestrial and breeding habitats during construction. The need to salvage and relocate will be reassessed prior to commissioning.

- **Breeding Ponds**—To minimize the risk of toads being killed as a result of on-land disposal activities disposal into potential breeding ponds will occur in the fall following completion of the western toad's breeding period. If disposal is required during the breeding season, exclusion fencing will be placed around potential breeding ponds, prior to the breeding period to deter use of the ponds.

11.3.3.3 Residual Effects

The risk of mortality due to vegetation clearing is expected to be low in magnitude, site-specific in geographic extent, short-term in duration, and reversible (i.e., the risk of mortality will no longer occur once vegetation clearing is completed). Mortality of birds is not expected, since vegetation clearing will be completed outside breeding bird periods (i.e., before April 1 and after July 31). Set-backs around the bald eagle nests will prevent disturbance and abandonment. The mitigation to salvage and relocate western toads during vegetation clearing will reduce potential mortality for adult toads during construction.

With mitigation in place, risk of mortality from waste management and disposal is expected to be low in magnitude, local in geographic extent, long-term in duration (as these activities will occur throughout the life of the Project), rare in frequency, and reversible following decommissioning of the Project. The ecological context of Ridley Island is that it is in a developed area, and as a result many animals in the area are habituated to human activities. Construction activities and presence of crew on the Project site may attract wildlife which can result in problems if they become habituated to human activities. Careful waste management should eliminate the risk of wildlife habituation and the need for removal of nuisance individuals. There are few occurrences of wolves, coyotes, or black bears on Ridley Island and with the proposed mitigation it is unlikely that nuisance wildlife will become an issue. Regardless, effective mitigation will be in place to ensure that any interaction that could occur minimizes the wildlife mortality.

On-land waste disposal is currently scheduled to occur outside of the breeding period for the western toad. Should the schedule change and this is no longer feasible the man-made ponds will be fenced prior to the breeding season to eliminate the potential for western toads to lay their eggs in the ponds. This will mitigate the risk of mortality to amphibian eggs and tadpoles from this activity. The proposed mitigation is based on recommendations from the Province of British Columbia and the Animal Care Committee because preventing amphibians from breeding in ponds prior to construction activities is better for amphibians than salvaging and relocating eggs or tadpoles.

With mitigation in place, the risk of mortality from road and rail traffic is expected to be low in magnitude and site-specific in geographic extent. The frequency of the road mortality would be rare as it will be limited to migration between breeding and terrestrial habitats between April and July each year. Similarly, most toad movement is nocturnal, and Project activities (including road traffic) will be concentrated during daylight hours. The effect will be long-term in duration as road and rail traffic will occur throughout the life of the Project, however, it will be reversible as traffic will cease after the Project is complete. The effect also occurs in a disturbed ecological context since there is vehicle traffic on the existing road. With mitigation, road and rail mortality will be low magnitude and is unlikely to result in change in the population status of western toads.

11.3.3.4 Determination of Significance

Overall, with mitigation measures in place, the risk of mortality for most wildlife is low. Consequently, the risk of mortality on wildlife is considered not significant. Based on professional opinion and judged effectiveness of the proposed mitigations, the confidence in this prediction is moderate to high.

11.3.4 Alteration of Movement

11.3.4.1 Potential Effects

Marine construction and operational noise and activities may elicit avoidance behavior from marine birds. Birds foraging in the ocean near Ridley Island might alter their normal movement patterns and expend additional energy avoiding disturbance from construction and operation activities. As a result, they may spend less time feeding in preferred habitats. Many species of seabirds forage in the marine habitats around Ridley Island at different stages of their life cycle. For example, marbled and ancient murrelets use the far shore of Ridley Island during spring and fall.

Construction involves dredging and disposal of marine sediment and construction of the facilities. These activities will increase marine construction traffic around Ridley Island. During operations, there will also be an increase of marine traffic with the arrival and departure of vessels to transport the potash. These activities can cause varying degrees of avoidance of the terminal depending on the species. For wildlife to tolerate (or habituate to) the disturbance, the activity must be predictable and not paired with a negative experience (Archibald *et al*. 1987). It is expected that disturbance effects from noise will occur throughout all Project phases. Although these activities will be unpredictable, they are unlikely to be paired with a negative experience for marine birds. The disturbance from these activities will be intermittent and infrequent. It is expected that marine birds will avoid the waters surrounding a disturbance while it is occurring, however, once the disturbance has stopped, the birds will resume their normal feeding behaviour.

Project activities on Ridley Island are unlikely to disrupt movement patterns of most bird and mammal species. There is potential for the road and rail corridor to alter the movement of western toads as they migrate between inland terrestrial habitats and aquatic breeding habitat in the ponds on the south east corner of Ridley Island; however the potential effect on western toad is addressed under the assessment of effects of change in habitat availability (Section 11.3.2) and risk of mortality (Section 11.3.3).

11.3.4.2 Mitigation

To minimize the effect of disturbance to marine birds the following measures will be employed:

- **Equipment**—Equipment used for construction and operation activities will be maintained in good working order and properly muffled to reduce unnecessary noise.

11.3.4.3 Residual Effects

The effect of alteration of movement from the marine terminal on marine birds will be adverse in direction, low in magnitude, and local in extent. The effect will occur continuously during construction, but less frequently during operations, it will occur throughout the life of the Project, but is reversible following reclamation. Prince Rupert Grain Terminals Limited and Ridley Terminals Inc. currently operate near Ridley Island and so the disturbance from construction and vessel traffic will not be a novel sensory disturbance for the birds inhabiting the area.

11.3.4.4 Determination of Significance

With mitigation measures in place, the effect of alteration of movement on wildlife is anticipated to be not significant. Based on professional opinion and the scientific literature, the confidence in this prediction is high.

Table 11-8: Summary of Project Residual Environmental Effects on Wildlife and Wildlife Habitat

Potential Residual Environmental Effects	Proposed Mitigation Measures	Residual Environmental Effects Characteristics: Adverse or Positive Effect	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Environmental Context	Significance	Prediction Confidence	Likelihood	Recommended Follow-up and Monitoring
Effect #1: Change in Habitat Availability											
Construction and Commissioning	▪ Limit and mark Project footprint clearing limits ▪ Establish wetland compensation program to replace and protect habitat for use by western toads.	A	L	L	P/O	R	D	N	M	H	Monitor use of wetland compensation area by western toads.
Operations		A	L	L	P/C	R	D				
Decommissioning		No effects anticipated; positive if any									
Residual environmental effects for all Phases.		A	L	L	P/O	R	D				
Effect #2: Risk of Mortality											
Construction and Commissioning	▪ Clear vegetation outside of the nesting season for birds (April 1 to July 31). ▪ Establish a 50 m no-development and no-disturbance setback around the two trees with Bald Eagle nests. ▪ Prohibit feeding and harassment of wildlife. ▪ Establish a wildlife encounter management plan to report Project related wildlife deaths and nuisance animals to Canpotex, and the appropriate provincial wildlife authority.	A	L	S	ST/O	R	D	N	M	M	The need for salvage and relocation will be reassessed following construction.
Operations		A	L	S	LT/R	R	D				
Decommissioning		No effects anticipated									
Residual environmental effects for all Phases.		A	L	S	LT/R	R	D				

Potential Residual Environmental Effects	Proposed Mitigation Measures	Residual Environmental Effects Characteristics						Significance	Prediction Confidence	Likelihood	Recommended Follow-up and Monitoring
		Adverse or Positive Effect	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Environmental Context				
	▪ Salvage and relocate western toads prior to vegetation clearing and grubbing. ▪ Salvage and relocate western toads to prevent road and rail mortality. ▪ Place exclusion fencing around western toad breeding ponds.										
Effect #3: Alteration of Movement											
Construction and Commissioning	Properly maintain equipment	A	L	L	MT/C	R	D	N	H	L	None necessary.
Operation		A	L	L	MT/C	R	D				
Decommissioning		No effects anticipated									
Residual environmental effects for all Phases.		A	L	L	C	R	D				

KEY

DIRECTION:

(P) *Positive*: condition is improving compared to baseline habitat quality or population status

(N) *Neutral*: no change compared to baseline habitat quality or population status

(A) *Adverse*: negative change compared to baseline habitat quality or population status

MAGNITUDE:

(L) *Low*: effect is detectable but only on a few individuals (<0.5% of the population).

(M) *Moderate*: effect is on many individuals (0.5 to 0.99% of the population).

(H) *High*: effect occurs at the population level (1% or more of the population).

GEOGRAPHIC EXTENT:

(S) *Site-specific:* environmental effects restricted to the site infrastructure (i.e., Project footprint).

(L) *Local:* environmental effects extend beyond the Project footprint but remain localized within the Local Assessment Area (Ridley Island).

(R) *Regional:* environmental effects extend beyond Ridley Island and the surrounding waters.

DURATION:

(ST) *Short-term:* effects are measurable for less than one month.

(MT) *Medium-term*: effects are measurable for one month but less than two years.

(LT) *Long-term*: effects are measurable for the life of the Project.

(P) *Permanent*: effects are permanent or measured well beyond the life of the Project.

FREQUENCY:

(O) Occurs *once*

(R) Occurs *monthly*

(C) *Continuous*.

REVERSIBILITY:

(R) *Reversible*

(I) *Irreversible*

ECOLOGICAL CONTEXT:

(U) *Undisturbed*: area relatively or not adversely affected by human activity.

(D) *Disturbed*: area has been substantially previously disturbed by human development or human development is still present

(N/A) *Not Applicable*

SIGNIFICANCE:

(S) *Significant*

(N) *Not Significant*

PREDICTION CONFIDENCE:

Based on scientific information and statistical analysis, professional judgment and effectiveness of mitigation

(L) *Low* level of confidence

(M) *Moderate* level of confidence

(H) *High* level of confidence

LIKELIHOOD:

Based on professional judgment

(L) *Low* probability of occurrence

(**M)** *Medium* probability of occurrence

(**H)** *High* probability of occurrence

11.4 Combined Effects and Overall Significance Determination

Overall, the individual Project effects of change in habitat availability, risk of mortality, and alteration of movement on Wildlife and Wildlife Habitat will be local and will affect only a small proportion of the assessed wildlife populations. The populations of most of the wildlife species with potential to be affected by the Project are secure. The western toad is listed as Special Concern under SARA, and the Project will reduce habitat availability and increase the risk of mortality for individuals in the population. Western toads are known to occur in high densities where there is suitable terrestrial habitat for foraging and hibernation and aquatic habitat for breeding, such as Ridley Island. Western toads are widely distributed in the interior of British Columbia; the reports of declines are primarily in the south coast of the province, which is highly populated by people (Wind and Dupius 2002). As a result, the primary threat to the majority of western toads in BC is habitat degradation and loss in the Lower Mainland of Vancouver and on Vancouver Island where toad populations have declined (BC CDC 2011, Wind and Dupuis 2002). With the proposed mitigation and compensation plan in place this Project will not affect the western toad population in British Columbia or Canada.

The combined Project effects on Wildlife and Wildlife Habitat are determined to be not significant. Based on the quality of the habitat modeling, and on the effectiveness of proposed mitigations, the level of confidence in this prediction is high.

11.5 Cumulative Effects Assessment

A screening of the Project’s potential contribution to the cumulative impacts of past, current, and announced future projects was done according to the procedures described in Section 3. The screening process establishes three conditions to warrant further assessment. These conditions are: 1) the Project results in a demonstrable residual effect; 2) these effects are likely to act in a cumulative fashion with those of other projects; and, 3) there is a reasonable expectation that the Project’s contribution to cumulative impacts will have a significant effect on wildlife resources.

The Project does result in demonstrable and measurable residual effects on wildlife resources and these Project-specific residual effects on wildlife will act cumulatively with the effects of other projects and activities in the area. However, given the mitigation measures in place, there is no reasonable expectation that the Project’s contribution to cumulative impacts will affect the sustainability of wildlife resources in the Prince Rupert region for a number of reasons:

- Alteration of movement to wildlife will be low in magnitude.
- Project-related effects to the risk of mortality will be minor as they will be mitigated using proven measures (such as adherence to timing windows, toad salvage and relocation, and applying toad fencing).
- The total area of habitat affected by the Project will primarily affect wildlife species with secure populations; habitat loss for western toads will be mitigated through wetland compensation.

The western toad, the most sensitive wildlife population that overlaps with the Project area, illustrates these points.

According to the habitat suitability models for the Project, there is 360 ha of suitable terrestrial habitat and 23.9 ha of suitable breeding habitat for western toad on Ridley Island. The Project will result in the loss or alteration of 119 ha of suitable terrestrial habitat on the island and 4.5 ha of suitable breeding habitat. Loss of habitat on Ridley Island will act cumulatively with habitat loss from other projects in the area.

The primary threats to western toad populations in Canada are: agricultural and urban development, road traffic, habitat degradation of breeding ponds, introduced predators and competitors (especially bullfrogs and predatory fish) and disease (i.e., *Saprolegnia* and *chytridiomycosis*). The factors leading to decline in the species populations in the United States are unknown (Wind and Dupuis 2002).

Western toads are widely distributed in the interior of British Columbia; the reports of declines are primarily in the south coast of the province, which is highly populated by people (Wind and Dupius 2002). As a result, the primary threat to the majority of western toads in BC is habitat degradation and loss in the Lower Mainland of Vancouver and on Vancouver Island where toad populations have declined (BC CDC 2011, Wind and Dupuis 2002). Potential declines of toads in the Lower Mainland and on southern Vancouver Island is likely related to the loss of approximately 75% of wetlands in the Greater Vancouver and Victoria areas, as these have been converted to agriculture and development (Wind and Dupuis 2002). The threat of disease and parasites is considered a secondary, but potentially serious concern based on trends in parts of the United States (BC CDC 2011).

While suitable toad habitat will be lost on Ridley Island, and will act cumulatively with habitat loss from existing and future projects, there is extensive habitat available for this generalist species throughout the province of British Columbia. There is no reasonable expectation that Project effects will affect the western toad population, nor is there any reasonable expectation that the Project's contribution to cumulative effects will affect the viability of western toad in the region. Consequently, both the direct Project effect and the Project's contribution to cumulative effects are judged to be not significant.

11.6 Follow-up Program

Details of the follow-up program will be developed through communication with Environment Canada but will include:

- Western toad mitigation plan (habitat compensation, salvage and relocation, fencing of ponds)
- Marine bird stationary counts and vessel transect surveys.

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11.8 Figures

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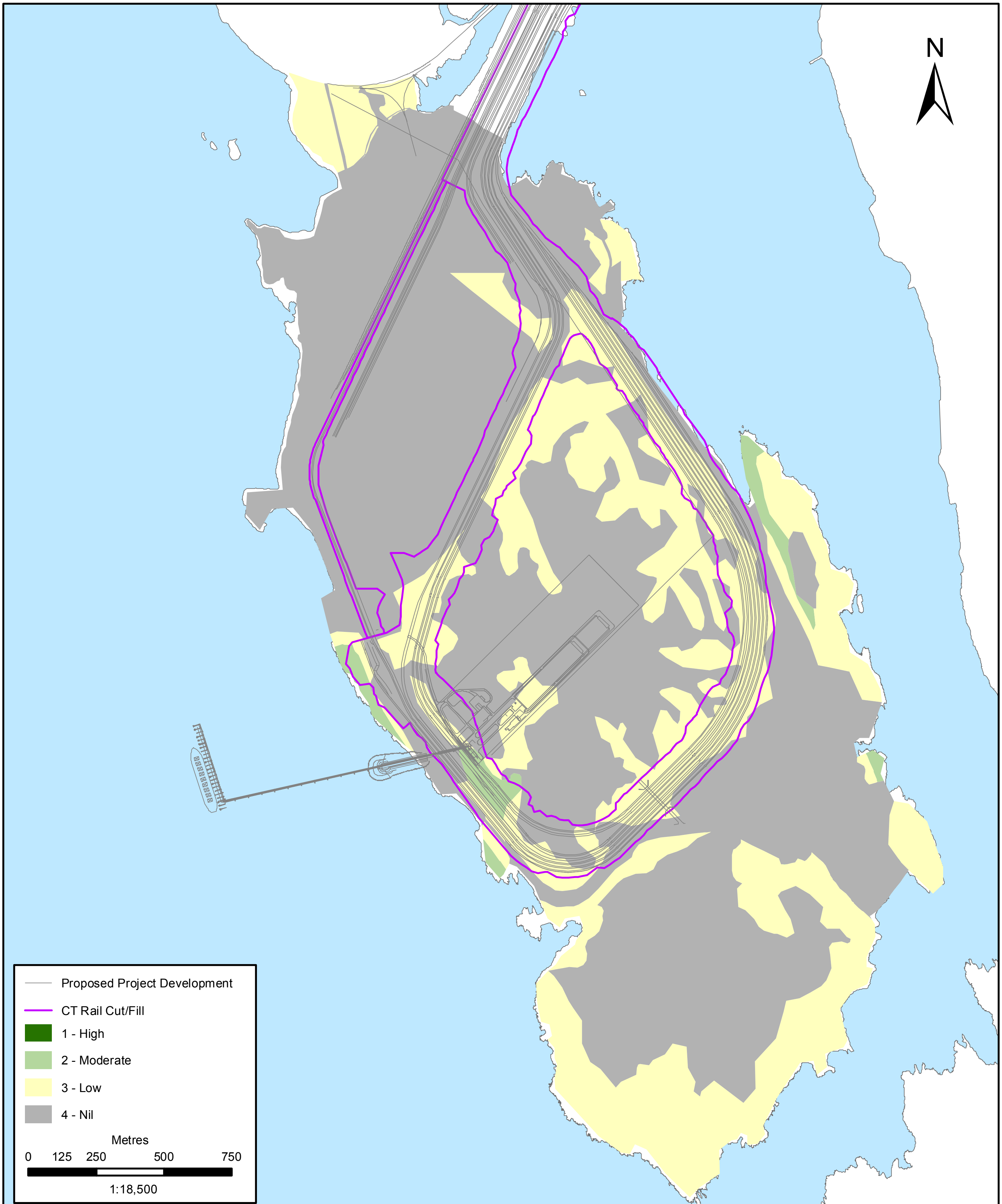

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Data Sources: Province of British Columbia, Government of Canada

HABITAT SUITABILITY FOR MARBLED MURRELET DURING BASELINE

ENVIRONMENTAL ASSESSMENT

RIDLEY ISLAND, BRITISH COLUMBIA

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Fig. No.: 11-1

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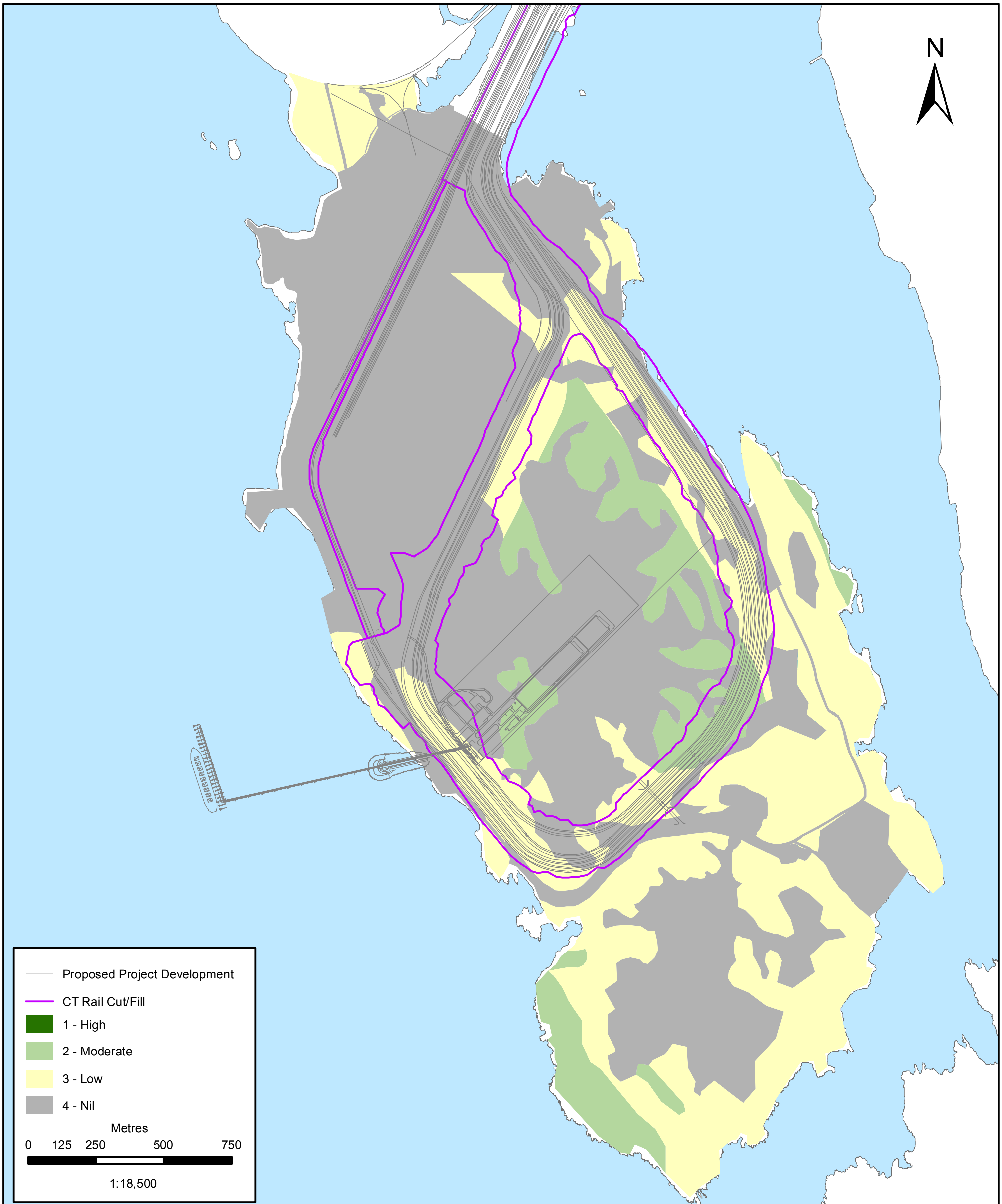

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Data Sources: Province of British Columbia, Government of Canada

HABITAT SUITABILITY FOR NORTHERN GOSHAWK AT BASELINE DURING BREEDING

ENVIRONMENTAL ASSESSMENT

RIDLEY ISLAND, BRITISH COLUMBIA

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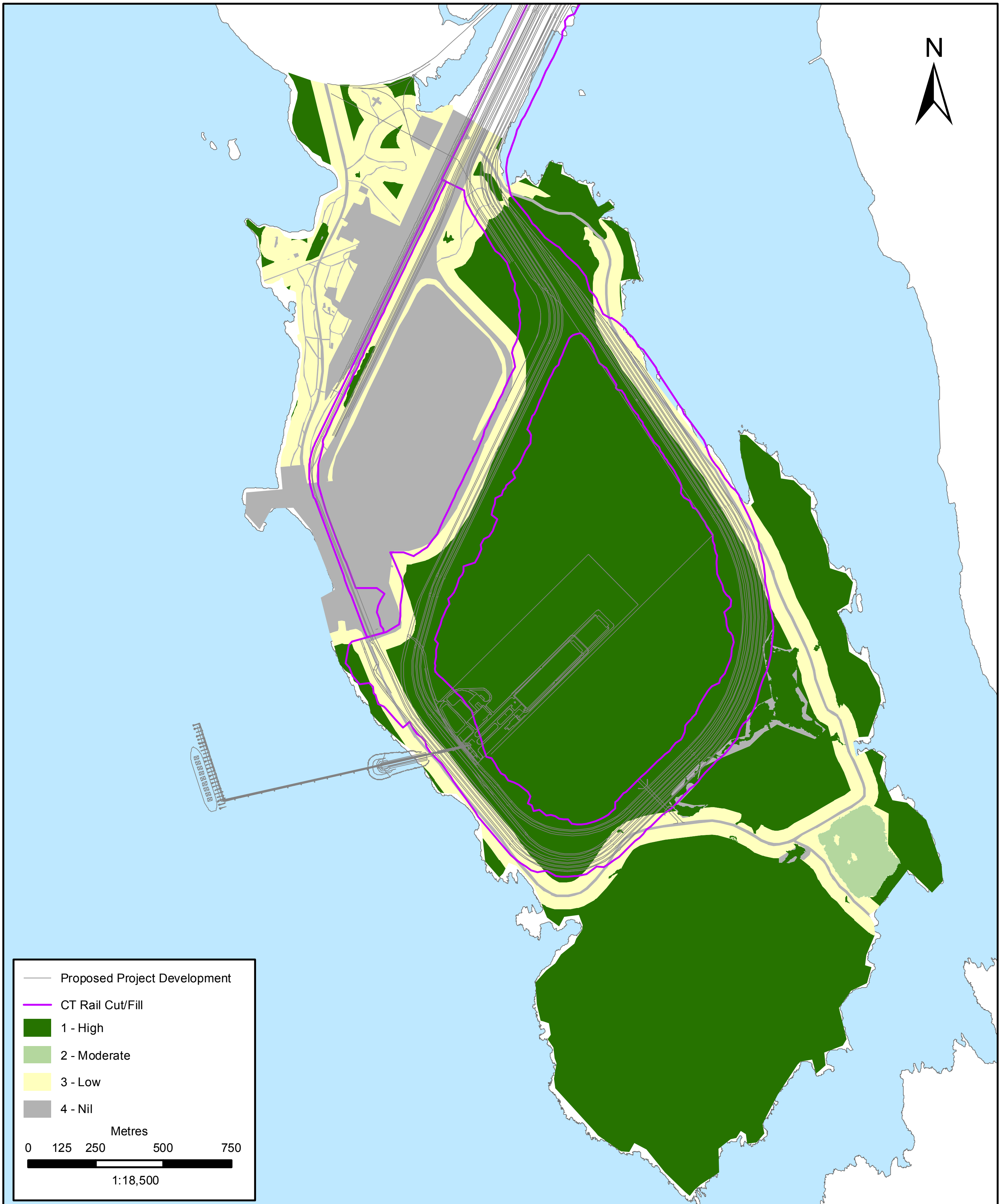

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PRINCE RUPERT PORT AUTHORITY

Data Sources: Province of British Columbia, Government of Canada

HABITAT SUITABILITY FOR WESTERN TOAD AT BASELINE FOR LIVING REQUIREMENTS IN ALL SEASONS
ENVIRONMENTAL ASSESSMENT
RIDLEY ISLAND, BRITISH COLUMBIA

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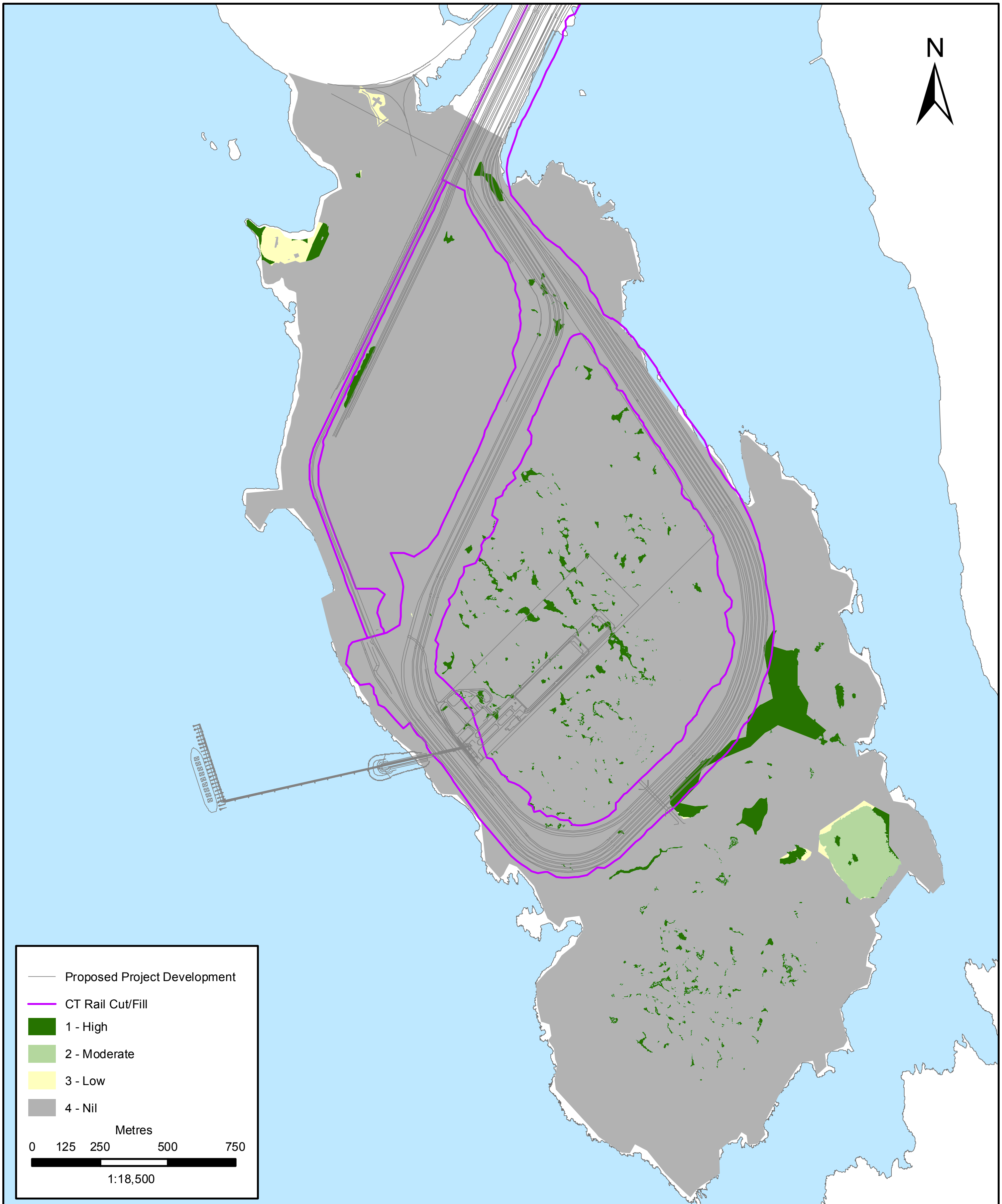

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HABITAT SUITABILITY FOR WESTERN TOAD AT BASELINE DURING BREEDING

ENVIRONMENTAL ASSESSMENT

RIDLEY ISLAND, BRITISH COLUMBIA

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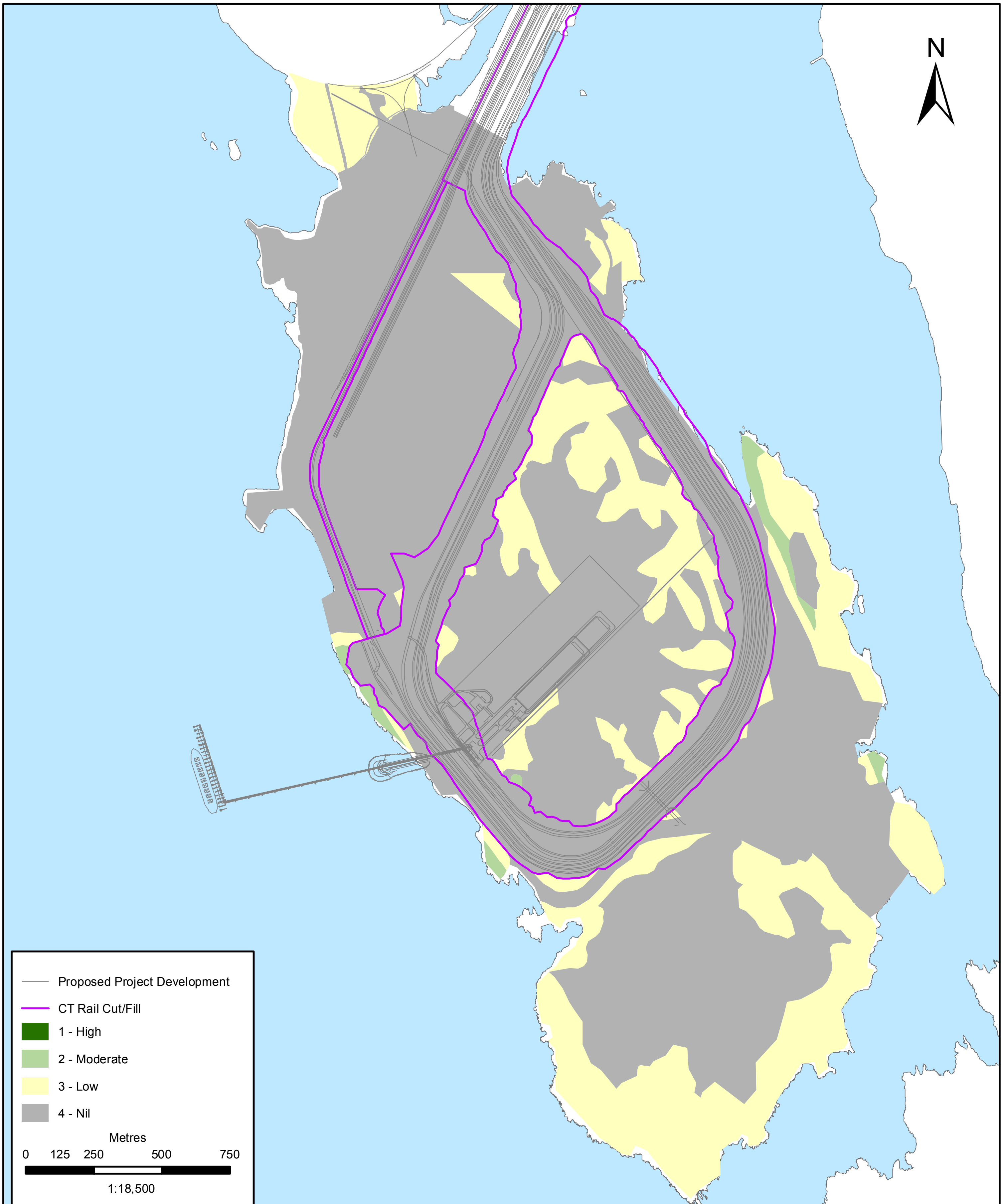

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Data Sources: Province of British Columbia, Government of Canada

HABITAT SUITABILITY FOR MARBLED MURRELET DURING MAXIMUM BUILD OUT
ENVIRONMENTAL ASSESSMENT
RIDLEY ISLAND, BRITISH COLUMBIA

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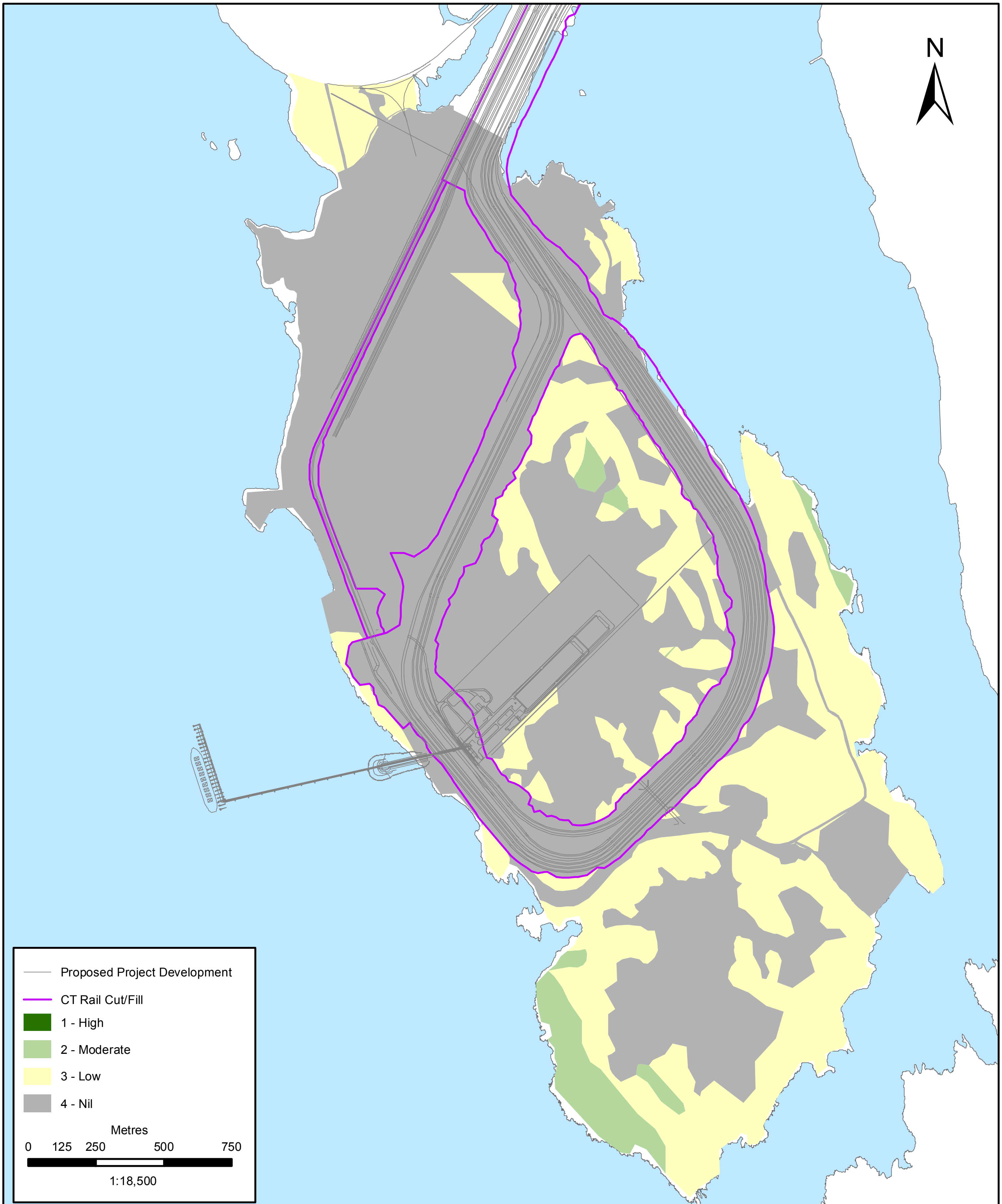

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Data Sources: Province of British Columbia, Government of Canada

HABITAT SUITABILITY FOR NORTHERN GOSHAWK AT MAXIMUM BUILD OUT DURING BREEDING

ENVIRONMENTAL ASSESSMENT

RIDLEY ISLAND, BRITISH COLUMBIA

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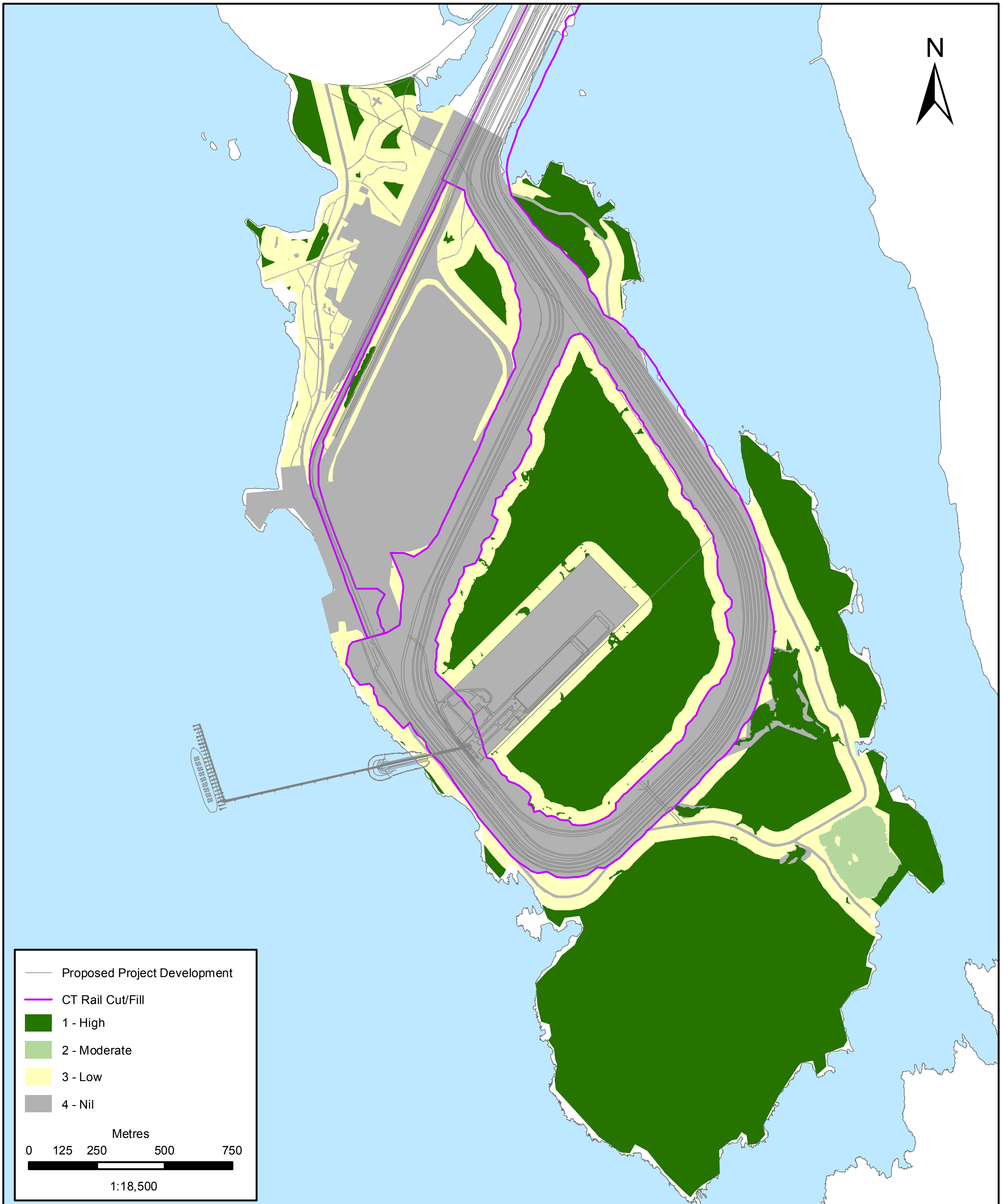

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Data Sources: Province of British Columbia, Government of Canada

HABITAT SUITABILITY FOR WESTERN TOAD AT MAXIMUM BUILD OUT FOR LIVING REQUIREMENTS IN ALL SEASONS
ENVIRONMENTAL ASSESSMENT
RIDLEY ISLAND, BRITISH COLUMBIA

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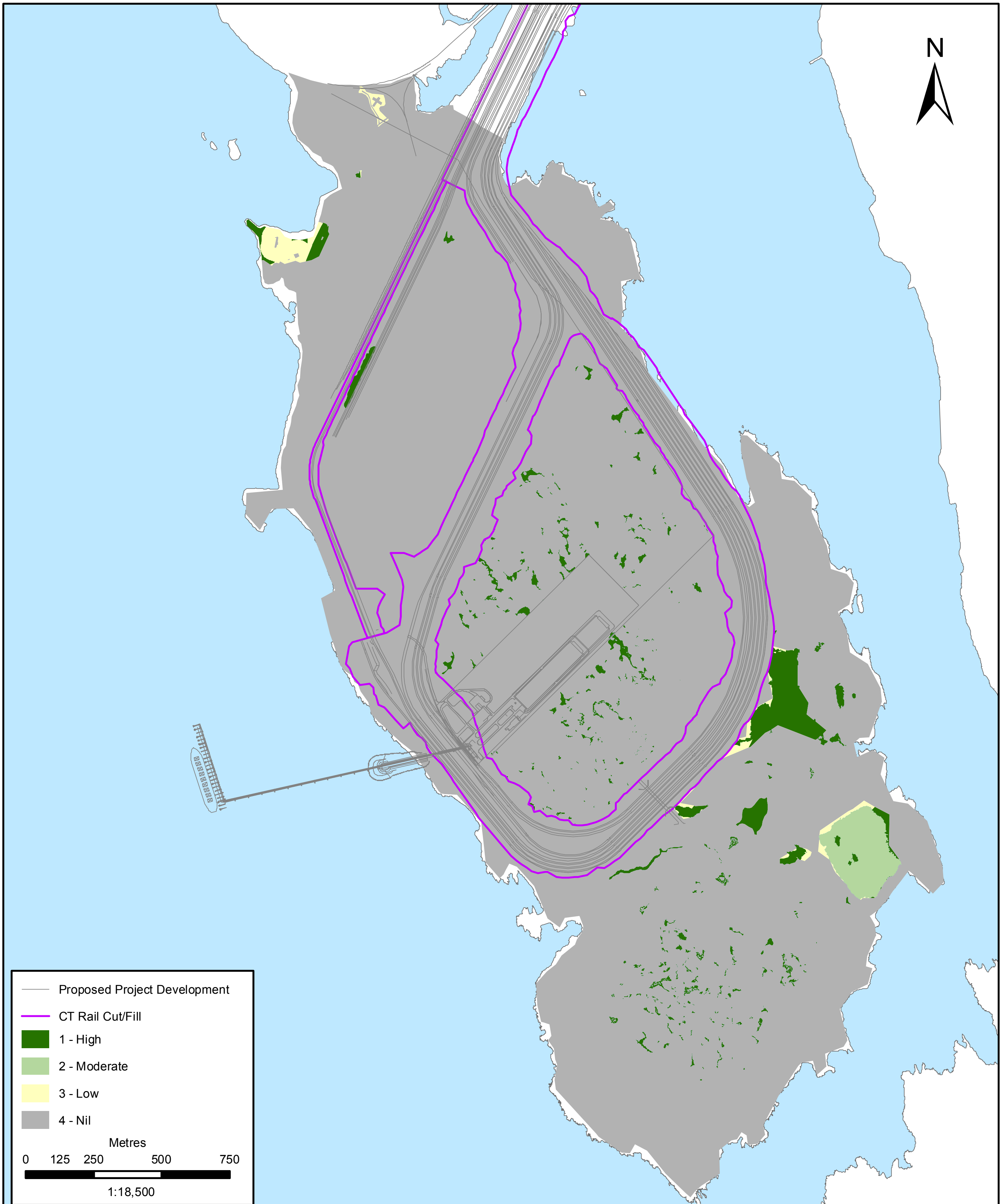

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HABITAT SUITABILITY FOR WESTERN TOAD AT MAXIMUM BUILD OUT DURING BREEDING

ENVIRONMENTAL ASSESSMENT

RIDLEY ISLAND, BRITISH COLUMBIA

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12 AQUATIC ENVIRONMENT ASSESSMENT

The Aquatic Environment, which includes both marine and freshwater components, has ecological, economic, recreational, and cultural importance. It has been selected as a VEC because of the potential for Project activities to adversely affect fish and/or fish habitat.

Effects of the Project on the Aquatic Environment may include: loss or alteration of aquatic habitats (e.g., harmful alteration, disruption or destruction of fish habitat), direct mortality or physical injury to aquatic species, sensory disturbance to aquatic species (e.g., from loud construction activities), and changes to sediment and water quality (e.g., increased suspended sediment or contaminant levels). This assessment focuses on losses of managed stocks, sensitive habitats, and species of conservation concern where Project activities may have an adverse effect on a local population.

12.1 Scope of Assessment

12.1.1 Regulatory/Policy Setting

Fish and fish habitat are protected through federal legislation. Project activities in the Aquatic Environment are regulated under the habitat protection provisions of the *Fisheries Act* and through Fisheries and Oceans Canada (DFO)'s policies and programs addressing the management of fish habitat. Under the *Fisheries Act*, "fish" are defined as all parts of fish, shellfish, crustaceans and marine animals, and their eggs, sperm, spawn, larvae, spat and juvenile stages[4]. Fish habitat includes the spawning grounds and nursery, rearing, food supply and migration areas on which fish depend directly or indirectly to carry out their life processes.

Sections of the *Fisheries Act* that are pertinent to the Project include the following:

- **Section 32**—prohibits the killing of fish (without authorization) by any means other than fishing
- **Section 35**—prohibits any harmful alteration, disruption or destruction of fish habitat (HADD) without authorization
- **Section 36**—prohibits the deposition of a deleterious substance into waters used by fish.

In addition, the *Marine Mammal Regulations*, under the *Fisheries Act*, prohibit the disturbance of marine mammals and killing for reasons other than fishing under a license (Department of Justice Canada 1993). Although section 32 of the *Fisheries Act* applies to all fish species, highest priority is assigned to the mortality of individuals of a managed stock (i.e., a stock that has a fishery) or a species of conservation concern. DFO's policies and guidance documents that address the management of fish habitat include the following:

- *Policy for the Management of Fish Habitat* (DFO 2001)

[4] This definition will be used regularly throughout the assessment and any generic reference to 'effects on fish' should be assumed to include effects on marine mammals etc.

- *Habitat Conservation and Protection Guidelines, Second Edition* (DFO 1998)
- *Decision Framework for the Determination and Authorization of Harmful Alteration, Disruption or Destruction of Fish Habitat* (DFO 2008a)
- *Practitioners Guide to the Risk Management Framework for DFO Habitat Management Staff, Version 1* (DFO 2010)
- DFO Operational Policy Statements for the Pacific Region.

DFO's *Policy for the Management of Fish Habitat* (2001) applies to all projects and activities in or near water that could alter, disrupt or destroy fish habitat by chemical, physical or biological means. The guiding principle of the policy is to achieve no net loss of fish habitat with respect to productive capacity. Authorization for Project activities that will impact fish habitat will require that compensation be provided through habitat creation or restoration initiatives. These initiatives must contribute to increasing the productive capacity of fisheries resources.

Aquatic species of conservation concern receive further legal protection under the SARA. SARA is a federal commitment to prevent "at risk" wildlife species from becoming extinct and to secure the necessary actions for their recovery. It provides for the legal protection of wildlife species and the conservation of biological diversity. Through the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), species are ranked according to their level of conservation concern (i.e., *Extinct*, *Extirpated*, *Endangered*, *Threatened*, *Special Concern*, *Not at Risk* or *Data Deficient*). If a species is listed under Schedule 1 of SARA as *Extirpated, Endangered* or *Threatened*, it is an offence to kill, harm, harass, capture or take an individual, and that species has legal protection related to the species' residence and critical habitats.

12.1.2 Key Issues

The Aquatic Environment has been selected as a VEC because of its ecological, economic, recreational, and cultural importance, and because federal legislation (e.g., *Fisheries Act*, SARA) protects aquatic species and habitat that may be affected by Project activities.

Key potential effects associated with Project activities include:

- Loss or alteration of fish habitat
- Direct mortality or physical injury
- Sensory disturbance (i.e., as a result of Project-related underwater noise)
- Degradation of water and sediment quality.

Table 12-1 provides a summary of how potential environmental effects may result from interactions between the Project and the Aquatic Environment. Effects on the Aquatic Environment will vary depending on the phase of the Project. As a result, activities in Table 12-1 are divided between the construction and commissioning phase, and the operations phase. Project decommissioning will include removal of the land-based above-ground infrastructure and the conveyor and ship-loading equipment from the trestle and berth; however, all in-water marine infrastructure will remain in place. Consequently, there are no expected effects as a result of activities during decommissioning. The potential for cumulative effects based on interactions with other projects (present and future) are also ranked in Table 12-1.

Land-based site preparation (e.g., site grading, clearing and grubbing) was given a rank of ‘1’ in Table 3-4. The potential exists for these activities to result in the introduction of sediment into the Aquatic Environment as a result of erosion. However, standard sediment and erosion control best management practices (e.g., use of silt fences, temporary diversion berms and sandbags) and water management measures (e.g., installation of a stormwater collection system) will be in place to minimize these effects. Therefore these Project activities were not carried through to the effects assessment. Other land-based activities that were assigned a ‘0’ in Table 3-4 are unlikely to have any interaction with the Aquatic Environment and are thus not assessed.

Table 12-1: Potential Environmental Effects to Aquatic Environment Associated with Project

Loss or Alteration of Habitat	Potential Effects on Aquatic Environments			
	Loss or Alteration of Habitat	Direct Mortality or Physical Injury	Sensory Disturbance	Degradation of Water and Sediment Quality
Construction and Commissioning				
Rail Loop Construction	✓	✓	–	–
Dredging	✓	✓	✓	✓
Marine Facilities Construction (causeway, trestle, and berth)	✓	✓	✓	✓
Disposal at Sea	✓	✓	✓	✓
Operations				
Waste Management (sewage, stormwater, wastewater)	–	–	–	✓
Arrival and departure of vessels	–	–	✓	–
Interaction of Other Projects and Activities in the Boundary for Assessment (potential for cumulative effects; see rankings below)				
Ridley Terminals Inc.	1	1	1	1
Prince Rupert Grain Ltd.	1	1	1	1
Ridley Island Log Sort (Not Operational)	1	0	0	0
China Paper Group Pulp Mill (Not Operational)	1	0	0	0
Fairview Terminal (existing and Phase II)	2	2	2	1
CN Aquatrain Facility	1	1	1	0
BC Ferries and Cruise Ship Terminal	1	1	1	0

NOTES:

Project Environmental Effects

Only Project – Environment interactions ranked as 2 in Table 3-4 are carried forward to this Table. A ✓ indicates that an activity is likely to contribute to the environmental effect.

Cumulative Environmental Effects

Cumulative environmental effects were ranked as follows:

0 = Project environmental effects do not act cumulatively with those of other projects and activities

1 = Project environmental effects act cumulatively with those of other project and activities, but are unlikely to result in significant cumulative environmental effects OR Project environmental effects act cumulatively with existing significant levels of cumulative environmental effects but will not measurably change the state of the VEC

2 = Project environmental effects act cumulatively with those of other projects and activities, and may result in significant cumulative environmental effects OR Project environmental effects act cumulatively with existing significant levels of cumulative environmental effects and may measurably change the state of the VEC

12.1.3 Selection of Measurable Parameters

Measurable parameters facilitate quantitative or qualitative measurement of potential Project and cumulative effects, and provide a means to determine the level or amount of change to a VEC. The measureable parameters that will be used to assess potential Project effects to the Aquatic Environment are described in Table 12-2.

Table 12-2: Measurable Parameters for the Aquatic Environment

Potential Environmental Effect	Measurable Parameter(s) for the Environmental Effect	Rationale for Selection of the Measureable Parameter
Loss or Alteration of Habitat	▪ Area of marine fish habitat affected (in m^2) ▪ Importance and quality of habitat for spawning, rearing, or migration	To ensure the Project has no effect on the productive capacity of fish habitat To ensure the Project meets the requirements of Section 35 of the *Fisheries Act*, and for habitat of listed species, that it follows any protective measures under SARA
Direct Mortality or Physical Injury	▪ Likelihood of fish injury or mortality due to in-water Project construction activities	To ensure the Project meets the regulatory requirements of Section 32 of *Fisheries Act*, and for listed species, that it follows any protective measures under SARA
Sensory Disturbance	▪ Underwater sound energy levels resulting from in-water Project activities ▪ Areal extent of ensonified areas	To ensure that sounds emitted during Project activities do not result in a change in behaviour or habitat use
Degradation of Water and Sediment Quality	▪ Changes in concentrations of total suspended solids, salinity, pH, fecal coliform, or contaminants	To ensure the Project meets the regulatory requirements of Section 36 of the *Fisheries Act*

The assessment of loss or alteration of habitat focuses on the areal extent (m^2) of affected marine fish habitats. As per the *Fisheries Act*, Section 35(2), any loss or alteration of fish habitat requires compensation to ensure that there is no net loss of productive capacity. The areal extent of lost or disturbed fish habitats will be used in development of a Project-specific habitat compensation plan.

The assessment of direct mortality or physical injury focuses primarily on sessile and slow-moving marine organisms within the Project footprint (e.g., intertidal and subtidal invertebrates). These organisms may be crushed or buried in areas of infilling and dredging during Project construction.

Faster moving organisms (e.g., fish and marine mammals) are expected to avoid in-water construction activities. The potential for intense underwater sounds (e.g., pile driving and blasting) to harm fish and marine mammals is also assessed under this effect.

The assessment of sensory disturbance focuses on Project activities that produce underwater sounds that could induce habitat avoidance in fish and marine mammals. Sound levels were quantified based on frequency, duration and decibels at a reference pressure of 1 µPa (micropascal). Decibels re 1 µPa are the accepted unit for measuring underwater sound as it relates to fish and marine mammals (Richardson *et al.* 1995, Popper *et al.* 2006, Southall *et al.* 2007). To determine potential effects of underwater sound on fish and marine mammals, source sound levels were contrasted with threshold sound levels predicted to induce behavioural responses.

The assessment of degradation of water and sediment quality focuses on changes in water quality parameters relative to current baseline levels and on whether parameters will exceed water and sediment quality guidelines. Exceedances have the potential to negatively affect fish and fish habitat.

12.1.4 Characterization of Residual Effects

Terms that will be used to characterize residual environmental effects are provided in Table 12-3.

Table 12-3: Characterization Criteria for Residual Environmental Effects on the Aquatic Environment

Criterion	Description
Direction	**Positive:** condition is improving compared to baseline habitat quality or population status **Neutral:** no change compared to baseline habitat quality or population status **Adverse:** negative change compared to baseline habitat quality or population status
Magnitude	**Negligible:** no measurable adverse effects anticipated **Low:** measurable effects to habitat function anticipated in low-sensitivity habitats and no measurable reduction in number of any fish species anticipated **Moderate:** measurable effects to habitat function anticipated in moderately sensitive habitats or anticipated mortality risk to non-listed species **High:** measurable effects to habitat function anticipated in highly sensitive habitat or habitat designated as important for listed species or anticipated mortality risk to listed species
Geographical Extent	**Site-specific:** effects restricted to habitat within the Project footprint **Local:** effects extend beyond Project footprint but remain within the local assessment area **Regional:** effects extend into the regional assessment area
Frequency	**Once:** effect occurs once **Sporadic:** effect occurs more than once at irregular intervals **Regular:** effect occurs on a regular basis and at regular intervals **Continuous:** effect occurs continuously
Duration	**Short-term:** effects are measurable for days to a few months **Medium-term:** effects are measurable for many months to two years **Long-term:** effects are measurable for multiple years but are not permanent **Permanent:** effects are permanent

Criterion	Description
Reversibility	**Reversible:** effects will cease during or after the Project is complete **Irreversible:** effects will persist after the life of the Project, even after habitat restoration and compensation works
Ecological Context	**Disturbed:** effect takes place in an area that has been previously adversely affected by human development or in an area where human development is still present **Undisturbed:** effect takes place in an area that has not been adversely affected by human development

12.1.5 Standards or Thresholds for Determining Significance

For the Aquatic Environment, an effect is considered 'significant' if it has a moderate to high probability of affecting the long-term productive capacity of fish habitat in the Prince Rupert area or the viability of a local population.

12.2 Baseline Conditions

Baseline conditions for the freshwater and marine components of the Aquatic Environment VEC will focus on the Local Assessment Area (LAA; see Figure 12-1). The LAA includes all freshwater habitats on Ridley Island and all marine habitats within a 500 m buffer around Ridley Island and Coast Island.

To assess potential Project effects on the Aquatic Environment, the aquatic habitats and associated biological communities within the LAA were documented. Freshwater baseline surveys included fish surveys and surface water quality surveys. Marine baseline surveys included intertidal surveys, subtidal fish and fish habitat surveys, and sediment sampling in the marine area leased for the terminal causeway, trestle and berth (Canpotex water lot). Field surveys provided a species inventory and characterized the baseline conditions at representative freshwater and marine habitats within the LAA. The results of the baseline surveys are presented in detail in the Aquatic Environment Technical Data Report (TDR). These surveys were used to supplement existing baseline information identified during previous assessments in the Prince Rupert area or through government agencies and peer-reviewed literature.

12.2.1 Baseline Conditions in the Freshwater Component of the Aquatic Environment

12.2.1.1 General Physical and Geological Conditions

The predominant underlying geology on the north coast of British Columbia, including the Prince Rupert area, is granitic with minimal glacial till. The impermeable character of the geological formation underlying surface soils commonly results in high water tables and the formation of bog-type wetlands. This geological characteristic is consistent with what has been observed in the Project footprint: the site is dominated by sphagnum bogs with a few scattered fens and forested patches.

12.2.1.2 Freshwater Surface Water Quality

Freshwater surface water quality surveys were undertaken on Ridley Island in 2006 and 2008. During the 2006 survey, eight watercourses and seven wetland sites were identified within the central portion of Ridley Island (Jacques Whitford AXYS 2007). In 2008, an additional 10 watercourses were identified on the southern and eastern portions of Ridley Island (Jacques Whitford AXYS 2008b). For each watercourse, temperature, dissolved oxygen, conductivity and pH were measured. Table 12-4 provides a summary of these water quality parameters. Figure 12-2 shows the locations of the 18 watercourses and seven wetland sites surveyed within the LAA.

Table 12-4: Freshwater Surface Water Quality within the LAA

Survey Type	Watercourses (18)	Wetlands (7)
Water Temperature (°C)	6.0 – 12.5	13.4 – 18.4
Dissolved Oxygen (mg/L)	3.2 – 10.8	5.0 – 11.5
Conductivity (µS/cm)	23 – 948	30 – 45
pH	3.7 – 6.5	3.7 – 4.4

NOTES:
Data from (Jacques Whitford AXYS 2006, 2007, 2008b)

Measured water temperatures varied from a low of 6.0°C in watercourses to a high of 18.4°C in wetlands (Table 12-4). These values are within the provincial water quality guidelines for the protection of aquatic life (maximum daily water temperature of 19°C for streams with unknown fish distribution (BC Ministry of Environment 2006).

Dissolved oxygen (DO) levels varied from 3.2 to 10.8 mg/L for assessed watercourses (Table 12-4). The federal guidelines for DO are 9.5 mg/L for early life stages and 6.5 mg/L for other life stages of cold water species (CCME 2007). Of the eighteen watercourses surveyed, only three had DO levels suitable for all life stages (i.e., >9.5 mg/L). Ten watercourses had DO levels between 6.5 mg/L and 9.5 mg/L, suggesting that these could support adult fish but not early life stages. Five watercourses had DO levels unsuitable for any life stages (i.e., <6.5 mg/L). A DO concentration below 6.0 mg/L can cause the appearance of distress symptoms in some fish species, while DO levels of less than 5.0 mg/L can inhibit growth in juvenile salmonids, and interrupt spawning (Bjornn and Reiser 1991).

DO levels in wetland sites ranged from 5.0 to 11.5 mg/L (Table 12-4). One site was suitable for all life stages (DO >9.5 mg/L), four sites were suitable for adult fish only (6.5 mg/L <DO <9.5 mg/L), and three sites were unsuitable for any life stages (DO <6.5 mg/L).

Although water temperature and DO levels in most watercourses and wetland sites indicate adequate levels for salmonids and other fish species, pH (alkalinity) levels were below the range considered appropriate for aquatic life (observed range – pH 3.3 to 6.5; Table 12-4). This is to be expected for the sphagnum bog-dominated conditions observed on site. Bogs dominated by sphagnum mosses are known to have unusually low pH levels (common pH values range between 3.2 and 4 [Clymo 1984]). Sphagnum bogs are acidic due to the decomposition of plant matter (peat), which releases organic acids. These acids act to buffer the pH levels, which results in fairly consistent pH levels throughout the year.

Water with pH 3.5 to 4.0 is lethal to salmonids and a host of other fish species (Alabaster and Lloyd 1982, Freda and McDonald 1988). The most commonly accepted lower limit for pH is 6.5 as evidenced by decreased egg production for minnows and emergence of macroinvertebrates (CCME 2007). All twenty five of the assessed watercourses and wetland sites had pH values ≤ 6.5. Twenty three of these sites had pH values ≤ 5.5. Additionally, most conductivity values measured on-site were low. Twenty-two of the 25 sites surveyed had conductivity values less than 50 µS/cm (Table 12-4). This indicates low concentrations of dissolved ions and minimal buffering capacity. Observed alkalinity values may be the result of one or several factors typical of coastal bogs; these include: CO_2 build-up, production of organic acids during decomposition, acid deposition, and high hydrogen ion production (Urban 1987).

Based on the observed water chemistry, it is unlikely that fish could utilize the watercourses or wetland sites within the LAA during any life stage. Although temperatures and dissolved oxygen concentrations were adequate at some sites, the low pH (high acidity) of the water would be detrimental to fish survival. Due to the low dissolved ion concentrations and minimal buffering observed, it is doubtful that the acidic conditions vary throughout the year.

12.2.1.3 Freshwater Fish and Fish Habitat

Watercourses within the LAA are characterized as relatively short (<1,000 m), narrow channels that drain the bog complex within the central portion of Ridley Island. Only one of the 18 surveyed watercourses has the potential to connect to the marine environment through a corrugated steel pipe culvert. However, the pipe outlet is located above the growth of rockweed (*Fucus gardneri*) and barnacles, suggesting that high tide does not reach the culvert inlet on a regular basis, thus limiting marine fish access. All other watercourses drain into roadside ditches that appear to seep through the road.

Channel substrate composition in surveyed watercourses was dominated by organic materials (peat) and fine substrate complexes. Riparian vegetation at all of the sites was relatively mixed, comprised of deciduous and coniferous trees ranging in size from pole saplings to mature tree stands.

Fish sampling was conducted in 2006 and 2008 to establish the presence/absence of fish in the watercourses within the LAA. All 18 of the identified watercourses were surveyed using visual observations, minnow traps and/or electrofishing. No fish were observed or caught in any of the watercourses.

Despite the poor quality of freshwater habitat within the LAA, threespine stickleback (*Gasterosteus aculeatus*) has been observed in the large muskeg disposal pond in the southeastern corner of Ridley Island near the perimeter road (see Figure 12-2). Stickleback are known to be able to live in bogs, ditches and water bodies with poor water quality. They are also common in the ocean and are therefore often found on islands (McPhail 2007). It is likely that the stickleback observed in the muskeg disposal and sediment ponds were trapped when Mudflat Bay was isolated from the marine environment. Over time, these fish would have acclimatized to freshwater conditions.

Due to the poor quality of freshwater habitat on Ridley Island, the absence of connectivity between the upland freshwater streams and the marine environment, and the low pH levels, it is unlikely that salmonids or any other harvested fish species would be present within the LAA. The muskeg disposal pond inhabited by stickleback is located in the southeastern portion of the Ridley Island and will not be affected by Project activities. Therefore, it is concluded that no freshwater fish habitat will be affected by the Project. As a result, the remainder of this assessment will focus only on potential Project effects on the marine component of the Aquatic Environment.

12.2.2 Baseline Conditions in the Marine Component of the Aquatic Environment

Four types of marine surveys were undertaken within the LAA. Survey types, purposes, and dates of completion are provided in Table 12-5.

Table 12-5: Marine Field Studies Undertaken within the LAA

Survey Type	Purpose	Dates
Intertidal Habitat Characterization	▪ Characterize intertidal area that may be impacted by construction of the marine causeway ▪ Characterize intertidal areas that may be impacted by construction of the road, rail, and utility corridor	October 13–15, 2008 May 23–27, 2009 August 5–6, 2009 June 14–17, 2011
Subtidal Video Survey	▪ Characterize subtidal areas that may be impacted by construction of the marine causeway, trestle and berth	January 20–21, 2009 May 18–20, 2009
Tidal Pond Survey	▪ Characterize the area that may be impacted by infilling of the tidal pond during construction of the road, rail and utility corridor	December 10–11, 2008
Sediment Sampling	▪ Assess baseline levels of contaminants in subtidal sediments within the dredge footprint (e.g., metals, PAHs, PCBs)	December 2008 June 2009

Baseline information for the marine component of the Aquatic Environment is described below in terms of general physical and oceanographic conditions, marine water quality, sediment quality, fish habitat, fish and marine mammal species composition, and species at risk. More detailed baseline information is provided in the Aquatic Environment TDR.

12.2.2.1 General Physical and Oceanographic Conditions

The north coast of British Columbia is typical of a fjord coast, with rocky indented shorelines and numerous inlets, straits, passes, sounds and narrows (Pickard and Giovando 1960). Numerous rivers empty into these coastal waters via glacier-formed valleys. The two closest rivers to the Project site are the Skeena and the Nass. The Skeena River is located to the south of the Project footprint and drains into Chatham Sound. The Nass River is located to the north of the Project footprint and drains into Dixon Entrance.

The seabed to the west of Ridley Island slopes gently to a depth of 10 to 15 m approximately 1,000 m offshore, and then drops to approximately 30 m depth over the next 500 m (CHS 1995). The average current speed in this area is approximately 1.5 knots (CHS 1995).

According to a 1992 oceanographic study of Prince Rupert harbour by Stucchi and Orr (1993), tides in the area are of high amplitude and vary semi-diurnally (two high and two low tides per day). The average tidal range is 4.9 m while the largest range is 7.7 m. The prevalent wind direction is southeast, except in June and July when it shifts to the west.

12.2.2.2 Marine Water Quality

The presence of two major rivers has a significant effect on the structure and circulation of marine waters within the LAA. For example, the temperature and salinity of coastal waters vary seasonally as a result of the varying degree of freshwater input from nearby rivers. Generally, drainage from the mainland causes coastal areas to be less saline than offshore areas. Coastal water temperatures in the vicinity of the LAA are approximately 12ºC during the summer months (June – September), and drop to approximately 6ºC in the winter months (December to February) (Crawford 1995). Salinity measurements taken for the same period indicate a summer range of 22 to 28 ppt and a winter range of 28.5 to 31.5 ppt (Crawford 1995).

The Skeena River has a large sediment plume that affects the LAA. This river has the second largest delta in BC; it extends about 30 km west into Chatham Sound. The largest water discharge occurs in May and June when the snow melts (i.e., freshet) (Stucchi and Orr 1993). A secondary peak in discharge takes place in the fall as a result of abundant precipitation (Stucchi and Orr 1993).

12.2.2.3 Marine Sediment Quality

The coastline surrounding Ridley Island is characterized by discontinuous sand, gravel, and boulder beaches (Thomson 1981). Subtidal sediments are predominantly fine-grained, and consist of mud, silt and sand. Layers of sediment can extend for 25 – 35 m over top of bedrock (Golder Associates 2008).

Sediment around Ridley Island may be exposed to contaminants from the Prince Rupert Grain Terminal and Ridley Terminals Inc.'s coal terminal (Jacques Whitford AXYS 2008a). Contaminants may enter the marine environment as a result of runoff or atmospheric fallout. The coal terminal has a number of environmental protection protocols in place that limit the likelihood of these contaminants entering the marine environment.

Marine sediment quality may also reflect historical industry in the region. In the 1950s, a pulp mill located in Porpoise Harbour (on Watson Island) discharged sulphite into the marine environment. In the 1960s, a waste pipe was built from the mill, across Porpoise Harbour and Ridley Island, and into 'Discharge Cove', north of the present grain and coal terminals. This discharge led to dramatic adverse environmental effects on marine life in the immediate vicinity (Tutt 1983). The waste pipe was abandoned in the 1970s and the affected area has apparently recovered.

In preparation for a Disposal at Sea application and to delineate baseline conditions at the Project site, sediment was collected from the proposed dredge footprint in December 2008 and June 2009 for chemical analysis. Detailed results are presented in the Marine Sediment TDR and are summarized briefly below.

Sediment is composed mainly of fine material (25 – 43% clay and 53 – 69% silt). These fine sediments are the result of constant deposition from the Skeena River. Organic carbon, derived mainly from detritus settling in the water column, binds readily with silt and clay, so levels of total organic carbon (TOC) are generally higher in fine-grained sediment than in coarser substrates. This was the case for the 32 sediment sampling stations, where TOC ranged from 0.67 to 2.1% across samples taken from surface sediment down to 5 m depth.

Nickel concentrations were above the BC working guideline for sediments of 30 mg/kg (Nagpal *et al*. 2006) in four of 32 surface sediment samples, four of 12 samples collected at 2 m depth, and four of 12 samples collected at 5 m depth. Concentrations of arsenic exceeded the Canadian Interim Sediment Quality Guideline (ISQG) for the protection of aquatic life of 7.24 mg/kg (Canadian Council of Ministers of the Environment (CCME) 2002) at all stations and all depths; however, all concentrations were well below the guideline for probable biological effects (Probable Effects Level [PEL]) of 41.6 mg/kg (Canadian Council of Ministers of the Environment (CCME) 2002). The ISQG for copper of 18.7 mg/kg (CCME 2007)) was exceeded at all stations and all depths, but no copper value higher than the PEL of 108 mg/kg (Canadian Council of Ministers of the Environment (CCME) 2002) was reported. All other analyzed metals were below either the detection limit or the established guidelines. All Environment Canada Disposal at Sea screening limits for metals were met.

Polycyclic aromatic hydrocarbon (PAH) concentrations in sediment were below analytical detection limits in all samples collected from 2 m and 5 m depths. The fluoranthene concentration in one surface sediment sample exceeded the ISQG concentration but was well below the PEL and when a replicate sample was collected at the same station, fluoranthene met the ISQG. None of the PAH concentrations exceeded Disposal at Sea screening limits.

Polychlorinated Biphenyl (PCB) concentrations were all less than analytical detection limits and were lower than the Disposal at Sea screening limit of 0.1 mg/kg total PCB. As analytical detection limits for PCB compounds varied from 0.05 to 0.07 mg/kg, it was not possible to assess whether PCB-1254 and total PCB concentrations were below the ISQGs (0.06 mg/kg and 0.02 mg/kg, respectively) for all samples.

12.2.2.4 Marine Fish Habitat

Marine fish habitat within the LAA can be divided into intertidal (foreshore) habitat and subtidal habitat.

Intertidal Habitat

The foreshore environment around Ridley Island has been described in the *Prince Rupert Harbour Foreshore Habitat Classification and Proposed Development Criteria* (Archipelago Marine Research Ltd. 1999), the *Ridley Island Master Development Plan* (Jacques Whitford AXYS 2008b) and, most recently, the Aquatic Resources TDR. The Aquatic Resources TDR summarizes the findings of four intertidal surveys completed by Stantec in October 2008, May and August 2009, and June 2011. These studies and reports describe the shoreline of Ridley Island as being largely composed of bedrock, boulder cobble and some areas of fine-grained sediment. Sediment is found primarily along the protected eastern shores in Porpoise Harbour and in protected bays along the otherwise exposed, western, rocky shore. There is also a stretch of sandy beach on the western shore of Ridley Island, immediately east of Coast Island.

Within the intertidal portion of the LAA, a total of 17 transects were completed over the course of the four intertidal surveys (Figure 12-3 and Figure 12-4; for details see Aquatic Environment TDR). Each transect was run perpendicular to the shore and was divided into three zones: high intertidal, mid intertidal, and low intertidal. Within each zone, all species of marine algae and invertebrates were identified and their abundances were recorded. A total of 49 species were observed within the LAA.

Overall, species diversity and abundance were higher on the west coast of Ridley Island than in Porpoise Harbour. This result is likely attributed to the fact that Porpoise Harbour is much more protected than the west cost of Ridley Island. The gently sloping shoreline in Porpoise Harbour experiences low wave exposure, which has led to the build-up of fine silts and mud. These sediments do not provide anchoring points for algae and sessile intertidal invertebrates, resulting in lower biotic diversity and abundance.

Results of the intertidal surveys within the LAA are discussed in detail in the Aquatic Environment TDR. General findings are summarized briefly below.

High Intertidal Zone

The high intertidal zone was characterized by bedrock, boulder and cobble and was dominated by the brown algae, *Fucus*. Dominant red algae in this zone included *Mastocarpus* and *Halosaccion*. Various barnacles (*Balanus* spp.) were abundant as well as shore crabs (*Pagarus* spp. and *Hemigrapsus* spp.). Several species of snails were present, with *Tegula* spp. being the most frequently encountered. Plate limpets (*Tectura* spp.) and ribbed limpets (*Lottia* spp.) were also present.

Mid Intertidal Zone

In the mid intertidal zone, the seaweed community was predominantly *Alaria*, with some *Fucus*. *Ulva* was the most abundant green seaweed and *Mastocarpus, Porphyra, Odonthalia*, *Neorhodomela*, and *Halosacchion* were the most prominent red algae. The thatched acorn barnacle (*Semibalanus cariosus*) was the most abundant barnacle in the mid intertidal zone. The dire whelk (*Lirabuccinum dirum*) was also abundant and the plate limpet (*Tectura* spp.) was common.

Low Intertidal Zone

The low intertidal zone on the west side of Ridley Island is characterized by bedrock, boulder and cobble, whereas the low intertidal zone in Porpoise Harbour is primarily mudflat.

On the west side of Ridley Island, the dominant algae in the low intertidal zone are *Laminari*a and *Alaria*. Red algae observed in this zone include *Odonthalia*, *Neohrodomela*, *Mazzaella*, and *Palmaria*. The invertebrate community consists of the topsnail (*Calliostoma* spp.) and the lined chiton

(*Tonicella lineata*) at relatively high abundance. The low intertidal zone was the only area that shrimp (*Pandalus* spp.) were observed.

In Porpoise Harbour, invertebrates observed in the low intertidal zone include limpets (*Tectura* spp.), snails (*Littorina* spp.), crabs (*Pagurus* spp.) and worms (*Serpula* spp.). Small mounds and holes in the sediment indicate the presence of soft-sediment infauna (e.g., clams, mud shrimp).

Subtidal Habitat

In May 2009, Ocean Ecology conducted a subtidal video survey within the LAA, in the area potentially affected by construction of the marine terminal (Figure 12-5). A detailed survey summary can be found in the Aquatic Environment TDR. The following section provides a brief overview of the main survey results.

The subtidal survey characterized the seafloor as being predominantly comprised of silt and mud. Rock substrates were found only in shallow areas close to Ridley Island, Coast Island, and in the vicinity of the reef between Coast Island and Ridley Island. Species richness was generally higher on rock substrates than on soft sediments.

Subtidal kelps were observed only on rock substrates less than 10 m deep. Bull kelp (*Nereocystis luetkeana*) was the only canopy-forming species identified and *Laminaria* species were the most common understory kelps. Bull kelp was abundant around Coast Island and on the reef between Coast and Ridley Islands. It was also identified at low abundance along the western shoreline of Ridley Island (Figure 12-6).

Canopy-forming kelps add three-dimensional structure to the marine environment, providing important habitat for a variety of fish and invertebrate species. Kelp canopies help to stabilize hydrodynamic conditions, slowing water movement and trapping plankton. Many commercially important fish species including juvenile salmon (*Oncorhynchus* spp.), Pacific herring (*Clupea pallasii*), and rockfish (*Sebastes* spp.) are attracted to kelp canopies, where they feed on other small fish and invertebrates.

A number of commercially important soft-sediment dwelling invertebrates were observed during the subtidal video survey. These include: spiny pink shrimp (*Pandalus borealis eous*), Dungeness crabs (*Metacarcinus magister*), spot prawns (*Pandalus platyceros*), geoduck clams (*Panopea abrupta*), California sea cucumbers (*Parastichopus californicus*), and scallops (*Chlamys* spp.). Several commercial crab traps were also observed during the survey, indicating this area's importance for the crab fishery.

Along the west coast of Ridley Island where soft sediments accumulate, there are two nearshore areas that support small, fringing eelgrass beds (Figure 12-6). The first area is located south of the proposed marine terminal in a protected cove that receives freshwater input from Ridley Island. As this eelgrass bed will not be affected by the Project, it was not characterized during the subtidal video survey. The second area is located along a stretch of sandy beach between Ridley and Coast Islands. The subtidal video survey indicated that this eelgrass bed is discontinuous over a distance of approximately 350 m and fringes the shoreline at depths of +1 to -1 m chart datum. Plants within this bed have a relatively sparse distribution, with coverage seldom exceeding 75%.

Eelgrass beds are extremely productive and provide important nursery habitat for a number of economically, culturally, and ecologically important species, including juvenile salmon, Pacific herring, rockfish, and Dungeness crab (*Metacarcinus magister*). In addition, the soft sediment associated with eelgrass supports rich bivalve communities. Bivalve shells observed within the LAA include Pacific littleneck clam (*Protothaca staminea*), Nuttall's cockle (*Clinocardium nuttallii*), gaper or horse clam (*Tresus capax*), butter clam (*Saxidomus gigantea*), and soft-shell clam (*Mya truncata*) (Jacques Whitford AXYS 2008b). No northern abalone (*Haliotis kamtschatkana*) was seen during subtidal surveys. Though a shellfish closure has been in effect in Prince Rupert Harbour since 2008 (DFO 2008b), bivalves located around Ridley Island can act as a seed bank to populate other areas.

12.2.2.5 Marine Fish

The subtidal video survey conducted in May 2009 found a relatively low diversity of fish within the survey area (Ocean Ecology 2009). Northern ronquils (*Ronquilus jordani*) and a variety of eelpout and flatfish species were found at moderate abundance. Longnose skate (*Raja rhina*), copper rockfish (*Sebastes caurinus*), and black-eyed goby (*Rhinogobiops nicholsii*) were also recorded but at low abundance.

The most likely flatfish species to be present in the LAA is the English sole, as they are common across the BC coast in shallow (<100 m) inshore areas over sand and silt substrate and are tolerant of estuarine conditions (Hart 1988). There is a sizeable commercial fishery for English sole in Hecate Strait and Queen Charlotte Sound.

A literature review identified a number of other fish species that likely occur in the LAA including Pacific salmon, eulachon (*Thaleichthys pacificus*), Pacific herring, and rockfish.

There are five species of Pacific salmon: sockeye, Chinook, coho, pink, and chum. These fish migrate from freshwater streams (e.g., Skeena watershed) to saltwater as smolts and back to freshwater as adults to spawn. There are no major salmon rivers within the LAA, however, the nearby Skeena River and its tributaries hold some of the largest salmon runs in the province (Fisheries and Oceans Canada 2001). During the outmigration (i.e., March – July) of these salmon runs, salmonid smolts can be expected in foreshore environments.

Studies conducted on the path of juvenile salmon leaving the Skeena River suggest that juveniles migrate either south through Ogden Channel or north to Chatham Sound (Manzer and Shepard 1956, Higgins and Schouwenburg 1973, Gottesfeld *et al.* 2006). Fish that migrate north pass through Inverness Passage and Flora Banks and then spread out along the eastern edges of the islands located along the western side of Chatham Sound. Sampling stations located on the west side of Ridley Island indicated that some salmon traveled through this area; however, these fish were often on their own or in small groups, suggesting they were not part of the major migration.

Eulachon are common along the north coast and major eulachon runs are known to occur in both the Nass and the Skeena Rivers (Schwiegert *et al*. 2007). Eulachon may be present within the LAA during annual migrations between freshwater spawning habitats and offshore feeding habitats.

The North Coast is home to one of the five major Pacific herring stocks in BC (Schwiegert *et al*. 2007). Pacific herring spawn from March to April along foreshore areas over intertidal and subtidal vegetation (Hart 1988). Most of the spawning activity in Chatham Sound occurs along the western side of Digby Island. No spawning activity has been recorded within the LAA (Fisheries and Oceans Canada 2006). However, as herring are widely distributed in the marine environment, they may occur within the LAA at any time of year.

Rockfish are a diverse group of marine fish that exhibit a wide range of life histories. Most rockfish show preference for high-relief rocky bottoms in water depths greater than 10 m (Love *et al*. 2002). As this type of habitat is limited around Ridley Island, rockfish are not likely to occur at high abundance within the LAA.

12.2.2.6 Marine Mammals

Marine mammals have high ecological and socio-economic importance in coastal BC. They play key roles in marine food webs and are the focal point of whale-watching and tourism activities on the north coast of BC.

A number of marine mammals have home ranges that include the LAA. Those species considered common to the North Coast inlets include minke whales (*Balaenoptera acutorostrata*), humpback whales (*Megaptera novaeangliae*), northern resident and transient killer whales (*Orcinus orca*), harbour porpoises (*Phocoena phocoena*), Dall's porpoises (*Phocoenoides dalli*), Pacific white-sided dolphins (*Lagenorhynchus obliquidens*), Steller sea lions (*Eumetopias jubatus*) and harbour seals (*Phoca vitulina*) (Spalding 1998, Baird 2001, 2003b, a). For the purposes of this assessment, humpback whales, harbour porpoises and killer whales have been selected as representative species. These species are listed under SARA (see Section 12.2.2.7 below).

Data on the exact presence and frequency of humpback whales, killer whales and harbour porpoises in the LAA are unavailable. However, incidental observations by Stantec biologists and local knowledge from the owner/operator of Prince Rupert Adventure Tours (an ecotourism company) offers first-hand accounts of marine mammal presence in the region.

Harbour porpoises are seen year-round in the vicinity of Ridley Island, particularly in Porpoise Harbour and between Ridley and Kinahan Islands. Humpback whales are seen seasonally from November to February in the waters to the west of Ridley Island (Davis 2006). During sediment sampling offshore from the proposed terminal location in November 2010, Stantec biologists observed several groups of feeding humpback whales within the port boundaries and within several hundred metres offshore from the proposed terminal. During intertidal surveys, marine mammals were also observed opportunistically in the vicinity of Ridley Island. These observations included harbour porpoises and harbour seals. Detailed species lists can be found in the Aquatic Environment TDR.

The LAA is located within Chatham Sound, which has been identified as potentially important for northern resident killer whales (Ford 2006). Killer whales use these waters primarily in early summer (May to mid-July), when Chinook salmon migrate to the Skeena and Nass rivers and chum salmon are present in the area. Northern resident killer whales are generally scarce in Chatham Sound after mid-July (Ford 2006). Transient killer whales may also occur within the LAA at all times of the year.

12.2.2.7 Marine Species at Risk

Table 12-6 lists aquatic species that may occur in or near the LAA and that have been identified as at-risk by COSEWIC. Table 12-6 also provides their federal status under SARA and their provincial status according to the BC Conservation Data Centre (CDC). Species listed on the CDC red or blue lists that are not listed by either COSEWIC or SARA were not included.

There are 11 *designatable units*[5] listed at-risk by COSEWIC that may occur in or near the LAA. Of these, eight are listed in Schedule 1 of SARA. The presence of listed species was identified based on range and distributions reported in COSEWIC status reports and on expert opinion. Although other species-at-risk may be encountered in the general vicinity of the LAA on rare occasions, those listed below are considered to be the most likely.

Table 12-6: Marine Species of Conservation Concern Most Likely to Occur In or Near LAA

Common Name	Scientific Name	COSEWIC Status	SARA Schedule[1]	British Columbia Status
Fish				
Eulachon (Nass/Skeena Rivers population)	*Thaleichthys pacificus*	Threatened	No schedule, No status	Blue
Green sturgeon	*Acipenser medirostris*	Special Concern	Schedule 1	Red
Quillback rockfish	*Sebastes maliger*	Threatened	No schedule, No status	No status
Yelloweye rockfish (outside waters population)	*Sebastes ruberrimus*	Special Concern	No schedule, No Status	No status
Marine Mammals				
Grey whale	*Eschrichtius robustus*	Special Concern	Schedule 1	Blue
Harbour porpoise	*Phocoena phocoena*	Special Concern	Schedule 1	Blue
Humpback whale	*Megaptera novaeangliae*	Special Concern	Schedule 1 (Threatened)	Blue
Killer whale (northern resident)	*Orcinus orca*	Threatened	Schedule 1	Red
Killer whale (transient)	*Orcinus orca*	Threatened	Schedule 1	Red
Steller sea lion	*Eumetopias jubatus*	Special Concern	Schedule 1	Blue

NOTES:
[1]Status under SARA is the same as COSEWIC status unless otherwise stated.

[5] This grouping includes species that have been broken down into separate populations, stocks, or ecotypes, and are listed as such (i.e., an individual species may have more than a single listing).

12.3 Effects Assessment

12.3.1 Assessment Methods

The approach used in the assessment of potential environmental effects of the Project on the Aquatic Environment followed the steps listed below:

1. Identify the location, size, value and connectivity of habitat features that may be affected
2. Identify the types of biota that may be affected and the magnitude of potential effects
3. Develop environmental protection measures to eliminate or minimize effects
4. Identify habitat compensation opportunities to offset any residual effects.

Potential effects of the Project on marine fish habitat (e.g., loss or alteration) were assessed by quantifying the areal extents of loss or altered habitats as a result of in-water Project activities. Species potentially affected within these habitats were identified through a review of existing literature, as well as intertidal and subtidal surveys conducted within the LAA (see Aquatic Environment TDR).

Potential effects of underwater sounds on marine organisms (i.e., direct mortality, physical injury and sensory disturbance) were assessed by comparing the source levels of sounds produced by Project activities to known threshold sound levels capable of inducing mortality, physical injury and/or sensory disturbance in fish and marine mammals. Species potentially affected were identified through a review of the existing literature, as well as intertidal and subtidal surveys conducted within the LAA (see Aquatic Environment TDR).

Potential effects of the Project on sediment and water quality were assessed largely based on the extent and duration of increased suspended sediment levels. Potential exposure of marine biota to resuspended contaminants was also assessed based on known contaminant concentrations within the dredge area (see Aquatic Environment TDR).

12.3.2 Loss or Alteration of Fish Habitat

Project activities associated with construction of the marine terminal and the road, rail and utility corridor have the potential to result in harmful alteration, disruption or destruction of fish habitat (HADD). These activities include shoreline infilling, pile installation, and dredging.

Measurable parameters used to assess the potential environmental effect of loss or alteration of fish habitat are:

- Area of fish habitat that will be affected by the Project
- Quality and productivity of fish habitat that will be affected by the Project, with special emphasis on the importance of habitats for fish rearing, spawning, and migration.

12.3.2.1 Potential Effects

Construction and Commissioning

The construction phase poses the greatest opportunity for adverse environmental effects to marine fish habitat. Habitat loss and alteration will occur as a result of construction of the marine causeway trestle and berth, and infilling associated with construction of the road, rail and utility corridor (RRUC). Habitat disruption will occur as a result of dredging and blasting for the marine terminal berth, and as a result of disposing of dredged material at sea. Areas of habitat loss, alteration and disruption are shown in Figure 12-6 and Figure 12-7, and are summarized in Table 12-7.

Table 12-7: Type and Amount of Affected Marine Habitat

Habitat Type	Area (m^2)		
	Total	Terminal	RRUC
Eelgrass habitat (Loss)	240	240	0
Kelp habitat (Loss)	40	40	0
Intertidal substrate (Loss/Alteration)	66,200	3,400	62,800
Subtidal substrate (Loss/Alteration)	12,720	12,720	0
Subtidal substrate (Disruption)	161,000	161,000	0
Natural backshore vegetation (Loss)	960	960	0
Modified backshore vegetation (Loss)	24,390	0	24,390
Total Habitat Affected	**265,550**	**178,360**	**87,190**

NOTES:
Loss: Habitat permanently lost
Alteration: Habitat altered but not permanently lost
Disruption: Habitat productivity temporarily diminished

Construction of the marine terminal trestle and berth will require the installation of a 185 m long causeway that will extend into the subtidal zone to a depth of approximately -6 m CD. The total marine footprint of the causeway will be 16,200 m^2, which includes 240 m^2 of eelgrass habitat, 40 m^2 of kelp habitat, 12,520 m^2 of subtidal substrate, and 3,400 m^2 of intertidal substrate. Kelp, eelgrass, and intertidal habitats affected by the causeway are considered valuable marine habitats that provide food and shelter for diverse assemblages of algae, invertebrates and fish. Subtidal habitats affected by the causeway have low structural complexity and support a relatively low diversity of marine biota. For a detailed discussion of these habitats and the species they support, see the Aquatic Resources TDR.

Although the causeway will permanently cover 16,200 m^2 of marine fish habitat, it will also create 14,100 m^2 of rocky intertidal (2,100 m^2) and subtidal (12,000 m^2) habitat. The large angular rock (rip-rap) used to construct the causeway's foundation will provide anchoring sites for a diverse assemblage of algae and invertebrates. It will also provide foraging habitat and refuge for juvenile fish, such as salmon, herring, eulachon, and rockfish.

To support the marine terminal trestle and berths, 166 steel piles of three different sizes (50 piles @ 914 mm diameter, 76 piles @ 1219 mm diameter, 40 piles @ 1524 mm diameter) will be installed in water depths between 0 m and -15 m CD. Drilling and installation of these piles will result in the loss of approximately 200 m^2 of subtidal habitat. This habitat is composed primarily of fine-grained sediments (e.g., sand, mud) and supports a relatively low diversity of epifaunal organisms.

Shoreline infilling associated with construction of the road, rail and utility corridor will result in the loss of 59,000 m^2 of intertidal habitat, mostly in the mid to high intertidal zone in Porpoise Harbour. The shoreline of Porpoise Harbour is gently sloping and is primarily composed of mud and silt, with some areas of cobble and gravel. Low wave exposure and high rates of sedimentation render this intertidal habitat less biologically diverse and productive than habitats on the west side of Ridley Island.

Construction of the road, rail and utility corridor will also include the infilling of a 155 m by 30 m tidal pond on the northeast corner of Ridley Island. Field surveys concluded that the pond, which is formed by anthropogenic structures (gravel roads, railway lines and the abandoned Ridley Island Log Sort), is fed by a small creek (pH 4.5), water draining from the log sort, and salt water that enters through two 0.91 m diameter corrugated culverts during high tide. The marine life in the pond is limited (barnacles, mussels, sculpins and purple shore crabs) and the area is unlikely to be used for fish rearing or spawning. The infilling of this pond will result in the loss of 3,800 m^2 of habitat.

On-land site preparation will lead to the loss of 24,390 m^2 of backshore vegetation along the northern and western shorelines of Porpoise Harbour and 960 m^2 of vegetation on the west side of Ridley Island. Backshore vegetation in Porpoise Harbour is dominated by early successional species, including red alder (*Alnus rubra*) and salmonberry (*Rubus spectabilis*). This vegetation provides a buffer between the marine environment and up-land human activity (e.g., the rail line), but likely has little value as marine fish habitat. Backshore vegetation on the west side of Ridley Island is composed of coniferous and deciduous trees and understory shrubs. This vegetation is close to the marine environment (due to the steep shoreline), and likely provides shade to intertidal and shallow subtidal organisms. Insects and detrital matter originating from this habitat may represent a source of nutrients to the marine environment.

None of the areas of identified habitat loss represent known spawning habitat for any fish species targeted by commercial, recreational, or FSC (First Nations' food, social, and ceremonial) fisheries. All affected habitats are common within the LAA and in the surrounding region. The loss of marine habitats within the Project footprint will lead to only a minimal reduction in the availability of fish habitat within the LAA, and will not affect the viability of any local populations.

Where the loss of marine fish habitat is unavoidable, losses will be compensated for with the rehabilitation of existing habitat and/or creation of new productive fish habitats. Specific compensation measures will be developed in collaboration with DFO and will be presented in a detailed Habitat Compensation Plan (HCP). Where possible, marine fish habitats lost as a result of the Project will be replaced like for like (e.g., the loss of an eelgrass bed will be compensated for by the creation or rehabilitation of another eelgrass bed). The HCP will be designed to achieve DFO's guiding principle of 'no net loss' of productive fish habitat in the short term and a 'net gain' in the productive capacity of fish habitat in the long term.

Dredging and blasting of the berth pocket at the end of the marine trestle will disrupt a maximum of 161,000 m^2 of subtidal habitat. The surface layer of sediment and some bedrock will be removed, resulting in the exposure of similar habitat types below. Blasting of buried bedrock in some areas of the berth pocket may also expose rock substrate. Epibenthic and infaunal organisms living within these disturbed habitats will be displaced or lost. However, the physical habitat will remain intact and will be recolonized by a similar suite of marine organisms following the disturbance. Compensation will be provided for the short-term loss of productive capacity at the dredge site.

Construction of the terminal trestle will result in shading that could decrease the quality of marine fish habitat. Fixed piers limit the amount of light available to algal species living beneath them, causing a decrease in primary production (Nightingale and Simenstad 2001). If shading is extensive this can limit the growth and abundance of primary and secondary consumers, including fish prey. The loss of algae can also decrease the structural complexity of fish habitat. The degree to which an overwater structure affects the quality of fish habitat beneath it is influenced by its design (Nightingale and Simenstad 2001). If a pier or trestle is built high above the water, has a low pile density, and does not cast large areas of shade, its effects on marine algae and associated benthic communities will be minimal. The proposed terminal meets all of these requirements: the deck will be 11.5 m above CD, the supporting piles will be spaced far apart, and the trestle will be narrow. Given this design, few if any areas of the seafloor will be permanently shaded; therefore, effects of shading are expected to be minimal.

Installation on in-water infrastructure (i.e., causeway and piles) may affect the sediment transport regime in the vicinity of the Project footprint, leading to the alteration of marine fish habitat. To evaluate the potential impact of marine structures on sediment dynamics near the terminal, a sediment transport model was run using hydraulic and sediment data collected *in situ* (Venturini 2011). The model indicates that the net direction of sediment transport in the area is northward. Predicted sediment transport rates range from 1.64×10^{-4} m^3/m/s during average hydrodynamic conditions to 3.73×10^{-3} m^3/m/s during storm events. However, these values may overestimate true transport rates because the model does not account for the cohesive properties of seabed material. The high percentage of clay material and organic matter at the Project site suggests that sediments will consolidate rapidly after deposition, leading to lower transport rates.

In addition to modeling sediment transport rates, the study by Venturini (2011) assessed historical bathymetric changes along the west coast of Ridley Island. Comparison of bathymetric surveys carried out by the Canadian Hydrographic Service between 1942 and 1983 with a multi-beam survey conducted in 2009 indicates that the seabed elevation has been generally constant over the past 70 years. In addition to this, the Ridley Terminal, which was opened in 1984, has not reported any dredging requirements, significant pile undermining due to local scour, or impacts to their adjacent coastline. The Ridley Terminal has similar in-water infrastructure to the proposed Canpotex Terminal, including a nearshore causeway and a piled trestle and berth. Based on the sediment transport model and the analysis of bathymetric changes along the west coast of Ridley Island, Venturini (2011) concludes that the Canpotex marine terminal is not expected to have a significant effect on the hydrodynamic regime of the area.

Dredging operations at terminal berth will recover a maximum of 800,000 m^3 of soft sediment (silt, clay) and 40,000 m^3 of rock. During dredging, some sediment is expected to escape the mechanical dredge and become re-suspended in the water column. This sediment has the potential to decrease the quality of marine fish habitat through sedimentation. Based on studies of previous dredging operations, it is expected that between 0.2 to 3% of the total volume of dredged material will be lost in the water column (Schroeder and Ziegler 2004). However, fine suspended particles that remain in the water column after dredging are expected to settle within a few days and sedimentation of fish habitats outside of the dredge footprint is expected to be minimal.

Materials dredged at the Project site will be disposed of at an approved disposal at sea site. Two new potential sites have been identified (Sites A and B) and a report has been submitted to Environment Canada requesting approval to use these sites (Stantec Consulting Ltd. 2011). This application also assesses the potential environmental effects of disposing of dredged materials at these sites. If necessary, should Sites A or B not meet approval, the current Environment Canada approved disposal site in Brown Passage will be used.

Sites A and B are both located within the boundaries of the Port of Prince Rupert (see Figure 2-5 in Section 2). Site A is approximately 1 km west of the dredge site, offshore of Coast Island, and Site B is approximately 6 km southwest of the dredge site, near the Kinahan Islands. Subtidal surveys at both sites revealed relatively low biotic diversity. Two types of crab, Dungeness crab (*Metacarcinus magister*) and tanner crab (*Chionoecetes* spp.), and various species of shrimp (*Pandalus* spp.) have the potential to occur at these sites. Several fish species are also present within Chatham Sound and may occur at and around the disposal site; however, important fish habitat (as identified for the Pacific North Coast Integrated Management Area [PNCIMA]), has not been identified at either of the proposed disposal sites.

The Brown Passage disposal site is located 35 km west of Prince Rupert, just north of Triple Island (see Figure 2-5 in Section 2). The site is 1.8 km in diameter and has water depths of approximately 200 m. Disposal of dredged and other material has been authorized at Brown Passage on seven occasions since 1972, most recently in 2006/2007 for the Fairview Phase I project. The environmental effects of disposing of dredged material at Brown Passage were assessed as part of the Fairview Phase II project (Stantec Consulting Ltd. 2010). Important marine resources inhabiting seafloor habitats in Brown Passage include Dungeness crab, tanner crab, shrimp and various demersal fishes; however, important habitat areas for these species do not overlap with the Brown Passage disposal site.

Materials disposed of at sea will cover a portion of the seafloor, leading to alteration of marine fish habitat. The productive capacity of this habitat will be temporarily diminished as marine organisms either move away from the area or are lost. However, recolonization will occur as infauna migrate up into the newly deposited sediments and epifauna move in from surrounding undisturbed habitats. Given the ubiquity of soft-sediment habitats in the Prince Rupert area, disturbance at the disposal site will have a minimal effect on the regional habitat availability. As such, disposal activities will not affect the viability of any local populations.

Operations

No activities or physical works during the operations phase of the Project are expected to interact with the marine environment in such a way as to result in habitat loss or alteration. Sediment disturbance during berthing of vessels is unlikely, as the depth of water at the berth should be sufficient to prevent effects of propeller wash. No maintenance dredging will be required.

Decommissioning

No activities or physical works during the decommissioning phase of the Project are expected to interact with the marine environment in such a way as to result in habitat loss or alteration.

12.3.2.2 Mitigation

In the interest of achieving DFO's first goal of habitat conservation, the proponent has designed the proposed marine terminal to minimize the footprint of the Project in marine habitat. Two alternate designs for the terminal causeway were considered: one extending 401 m southwest of Ridley Island, and one extending 185 m. Although both options were feasible from an engineering perspective and the costs were similar, the shorter causeway was selected in order to minimize the impact on marine habitats.

Where habitat loss cannot be avoided, it will be compensated for with the rehabilitation of existing marine fish habitats or the creation of new habitats. A detailed HCP will be developed in consultation with DFO and implemented at the Project site. Where possible, habitats will be replaced like for like (e.g., the loss of an eelgrass bed will be compensated for by the creation or rehabilitation of another eelgrass bed). The HCP will be designed to achieve DFO's guiding principle of 'no net loss' of productive fish habitat in the short-term and a 'net gain' in the productive capacity of fish habitat in the long-term.

12.3.2.3 Residual Effects

Fish habitats will be affected by the Project; however, these effects will occur only in the immediate vicinity of the Project footprint. Losses incurred as a result of Project activities will lead to only minimal reductions in the overall availability of fish habitats within the LAA, and will not affect the viability of any local populations. Habitats lost or disturbed by the Project will be compensated for with the rehabilitation and/or creation of new productive fish habitats, as detailed in a Project-specific HCP.

With the implementation of habitat compensation and mitigation measures, the environmental effects of loss or alteration of fish habitat will be moderate in magnitude, site-specific in extent, medium-term in duration, and reversible.

12.3.2.4 Determination of Significance

With mitigation and habitat compensation, the residual effects of loss or alteration of fish habitat are predicted to be not significant.

The level of confidence for this determination of significance is high. This is based on: 1) a good understanding of the marine species present within the LAA; and 2) a good understanding of the success of habitat compensation measures when implemented for other projects with similar biophysical considerations.

12.3.3 Direct Mortality or Physical Injury

Project activities have the potential to result in the direct mortality or physical injury of marine organisms. Non-motile organisms (e.g., some invertebrates) may be buried or crushed during shoreline infilling associated with construction of the marine causeway and the road, rail and utility corridor. Motile organisms (e.g., fish and marine mammals) may be harmed or killed by intense underwater sound levels produced by in-water construction activities such as blasting, pile-driving and dredging.

12.3.3.1 Potential Effects

Construction and Commissioning

Construction of the marine terminal causeway, and the road, rail and utility corridor will result in the direct mortality of some intertidal and subtidal organisms, primarily through burial and crushing. Sessile organisms (e.g., barnacles, mussels, chitons, limpets) will be most susceptible to harm, whereas mobile species (e.g., crabs, herring, salmon, and marine mammals) will generally be able to avoid harm by dispersing from the work area. The loss of intertidal invertebrates within the Project footprint will be temporary, as algae and invertebrates will colonize in-water structures (e.g., rip-rap, piles) after construction activities are completed. However, the establishment of a fully functioning intertidal community may take two to three years. Compensation for this temporal loss of productive capacity will include the creation of highly productive fish habitat within the RAA. Details of the compensation strategy will be provided in a Project-specific HCP as discussed in Section 12.3.2.

Dredging within the Project footprint will result in the direct mortality of some epibenthic and infaunal organisms. Common species identified within the dredge area include orange sea pens (*Ptilosarcus gurneyi*), California sea cucumber (*Parastichopus californicus*), and geoduck (*Panopea generosa*). Species removed by dredging are abundant in surrounding habitats and are expected to recolonize the dredge area following the disturbance.

Disposal of dredged sediment and rock at sea will result in the burial of some epibenthic organisms at the disposal site. The mud and silt seafloor at the two proposed disposal sites (A and B) and at Brown Passage is common in the Prince Rupert area and the organisms found here are widely distributed. As the benthic habitat at the disposal site will be altered but not permanently lost, it is expected that affected species will recolonize the seafloor once disposal activities are completed.

Some marine organisms may be exposed to concussive impacts associated with loud construction activities. Blasting, dredging and installation of large diameter steel piles can result in the generation of high energy pressure waves that radiate outwards from the sound source. This can result in harm to fish when the pressure waves pass through a fish’s swim bladder. It can also result in temporary or permanent damage to marine mammal hearing.

For fish, the interim criteria recommended to evaluate potential harm from pile driving is a peak sound pressure level (peak SPL) of 208 dB re: 1µPa per single strike and an accumulated sound exposure level (SEL) of 187 dB re: 1µPa^2-sec (Popper *et al*. 2006). Peak SPL determines whether the swim bladder and ear are subjected to extreme mechanical stress whereas SEL describes the potential for damage from different wave lengths and energy distributions.

With respect to marine mammals, concussive impacts and noise have the potential to result in auditory injury (permanent threshold shifts [PTS]), auditory fatigue (temporary threshold shifts [TTS]), behavioural avoidance, and auditory masking (Richardson *et al*. 1995). Each of these effects may compromise marine mammal feeding efficiency, predator detection, and/or migratory success, and can lead to reduced health and possibly death (Richardson *et al*. 1995). Sound levels capable of inducing TTS and PTS in marine mammals are not well established. TTS has only been observed in a few species of pinnipeds (i.e., seals and sea lions) and small toothed whales (Southall *et al*. 2007). PTS has not been observed in any marine mammal (Southall *et al*. 2007). Estimates of TTS- and PTS-inducing sound levels are often obtained by extrapolating from known or predicted marine mammal auditory thresholds (Richardson *et al.* 1995, Southall *et al.* 2007). The most recent estimates of TTS- and PTS-inducing SELs are those proposed by Southall *et al*. (2007). These values are based on a comprehensive analysis of existing research and are intentionally conservative.

Proposed injury criteria for peak SPLs of single pulse, multiple pulse and non-pulse sound sources are 230 dB re: 1µPa for all cetaceans and 218 dB re: 1µPa for pinnipeds in water (Southall *et al*. 2007). For cetaceans, SELs are 198 dB re: 1 µPa^2-s for pulse and 215 dB re: 1 µPa^2-s for non-pulse. For pinnipeds, SELs are 186 dB re: 1 µPa^2-s for pulse and 203 dB re: 1 µPa^2-s for non-pulse (Southall *et al*. 2007).

Proposed injury criteria for fish and marine mammals are summarized in Table 12-8.

Table 12-8: Proposed Injury Criteria for Underwater Sounds for Fish, Pinnipeds, and Cetaceans

Species Group	Proposed Injury Criteria for Underwater Sounds	
	Peak Sound Pressure Level (SPL) dB re: 1µPa	Sound Exposure Level (SEL) dB re: 1 µPa^2-s
Fish	208	187
Pinnipeds	218	186 (pulse); 203 (non-pulse)
Cetaceans	230	198 (pulse); 215 (non-pulse)

REFERENCES:
Fish values taken from Popper *et al*. 2006; marine mammal values taken from Southall *et al*. 2007.

Potential maximum sound pressure levels (unmitigated) produced by Project activities and the anticipated effects on marine organisms are discussed in the following sections.

Underwater Blasting

The blasting of underwater rock produces compressive shock waves that exhibit a rapid rise to a high peak pressure, followed by a rapid decay to below ambient pressure. These rapid changes in pressure may cause physical injury or direct mortality to marine organisms, including fish and marine mammals.

Fish

Explosive blast studies indicate that exposure can injure or mortally wound fish (Hastings and Popper 2005). The primary site of damage is the swim bladder, although other organs including the kidney, liver, and spleen may also be damaged (McCauley 1994, Wright and Hopky 1998b). Sensitive life history stages such as eggs and larvae may also be injured or killed (Wright and Hopky 1998b).

The severity of damage caused by an underwater explosion is related to the instantaneous pressure change caused by the blast. DFO's blast guidelines state that the instantaneous pressure change is not to exceed 100 kPa in or near fish habitat (Wright and Hopky 1998b). Factors that affect this value include: size of charge (kg), depth of burial (m), type of substrate, and density of substrate. To ensure that DFO's blast guidelines are met, a detailed Blasting Management Plan will be developed for the Project in consultation with DFO.

Marine Mammals

Underwater explosions have the potential to injure or kill marine mammals. Because shock waves from blasts attenuate over short distances, the likelihood of a marine mammal being injured decreases with increasing distance from the source. For an explosion with a maximum instantaneous pressure change of 100 kPa, marine mammals are unlikely to be injured or killed if they are at least 500 m from the source (Wright and Hopky 1998b). DFO's blasting guidelines require that this distance be maintained as a marine mammal exclusion zone during blasting operations. If a marine mammal is observed within this safety radius, blasting activities must be temporarily suspended.

To minimize potential effects of blasting on marine mammals, a Blasting Management Plan will be developed in consultation with DFO. This plan will include provisions for marine mammal observers to be on-site to enforce a 500 m radius exclusion zone during blasting operations.

Pile Driving

Sound levels produced during pile driving depend on a variety of factors, including type of pile (i.e., steel, concrete, or wood), diameter of the pile, method of installation (i.e., vibratory, drop hammer, or impact hammer), sediment type, and water depth (Illingworth and Rodkin 2007). Three types of piles will be used for the Project: 36-, 48- and 60-inch steel piles. The preferred installation method is vibratory driver. Where this method cannot be used due to engineering constraints, an impact hammer may be used.

Sound levels produced during in-water pile installation have been recorded during past construction projects. For large diameter steel piles, data are available for both vibratory driver and impact hammer installation. Sound pressure levels (SPL) and sound exposure levels (SEL) recorded for these activities are listed in Table 12-9.

Table 12-9: Sound Levels for Pile Driving

Pile Type and Size	Method of Installation	Peak Sound Pressure Level (SPL) dB re: 1µPa	Sound Exposure Level (SEL) dB re: 1 µPa^2-s
36-inch, Steel	Impact Hammer	210	183
60-inch, Steel	Impact Hammer	210	185
36-inch, Steel	Vibratory Driver	185	175
72-inch, Steel	Vibratory Driver	195	180

NOTES:
All sound levels measured 10 m from pile. Source: (Illingworth and Rodkin 2007)

Based on the data presented in Table 12-9, pile driving using an impact hammer produces SPLs that are between 15 and 25 dB louder than a vibratory driver. The difference for SELs is less, between 8 and 10 dB. A common method employed to reduce sound levels associated with impact hammers is the use of a bubble curtain. There are a variety of types of bubble curtains, but all rely on the same basic principle: surround the pile with bubbles to attenuate the sounds produced during impact. Bubbles may be released at the base of the pile through a perforated hose, or may be released at various depths up the pile. Isolation casings are sometimes used to contain bubbles, especially in areas of high current. In general, bubble curtains provide a reduction in SPLs and SELs of between 10 and 15 dB (Illingworth and Rodkin 2007). However, attenuation values may vary depending on a variety of factors, including current velocity, water depth, substrate type, and design of the bubble curtain.

Assuming a conservative value of 10 dB of attenuation, the use of a bubble curtain during impact hammer pile installation would reduce SPLs to approximately 200 dB re: 1µPa and SELs to 173 – 175 dB re: 1µPa (at 10 m from the pile).

Fish

Based on the injury criteria for fish (SPL of 208 dB re: 1µPa, SEL of 187 dB re: 1µPa), pile installation using a vibratory driver is unlikely to result in injury or mortality to fish. The use of an impact hammer with a functional bubble curtain is predicted to produce a maximum SPL of 200 dB re: 1µPa and an SEL of 175 dB re: 1 µPa^2-s at a distance of 10 m from the pile. Within very close proximity of the pile (e.g., <10 m) sound levels may exceed the injury criteria for fish. However, very few fish are expected to be within this area as they will likely be dispersed by the bubble curtain before installation commences.

Marine Mammals

Marine mammals are not expected to be injured by sounds emitted by pile driving as even unattenuated impact hammers are still below the injury criteria for cetaceans (SPL of 230 dB re:

1µPa and SEL of 198 dB re: 1 µPa^2-s) and pinnipeds (SPL of 218 dB re: 1µPa and SEL of 186 dB re: 1 µPa^2-s) (Southall *et al*. 2007).

Dredging

Sound levels emitted from dredging equipment are typically lower than pile driving, with a typical suction cutter dredge having a broadband source level (peak SPL) of 187 dB re 1 µPa @ 1 m, and a clamshell dredge having a maximum broadband source level of ~167 dB re 1 µPa @ 1 m (Richardson *et al*. 1995). Both of these levels are below the peak SPL interim criterion for fish and marine mammals.

Although sound levels produced during typical pile driving and dredging activities are below TTS and PTS levels of concern, these sounds may elicit behavioural responses that affect the health of fish and marine mammals (Richardson *et al.* 1995, Popper *et al.* 2006, Nowacek *et al.* 2007, Southall *et al.* 2007). These effects are discussed in Section 12.3.4.

Operations

No activities or physical works during the operations phase of the Project are expected to interact with the aquatic environment in such a way as to result in an increase in direct mortality or physical injury. The potential for mortality or physical injury as a result of a marine mammal-vessel strike are assessed under Accidents and Malfunctions (Section 19.8).

Decommissioning

No activities or physical works during the decommissioning phase of the Project are expected to interact with the aquatic environment in such a way as to result in an increase in direct mortality or physical injury.

12.3.3.2 Mitigation

Mitigation measures have been designed to reduce or eliminate the potential for in-water Project activities to harm or kill fish and marine mammals. These mitigation measures will also help reduce potential behavioural disturbance effects (discussed in Section 12.3.4). Best Management Practices (BMPs) and guidance materials to mitigate potential injuries and mortalities have been established by a number of government agencies and industry practices. The key mitigation measures and BMPs that will be used to minimize the potential environmental effect of direct mortality or physical injury are:

- **Seasonal Avoidance:** Blasting will be avoided where possible during the peak of the juvenile salmon migration as defined through conversations with DFO.
- **Marine Mammal Monitoring Program:** A marine mammal monitoring program will be implemented to enforce the 500 m exclusion zone during blasting operations. Blasting will only occur during daylight hours to ensure that marine mammals can be seen if they approach or enter the exclusion zone.

- **Bubble Curtains:** During pile driving, bubble curtains may be used to reduce sound levels emitted to the marine environment.
- **Fish Salvage Program:** A fish salvage will take place prior to infilling the tidal pond. Salvage methods will include the use of traps and seine nets. Fish will be released to suitable habitat undisturbed by the Project.
- **Blasting Guidelines:** Guidelines for underwater blasting (Wright and Hopky 1998a) recommended by DFO will be followed:
  - Ammonium nitrate-fuel oil mixtures will not be used.
  - After loading a charge in a hole, the hole will be back-filled (stemmed) with angular gravel to the level of the substrate/water interface or the hole collapsed to confine the force of the explosion to the formation being fractured. The angular gravel is to have a particle size of approximately 1/12th the diameter of the borehole.
  - All "shock-tubes" and detonation wires will be recovered and removed after each blast.
  - Explosives will not be knowingly detonated within 500 m of any marine mammal (or within visual contact from an observer using 7x35-power binocular).
  - The blasting contractor will use appropriate equations to ensure that no explosive is detonated in or near fish habitat that produces, or is likely to produce, an instantaneous pressure change (i.e., overpressure) greater than 100 kPa (14.5 psi) in the swim bladder of a fish.

12.3.3.3 Residual Effects

Direct mortality and physical injuries to sedentary invertebrates will be limited to the Project footprint (e.g., areas of infilling, dredging, and blasting). No species at risk or of management concern are expected to be affected. Organisms that will be affected have high reproductive rates and are expected to recolonize the affected areas following the completion of construction activities.

Project construction activities are not expected to result in harm to fish or marine mammals. These organisms are mobile and are expected to avoid directly-affected marine habitats (e.g., areas of infilling, dredging). Sounds produced by pile driving and dredging will be below the threshold levels capable of inducing injury or mortality to fish and marine mammals. The development of a marine mammal monitoring program will ensure that marine mammals are not harmed during blasting operations.

With the proposed mitigation measures, the environmental effects of direct mortality or physical injury are expected to be moderate in magnitude, local in extent, medium-term in duration, and reversible.

12.3.3.4 Determination of Significance

With mitigation, residual environmental effects of direct mortality or physical injury are predicted to be not significant.

The level of confidence for this determination of significance is moderate. This is based on: 1) a good understanding of the marine species present within the LAA; 2) a moderate understanding of the effects of acoustic emissions on fish and marine mammals; and, 3) a moderate understanding of the efficacy of the proposed mitigation measures when implemented for other projects with similar biophysical considerations.

12.3.4 Sensory Disturbance

In-water Project activities will produce underwater sounds that could elicit behavioural responses in marine organisms. Depending on the intensity and duration of underwater sounds, some fish and marine mammals may avoid ensonified areas during Project activities. Avoidance has the potential to affect an animal's ability to feed, socialize, and migrate.

Measurable parameters used to assess the potential environmental effect of sensory disturbance are:

- Underwater sound energy levels resulting from in-water Project activities
- Areal extent of ensonified areas.

12.3.4.1 Potential Effects

Construction and Commissioning

Project construction activities, particularly pile driving, dredging and blasting, will produce underwater sounds that could cause some fish and marine mammals to avoid the Project area (Richardson *et al*. 1995). The extent of this sensory disturbance depends on a number of factors, including: the source level of the underwater sound, the attenuation rate of the underwater sound, and the species in question (Richardson *et al.* 1995, Southall *et al.* 2007). Behavioural response thresholds for fish and marine mammals are not well established. For marine mammals they have been cited as 120 dB re: 1 µPa for continuous sounds and 160 dB re: 1 µPa for impulsive sounds (Federal Register 2005). For fish there are no published guidelines for behavioural response thresholds; however, for high intensity pulsed noises (e.g., seismic air guns, pile driving), short-term behavioural responses have been observed at received levels of 160 to 180 dB re: 1µPa (McCauley *et al*. 2000).

Pile driving, blasting, and dredging will produce high-intensity underwater sound in the audible ranges of fish and marine mammals (Richardson *et al*. 1995). Anticipated source levels from these activities are discussed in Section 12.3.3.1, above. These sounds have the potential to result in behavioural avoidance, which can affect an animal's ability to feed, socialize and migrate (Richardson *et al.* 1995, Popper and Hastings 2009a).

Disposal at sea will result in the production of underwater noise associated with vessel movement, but as these sounds will be similar to those produced during operations (i.e., departure and arrival of vessels at the marine terminal) they are not considered separately here (see 'Operations' below for an assessment of sensory disturbance resulting from vessel operations).

Fish

The behavioural responses of fish to underwater sound are poorly understood (Popper and Hastings 2009b, Popper and Hastings 2009a). Most research in this area has examined the responses of captive fish to high intensity sounds from seismic air guns and pile driving. In one of the few studies conducted in the natural marine environment, Wardle *et al*. (2001) used a video system to examine the behaviour of rocky reef fish in response to emissions from seismic air guns. The researchers found only minor temporary behavioural changes despite the high intensity of the sound (210 dB re 1µPa at 16 m). In other studies, startle responses (i.e., temporary increase in swim speed) have been observed at received levels of 160 to 180 dB re: 1µPa (McCauley *et al*. 2000).

Assuming a conservative behavioural response threshold of 160 dB re: 1µPa, sounds produced during blasting, pile driving and dredging may elicit behavioural responses in fish. These may include: startle responses, changes in swim depth, and localized avoidance. These responses are expected to be temporary, with behaviour returning to normal when sound production ceases. The areal extent of behavioural responses will encompass the distance over which sound levels exceed 160 dB re: 1µPa. This distance will depend on the source levels of underwater sounds, but is not expected to exceed several hundred metres.

Marine Mammals

In-water construction activities generally produce low-frequency sounds, with most acoustic energy below 1 kHz (Richardson *et al*. 1995). These sounds are in the frequency range of best hearing for baleen whales (e.g., humpback whales) but are well below the range for most odontocetes (e.g., harbour porpoises) (Mohl and Andersen 1973, Richardson *et al.* 1995). Low-frequency construction sounds are audible to most pinnipeds (Richardson *et al*. 1995)

Behavioural responses of marine mammals to underwater sounds are variable, context-dependent, and difficult to predict (Southall *et al*. 2007). Observed responses include changes in swim speed, dive depth and duration, vocalization behaviour, feeding behaviour, and distribution (Southall *et al*. 2007). Habitat avoidance is among the most severe behavioural responses, as displaced animals may be excluded from important foraging areas (Richardson *et al.* 1995, Southall *et al.* 2007). Past studies have documented localized avoidance of loud anthropogenic sounds by various species of marine mammals. For example, in Hawaii it has been shown that humpback whale mother and calf groups avoid nearshore waters where human activities are intense (Richardson *et al*. 1995). Similarly, a grey whale calving lagoon in Baja California was abandoned for several years during anthropogenic disruption (Richardson *et al*. 1995). Behavioural responses of harbour porpoises to construction activities include: localized avoidance, reduced activity levels, reduced foraging time, and reduced acoustic activity (Henriksen *et al.* 2004, Tougaard *et al.* 2004). Most studies report that marine mammal behaviour returns to normal after sound production ceases (Richardson *et al.* 1995, Southall *et al.* 2007).

For cetaceans, the proposed behavioural response threshold is 120 dB re: 1µPa for continuous sounds (e.g., dredging) and 160 dB re: 1µPa for impulsive sounds (e.g., blasting, pile driving) (Federal Register 2005). Sounds produced during construction activities will exceed these thresholds within portions of the LAA. The areal extent of behavioural effects will depend on the sound source levels and the species in question; however, most studies have documented avoidance behaviour in the range of 500 m to 1,000 m (Southall *et al*. 2007).

Based on these studies, it is plausible that some marine mammals may avoid areas around loud in-water construction activities. Localized displacement of some marine mammals within the LAA is not likely to compromise the fitness or survival of affected individuals. The marine habitat within and around the LAA has not been identified as important foraging or breeding habitat for any species of marine mammal, and similar habitats are common in the region. However, to minimize the potential for sensory disturbance, if feasible, blasting will take place between November 30 and February 15 to coincide with periods of lower abundance.

Operations

Between 130 and 150 large cargo vessels may visit the Ridley Island terminal each year. It should be noted that this number of ships represents terminal capacity and may not agree with actual potash supply and demand. Up to four tugboats are expected to assist the vessels in and out of berth. The large cargo vessels will create ambient noise levels in the range of 185 –190 dB re: 1 µPa at 1 m (Richardson *et al*. 1995). Docked vessels will emit sounds from pumps and other smaller sources; however, sounds will be much lower than those emitted by propulsion machinery and are not likely to induce behavioural responses in fish or marine mammals.

Fish

Few published studies have examined the behavioural responses of fish to underwater sounds produced by large ocean-going vessels (Mitson and Knudsen 2003, Popper and Hastings 2009b, Popper and Hastings 2009a). The existing studies have found some evidence of localized avoidance (e.g., sardines, anchovies; (Soria *et al*. 1996)) and changes in school structure and swim depth (e.g., bluefin tuna; (SARA *et al*. 2007). However, the geographic extent over which these effects are realized, and how individual or population-level fitness is affected, has not been quantified. Fish within the LAA may exhibit a localized behavioural response to the sounds produced by transiting vessels. However, there is no qualitative or quantitative evidence that vessel traffic interferes with the foraging or migratory behaviour of marine fish. For example, Vancouver and the Fraser River are the busiest shipping regions on the west coast of Canada (Statistics Canada 2009). Although underwater sounds produced by large vessels are pervasive in this marine environment, the Fraser River supports the largest runs of salmon in Canada.

Marine Mammals

Several studies have documented behavioural responses of marine mammals to vessels. Harbour porpoises exhibit avoidance behaviour as far as 1 to 1.5 km from moving vessels, although reactions are generally stronger within 400 m (Richardson *et al*. 1995). Killer whales in southern British Columbia are subject to intense vessel-based whale watching and are known to exhibit avoidance behaviour within 400 m of these vessels (Richardson *et al*. 1995). Reactions of humpback whales to large vessels are variable. In general, humpback whales are more likely to react to vessels while they are resting than while they are engaged in feeding (Richardson *et al*. 1995). Baker *et al*. (1982) suggest that humpback whales exhibit vertical avoidance (i.e., increased dive durations, decreased blow intervals and decreased swimming speeds) within 2 km of underway vessels.

Based on these studies, it is expected that marine mammals will exhibit localized avoidance of cargo vessels arriving and departing the marine terminal. However, avoidance is expected to occur only while vessels are in operation. At the expected frequency of one to two Project vessels per week, this represents a short-term effect. The behaviour and distribution of marine mammals is expected to return to normal when vessels are not operating within the Project area.

Decommissioning

No activities or physical works during the decommissioning phase of the Project are expected to interact with the marine environment in such a way as to result in sensory disturbance.

12.3.4.2 Mitigation

Mitigation for the potential effect of sensory disturbance will focus mostly on the high-intensity sounds produced during the construction phase. Mitigation measures will include:

- **Seasonal Avoidance:** Blasting will be avoided where possible during the peak of the juvenile salmon migration as defined through conversations with DFO.
- **Use of Vibratory Pile Driver:** For pile driving, a vibratory driver will be used wherever feasible, as this method produces lower sound levels than the conventional impact driver. Where this method cannot be used due to engineering constraints, impact hammer may be used.
- **Bubble Curtains:** During pile driving bubble curtains may be used to reduce sound levels emitted to the marine environment.

12.3.4.3 Residual Effects

Residual effects of underwater sounds produced by Project activities may include behavioural disturbance and localized displacement of fish and marine mammals from ensonified areas around the Project site. Loud construction activities such as pile driving, blasting and dredging have the greatest potential to induce behavioural responses in fish and marine mammals. Sounds produced by vessels during the operations phase of the Project may also elicit localized behavioural responses in fish and marine mammals. The areal extent of displacement is expected to be on the order of several hundred metres for most marine mammal species.

Localized displacement may temporarily reduce the foraging efficiency of affected individuals; however, this effect will be minimal as displacement is temporary and suitable foraging habitat is abundant in the region. Sensory disturbance is not expected to compromise the fitness or survival of any fish or marine mammal. With the proposed mitigation measures, the environmental effects of sensory disturbance are expected to be low in magnitude, long-term in duration, regional in extent, and reversible.

12.3.4.4 Determination of Significance

With mitigation, residual environmental effects of sensory disturbance are predicted to be not significant.

The level of confidence for this determination of significance is moderate. This is based on: 1) a good understanding of the marine species present within the LAA; 2) a moderate understanding of the timing of marine mammal presence in the region 3) a moderate understanding of the effects of acoustic emissions on fish and marine mammals; and 4) a moderate understanding of the efficacy of the proposed mitigation measures when implemented for other projects with similar biophysical considerations.

12.3.5 Degradation of Sediment and Water Quality

Sediment and water quality are important to all components of the marine ecosystem and, for this assessment, refer to the physical and chemical parameters of marine sediment and seawater, including inorganic and organic contaminants. The construction and operation of the Project could result in changes to sediment and water quality. The measureable parameters used to assess potential degradation of sediment and water quality are:

- Total suspended sediment (TSS) levels
- Contaminant levels in water and sediment.

While DFO regulates all activities that may affect fish habitat in the marine environment under the *Fisheries Act*, Environment Canada regulates the marine disposal of waste material, including disposal of dredged sediments, under the *Canadian Environmental Protection Act*.

12.3.5.1 Potential Effects

Suspension of sediment will occur primarily during dredging operations. In-water construction activities that disturb the seafloor (e.g., pile installation, infilling) may also result in localized increases in TSS levels. Increased TSS levels may result in increased turbidity, reduced light levels, and increased sedimentation, potentially affecting fish habitat. The effects of sedimentation on fish habitat are assessed in Section 12.3.2, above. The Project will not release contaminants into the marine environment; however, pre-existing contaminants in the sediment may be re-suspended and become bioavailable to marine biota.

Stormwater and wastewater effluent from the Project terminal site could affect water quality within the LAA. However, all discharged water will be treated according to the *Waste Management Act*, Petroleum Storage and Distribution Facilities Stormwater Regulation, and the Special Waste Regulation. Ballast water from cargo ships will be treated according to the *Canadian Shipping Act*.

Construction and Commissioning

In-water Project construction activities will cause the resuspension of marine sediments, leading to localized increases in TSS levels. Resuspension of sediments is most likely to occur during dredging and ocean disposal of dredged material, but may also occur during pile installation and shoreline infilling. Based on studies of previous dredging operations, it is expected that between 0.2 to 3% of the total volume of dredged material will be lost in the water column (Schroeder and Ziegler 2004). For TSS, the *Canadian Water Quality Guidelines for the Protection of Aquatic Life* (CCME 2007) are a maximum increase of 25 mg/L when ambient levels are below 250 mg/L and a maximum increase of 10% when ambient levels are above 250 mg/L. TSS levels may exceed this guideline within the immediate vicinity of the mechanical dredge. However, this effect is expected to be short-term and the area is already exposed to high levels of TSS as a result of its proximity to the Skeena River.

As discussed in Section 12.2.2.3, contaminant levels were assessed in sediments within the dredge footprint. Polycyclic aromatic hydrocarbons (PAHs) were below the interim sediment quality guidelines (ISQG) at all but one of the 32 sediment sampling stations. At this station fluoranthene exceeded the ISQG; however, the concentration was well below the probable effect level (PEL), and the fluoranthene concentration measured in a replicate sample collected at the same station met the ISQG. Concentrations of arsenic and copper exceeded the ISQG at all stations, but were well below the PEL. Nickel concentrations exceeded the BC Working Guidelines at four stations.

Most contaminants present in sediment are bound to organic compounds and are not soluble in seawater. The risk of bioaccumulation occurs when contaminants are re-suspended in the water column and ingested by marine biota. Fine suspended particles that remain in the water column after dredging are expected to settle within a few days and the risk of marine organisms being exposed to contaminants is expected to be minimal.

Disposal of dredged materials at the approved disposal site will result in localized increases in TSS levels. The sediment plume created during disposal was modeled for periods during and immediately after disposal events (Jiang and Fissel 2011). At site A, and just north of site A, the TSS guideline would be exceeded for only the first few hours after each disposal event and would return to background levels within six hours of completion of all disposal activities. At site B, and just southeast of site B, the guideline would only be exceeded for the first few hours after each disposal event and would return to background levels within seven hours of completion of all disposal activities. Movement of fish away from the area when there is elevated TSS is expected. However, changes in fish abundance are expected to be temporary.

Disposal of dredged materials at Brown Passage was modeled as part of the Fairview Phase II project (Stantec Consulting Ltd. 2010). Results of this modeling suggest that TSS levels will be within water quality guidelines in the top 140 m of the water column. In deeper waters, TSS levels are predicted to range from 1 to 781 mg/L above background levels during disposal, but will decrease to below guideline levels within several days. The sediment plume created during disposal is expected to extent to the southeast of the site. Maximum TSS levels outside of the disposal area are predicted to be on the order of <1 to 10 mg/L above background levels, and will be restricted to near-bottom waters. As with Sites A and B, fish may temporarily avoid affected habitats within Brown Passage during disposal operations.

Operations

Sewage water produced on-site will be treated at a Type II treatment facility that will achieve effluent quality better than 45 mg/L TSS and 45 mg/L BOD_5. Grey water will be routed into a buried tile field. Stormwater and run-off will be collected in catch basins and routed to a below-ground oil/water separator and then through a two-stage settling pond and constructed wetland before being discharged to the marine environment. Wastewater from the washdown systems designed to remove accumulated potash from the infrastructure will also be directed to the two-stage settling pond and constructed wetland.

All wastewater discharges from the terminal will comply with standards established under the *Waste Management Act*, Petroleum Storage and Distribution Facilities Stormwater Regulation, and the Special Waste Regulation. Because discharged water will comply with these regulations, it is not expected to exceed guideline levels for TSS or contaminants. Water runoff associated with the road, rail, and utility corridor will be collected in ditches and funnelled (via manholes and culverts) to outfalls located at various points around the island. Runoff will go through oil water separators prior to being released into the ocean.

Vessels could release bilge water or contaminated ballast water into local waters. Bilge and ballast water could affect water and sediment quality through the introduction of foreign substances, toxins, chemicals, or invasive organisms. However, any shipping associated with the Project will operate in conformance with all existing port, provincial, federal, and international shipping regulations. As per the *Canada Shipping Act, Ballast Water Control and Management Regulations*, ballast water from incoming ships will be exchanged or treated at sea, at least 200 nautical miles from shore (Transport Canada 2006). Therefore, the effects of ballast water from vessels at the Terminal are not expected to measurably alter local sediment and water quality through the introduction of foreign substances or invasive organisms. Sediment disturbance during berthing of vessels is unlikely, as the depth of water at the berth should be sufficient to prevent effects of propeller wash.

Decommissioning

No activities or physical works during the decommissioning phase of the Project are expected to interact with the marine environment in such a way as to result in the degradation of sediment and water quality.

12.3.5.2 Mitigation

A variety of mitigation measures will be implemented to preserve sediment and water quality at the Project site, including the following:

- **Erosion Control:** Erosion and runoff controls will be in place on land during construction and operation to minimize increases in TSS and turbidity in nearshore waters around the terminal.
- **Water Treatment:** Stormwater, wastewater, and sewage associated with the terminal will be collected and treated before discharge from the site, and a Waste Management Plan will be prepared for the construction and operation phases of the Project. Stormwater will be

diverted through drainage ditches to avoid contamination with potash and other materials and, where required, will undergo water/oil separation before being discharged to the marine environment. Sewage will undergo secondary treatment at an on-site treatment plant before being discharged. Follow-up monitoring of sewage discharge will be performed as per provincial and regional requirements. Potash washdown water will be routed through a two-stage, 1,500 m^3 settling pond prior to being discharged through the marine outfall. This settling pond allows the water to be tested to ensure pH and contaminant levels are suitable for disposal prior to discharge via the marine outfall.

- **Total Suspended Sediment (TSS) Monitoring:** TSS levels will be monitored during in-water construction activities (e.g., shoreline infilling, causeway construction, pile installation, blasting, dredging, and ocean disposal) to ensure that levels do not exceed the established guidelines.

12.3.5.3 Residual Effects

Although in-water construction activities may result in localized increases in TSS levels, the risk of exposure of marine organisms to re-suspended contaminants is expected to be minimal. Chemical analysis of sediments within the dredge area indicated that all potential contaminants are below the guideline levels for probable adverse effects on marine biota.

During operations, water will be discharged to the marine environment from the marine terminal and from berthed cargo vessels. All water will be appropriately treated prior to discharge and will comply with the applicable Provincial and Federal regulations. As such, discharged water will not decrease water quality within the LAA.

With the proposed mitigation measures, the environmental effects of a degradation of sediment and water quality are expected to be low in magnitude, short-term in duration, local in extent, and reversible.

12.3.5.4 Determination of Significance

With mitigation, residual environmental effects of a degradation of sediment and water quality are predicted to be not significant.

The level of confidence for this determination of significance is high. This is based on: 1) good, quantitative information on the contaminant concentrations present in sediments likely to be disturbed; 2) a good understanding of the marine species that may be affected within the LAA; and, 3) a good understanding of the efficacy of the proposed mitigation measures when implemented for other projects with similar biophysical considerations.

12.4 Combined Effects and Overall Significance Determination

The environmental effects of the Project on the Aquatic Environment were assessed by evaluating the effects of specific Project activities on freshwater and marine biota known or likely to occur within the local assessment area (LAA). The Aquatic Environment includes a broad range of species across intertidal and subtidal habitats. Thus, the parameters used for the assessment are equally numerous. The individual effects assessed in this document may act in a combined manner on the

Aquatic Environment, giving certain Project activities further-reaching implications. For example, habitat loss or alteration may exacerbate direct mortality and physical injury resulting from Project activities. Similarly, degradation of sediment and water quality can act as a stressor contributing to direct mortality or physical injury.

Although combined effects are possible, the mitigation measures that will be taken to minimize potential Project effects will also minimize the probability of combined effects. For example, habitat compensation measures will ensure that there is ‘no net loss’ of productive fish habitats within the LAA, offsetting the loss and alteration of marine habitats and ensuring that species that incur injury or suffer direct mortality recover to or above baseline abundances. Mitigation measures taken to minimize effects on sediment and water quality, such as wastewater treatment, will ensure that organisms affected by in-water construction activities do not experience additional stresses as a result of increased contaminant concentrations.

Given the extensive mitigation measures taken to address each potential environmental effect, the combined residual effects are not expected to lead to the permanent loss of species or habitat within the LAA. With the proposed mitigation, combined environmental effects are expected to be moderate in magnitude, medium-term in duration, local in extent, and reversible.

With mitigation, residual environmental effects are expected to be not significant. This determination is made with a high level of confidence, based on: 1) a good understanding of the effects mechanisms and the potential for effects to act in combination; and, 2) a good understanding of the efficacy of the proposed mitigation measures when implemented for other projects with similar biophysical considerations.

A summary of Project residual environmental effects on the Aquatic Environment is presented in Table 12-10.

Table 12-10: Summary of Project Residual Environmental Effects on the Aquatic Environment

Potential Residual Environmental Effects	Proposed Mitigation/Compensation Measures	Residual Environmental Effects Characteristics									Recommended Follow-up and Monitoring
		Direction	Magnitude	Geographic Extent	Duration and Frequency	Reversibility	Ecological Context	Significance	Prediction Confidence	Likelihood	
Habitat Loss or Alteration											
Construction and Commissioning	▪ Habitat compensation for lost/disturbed fish habitats ▪ Best management practices	A	M	S	MT/O	R	U	N	H	H	▪ Construction monitoring ▪ Habitat compensation
Operation		No effects anticipated									
Residual environmental effects for all Phases		A	M	S	MT/O	R	U				
Direct Mortality or Physical Injury											
Construction and Commissioning	▪ Seasonal Avoidance ▪ Marine Mammal Monitoring Program ▪ Bubble curtains ▪ Fish Salvage Program ▪ Blasting Guidelines ▪ Best management practices	A	M	L	MT/S	R	U	N	M	M	▪ Construction monitoring ▪ Marine mammal monitoring during blasting
Operation		No effects anticipated									
Residual environmental effects for all Phases		A	M	L	MT/S	R	U				
Sensory Disturbance											
Construction and Commissioning	▪ Seasonal Avoidance ▪ Use of vibratory pile driver wherever feasible ▪ Bubble curtains ▪ Best management practices	A	L	R	ST/S	R	U	N	M	M	▪ Construction Monitoring
Operation		A	L	R	LT/R	R	U				
Residual environmental effects for all Phases		A	L	R	LT/R	R	U				

Potential Residual Environmental Effects	Proposed Mitigation/Compensation Measures	Residual Environmental Effects Characteristics									Recommended Follow-up and Monitoring
		Direction	Magnitude	Geographic Extent	Duration and Frequency	Reversibility	Ecological Context	Significance	Prediction Confidence	Likelihood	
Degradation of Water and Sediment Quality											
Construction and Commissioning	▪ Erosion Control Waste water treatment ▪ Best management practices	A	L	L	ST/S	R	U	N	H	L	▪ Construction Monitoring ▪ Ongoing site water quality monitoring ▪ Wastewater monitoring
Operation		A	L	R	LT/R	R	U				
Decommissioning		No effects anticipated									
Combined Environmental Effect		A	L	L	ST/S	R	U				
Combined Residual Environmental Effects											
Construction and Commissioning		A	M	L	MT/S	R	U	N	H	L	▪ All follow-up and monitoring listed above
Operation		A	L	R	LT/R	R	U				
Combined Environmental Effect		A	M	L	MT/S	R	U				

KEY

DIRECTION:

(P) *Positive*: condition is improving compared to baseline habitat quality or population status

(N) *Neutral*: no change compared to baseline habitat quality or population status

(A) *Adverse*: negative change compared to baseline habitat quality or population status

MAGNITUDE:

(N) *Negligible*: no measurable adverse effects anticipated

(L) *Low*: measurable effects to habitat function anticipated in low-sensitivity habitats and no measurable reduction in number of any fish species anticipated

(M) *Moderate*: measurable effects to habitat function anticipated in moderately sensitive habitats or anticipated mortality risk to non-listed species

(H) *High*: measurable effects to habitat function anticipated in highly sensitive habitat or habitat designated as important for listed species or anticipated mortality risk to listed species

GEOGRAPHIC EXTENT:

(S) *Site-specific*: effects restricted to habitat within the Project footprint

(L) *Local*: effects extend beyond the Project footprint but remain within the local assessment area

(R) *Regional***:** effects extend into the regional assessment area

DURATION:

(ST) *Short-term*: effects are measurable for days to a few months

(MT) *Medium-term*: effects are measurable for many months to 2 years

(LT) *Long-term*: effects are measurable for multiple years but are not permanent

(P) *Permanent*: effects are permanent

FREQUENCY:

(O) *Once*: effect occurs once

(S) *Sporadic*: effect occurs more than once at irregular intervals

(R) *Regular*: effect occurs on a regular basis and at regular intervals

(C) *Continuous*: effect occurs continuously

REVERSIBILITY:

(R) *Reversible*: effects will cease during or after the Project is complete

(I) *Irreversible*: effects will persist after the life of the Project, even after habitat restoration and compensation works

ECOLOGICAL CONTEXT:

(D) *Disturbed*: effect takes place in an area that has been previously adversely affected by human development or in an area where human development is still present

(U) *Undisturbed*: effect takes place in an area that has not been adversely affected by human development

SIGNIFICANCE:

(S) *Significant*

(N) *Not Significant*

PREDICTION CONFIDENCE:

Based on scientific information, professional judgment and effectiveness of mitigation

(L) *Low* level of confidence

(M) *Moderate* level of confidence

(H) *High* level of confidence

LIKELIHOOD:

Based on professional judgment

(L) *Low* probability of occurrence

(M) *Medium* probability of occurrence

(H) *High* probability of occurrence

12.5 Cumulative Effects Assessment

The potential for cumulative effects exists due to interactions between the Project and several other large existing or planned future industrial developments in the vicinity of the Project. These projects are outlined in Table 12-1 above, and are discussed in more detail in Table 5-5, in the *Project Inclusion List*.

12.5.1 Cumulative Effects of Loss or Alteration of Fish Habitat

The Project site is located on federal lands within the industrially zoned Ridley Island. In 2011, the PRPA prepared the Port of Prince Rupert 2020 Land Use Management Plan, in which Ridley Island was earmarked for major industrial development (PRPA 2011). There are two existing industrial marine terminals on the northwest side of Ridley Island: Ridley Terminals Inc. and Prince Rupert Grain Limited. Both terminals have rail and road access, as well as jetties for marine shipping traffic that are capable of handling vessels greater than 300 m in length.

Construction of the existing terminals in 1984 and 1985 resulted in the loss of intertidal and subtidal marine fish habitat along the western shoreline of Ridley Island. Based on the footprints of the two terminals, the amount of habitat affected by each is likely similar to that assessed for the Project. At both sites, some natural rocky intertidal habitat has been replaced with rip-rap, and some soft sediment subtidal habitat has been covered by infilled causeways. Because the existing terminals were built over 25 years ago, the affected habitats have had sufficient time to be recolonized by marine biota. Therefore, the loss or alteration of marine habitat at the Project site will not act cumulatively with habitats previously affected at the Ridley Terminal or the Prince Rupert Grain Terminal.

Future developments on Ridley Island and on nearby Kaien Island will result in the loss or alteration of marine fish habitats. Major future projects that are likely to have in-water infrastructure components include the Fairview Terminal Phase II expansion (Kaien Island). Although the construction timelines for this Project are unknown, it is possible that they will overlap with the Project. If so, there may be a cumulative reduction in the productive capacity of fish habitats within the Port of Prince Rupert.

As discussed in Section 12.3.2, marine fish habitats lost or altered by the Project will be compensated for with the creation of high productivity fish habitats within the LAA. A detailed HCP will be developed in consultation with DFO, which will detail the compensation measures to be implemented. These measures will minimize any temporal losses of productive capacity of fish habitats and will ensure that overall there is ‘no net loss’ of productive fish habitats within the LAA. As habitat compensation is required for all habitat losses under the *Fisheries Act*, it is expected that other future developments within the Port of Prince Rupert will also have compensation plans to offset potential adverse effects on the marine environment.

With the proposed habitat compensation and mitigation measures, the cumulative environmental effects of habitat loss or alteration will be moderate in magnitude, regional in extent, medium-term in duration, and reversible. Based on this assessment, the residual cumulative effects of habitat loss or alteration are predicted to be not significant.

12.5.2 Cumulative Effects of Direct Mortality or Physical Injury

Construction of in-water infrastructure will result in the loss of sessile organisms that cannot move away from work areas. Mobile species such as fish and marine mammals are not likely to be affected. Within the Port of Prince Rupert, one proposed future marine terminal may result in direct mortality or physical injury to intertidal and subtidal organisms: the Fairview Terminal Phase II expansion (Kaien Island). This project may act cumulatively with the Project, resulting in a greater overall loss of sessile organisms within the Port of Prince Rupert.

As discussed previously, an HCP will be developed in consultation with DFO to compensate for the direct mortality or physical injury of marine organisms resulting from the Project. The HCP will include the creation of marine habitats that will allow for the colonization and recovery of species affected by in-water construction activities. The species affected are locally abundant in adjacent unaffected habitats, and are expected to recolonize the disturbed habitats and compensation features after construction. No species of special concern will be affected. Other projects in the Port of Prince Rupert that affect sessile marine organisms are expected to have similar HCPs.

In-water construction activities that produce intense underwater sound (e.g., blasting) have the potential to harm or kill fish and marine mammals. However, the area over which sound levels will be high enough to induce harm will be limited through the use of sound attenuating devices such as bubble curtains. Blasting will be avoided where possible during the peak of the juvenile salmon migration as defined through conversations with DFO. As the ensonified area will be limited to the immediate vicinity of the Project site, there will be no overlap with sounds produced by other project construction activities within the Port of Prince Rupert.

With the proposed habitat compensation and mitigation measures, the cumulative environmental effects of direct mortality or physical injury will be low in magnitude, regional in extent, short-term in duration, and reversible. Based on this assessment, the residual cumulative effects of direct mortality or physical injury are predicted to be not significant.

12.5.3 Cumulative Effects of Sensory Disturbance

During construction, the Project will produce underwater sounds that may cause fish and/or marine mammals to locally avoid the Project area. The zone of behavioural avoidance is variable, as it depends on the source level of the underwater sound and the species in question. Although the timelines of other proposed projects in the Port of Prince Rupert are unknown, it is possible that in-water construction activities will overlap with the Project. If this is the case, the combined underwater sounds may act cumulatively to increase the area of behavioural avoidance.

Although no critical fish or marine mammal habitats have been identified around Ridley Island, species such as Pacific salmon, humpback whales, northern resident and transient killer whales, and harbour porpoises may be locally displaced. This displacement is not expected to affect the fitness or survival of displaced animals as the ensonified area represents only a small fraction of the available foraging and rearing habitat in the Prince Rupert area. To limit the contribution of the Project to cumulative effects of sensory disturbance, a variety of mitigation measures will be implemented. For pile driving, a vibratory driver will be used wherever feasible, as this method produces lower sound levels than the conventional impact driver. Bubble curtains will be installed around piles during installation to further reduce acoustic emissions and blasting will be scheduled to minimize adverse effects on marine animals. It is expected that the other proposed projects in the Port of Prince Rupert will implement similar mitigation measures to minimize their potential residual effects.

During operations, 130 to 150 large cargo vessels will call on the Canpotex terminal each year. While underway, these vessels will contribute underwater sounds to the marine environment that may act cumulatively with existing and future vessel traffic arriving and departing the Port of Prince Rupert. Based on data provided by Statistics Canada, 592 large international cargo vessels called on the Port of Prince Rupert in 2009. This number underestimates true vessel traffic, as it does not include ferries, cruise ships, or large fishing vessels. Based on this data, vessels using the Canpotex terminal will increase existing cargo vessel traffic by approximately 12%. Vessels associated with future terminal developments (e.g., Fairview Phase II) will also contribute underwater sounds to the marine environment. The combined underwater noise produced by all vessels calling on the Port of Prince Rupert may lead to local displacement of some marine mammals from the shipping routes and surrounding areas. However, this effect will be site-specific and temporary, occurring only in the vicinity of transiting vessels. Thus, behavioural avoidance is not expected to affect the fitness or survival of any affected marine mammals.

With the proposed mitigation measures, the cumulative environmental effects of sensory disturbance will be low in magnitude, regional in extent, long-term in duration, and reversible. Based on this assessment, the residual cumulative effects of sensory disturbance are predicted to be not significant.

12.5.4 Cumulative Effects of Degradation of Sediment and Water Quality

During construction, the Project will result in localized increases in total suspended sediments (TSS) within the dredge footprint, at the disposal at sea site, and in the vicinity of in-water construction activities. However, it is not expected that there will be any spatial overlap with elevated TSS levels from other current or future projects within the Port of Prince Rupert. Therefore, the Project will not contribute to a cumulative environmental effect of degradation of sediment or water quality.

12.6 Follow-up Program

During construction, a trained environmental monitor will be onsite to observe and document all in-water construction activities. Construction monitoring will ensure that all in-water activities are carried out using best management practices, and that the specified mitigation measures are followed. A post-construction site assessment will also be carried out to verify the areal extent of marine habitats lost or disturbed by the Project. These values will be used in the HCP.

To compensate for the loss and alteration of marine fish habitats, Canpotex and PRPA will develop an HCP in consultation with DFO. Compensation measures may include the rehabilitation of existing, disturbed marine fish habitats, and the creation of new marine fish habitats. To ensure that compensation measures are successful, a monitoring program will be developed. This program will include construction monitoring and effectiveness monitoring. Effectiveness monitoring will entail annual surveys of the habitat compensation features to ensure that they are being utilized by the intended marine biota. The specifics of this monitoring program will be provided in the habitat compensation plan.

During operations, water discharged into the marine environment will be collected bi-annually by a trained environmental monitor and sent for analysis at a certified laboratory. This water will be analyzed for total suspended solids (TSS), turbidity, fecal coliforms, and contaminants (i.e., metals, PCBs, BTEX, and PAHs). This water monitoring program will ensure that all discharged water meets provincial and federal guidelines.

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12.8 Figures

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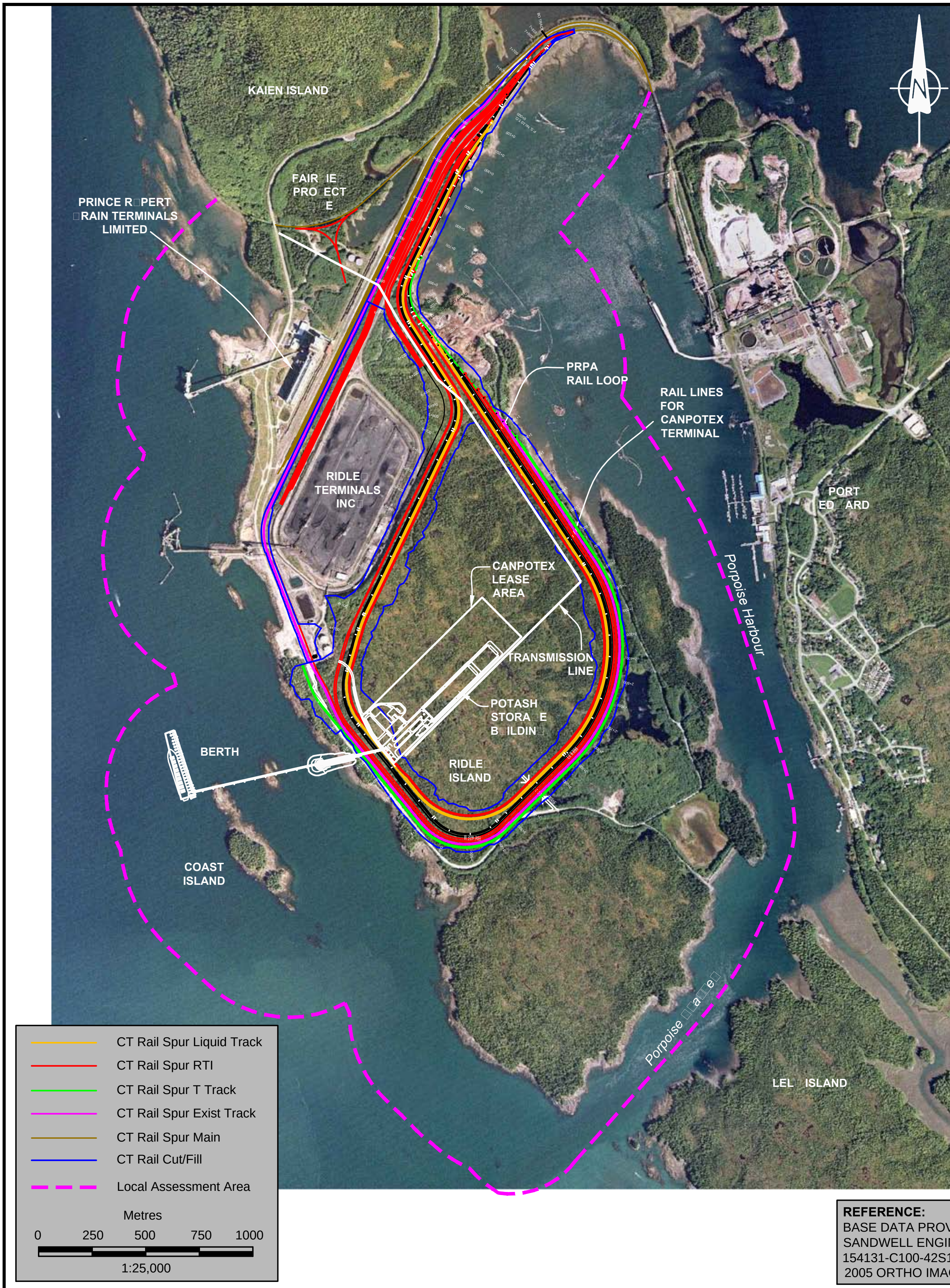

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LOCAL ASSESSMENT AREA
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RIDLEY ISLAND, BRITISH COLUMBIA

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FRESHWATER SAMPLING LOCATIONS
AQUATIC ENVIRONMENT
RIDLEY ISLAND, BRITISH COLUMBIA

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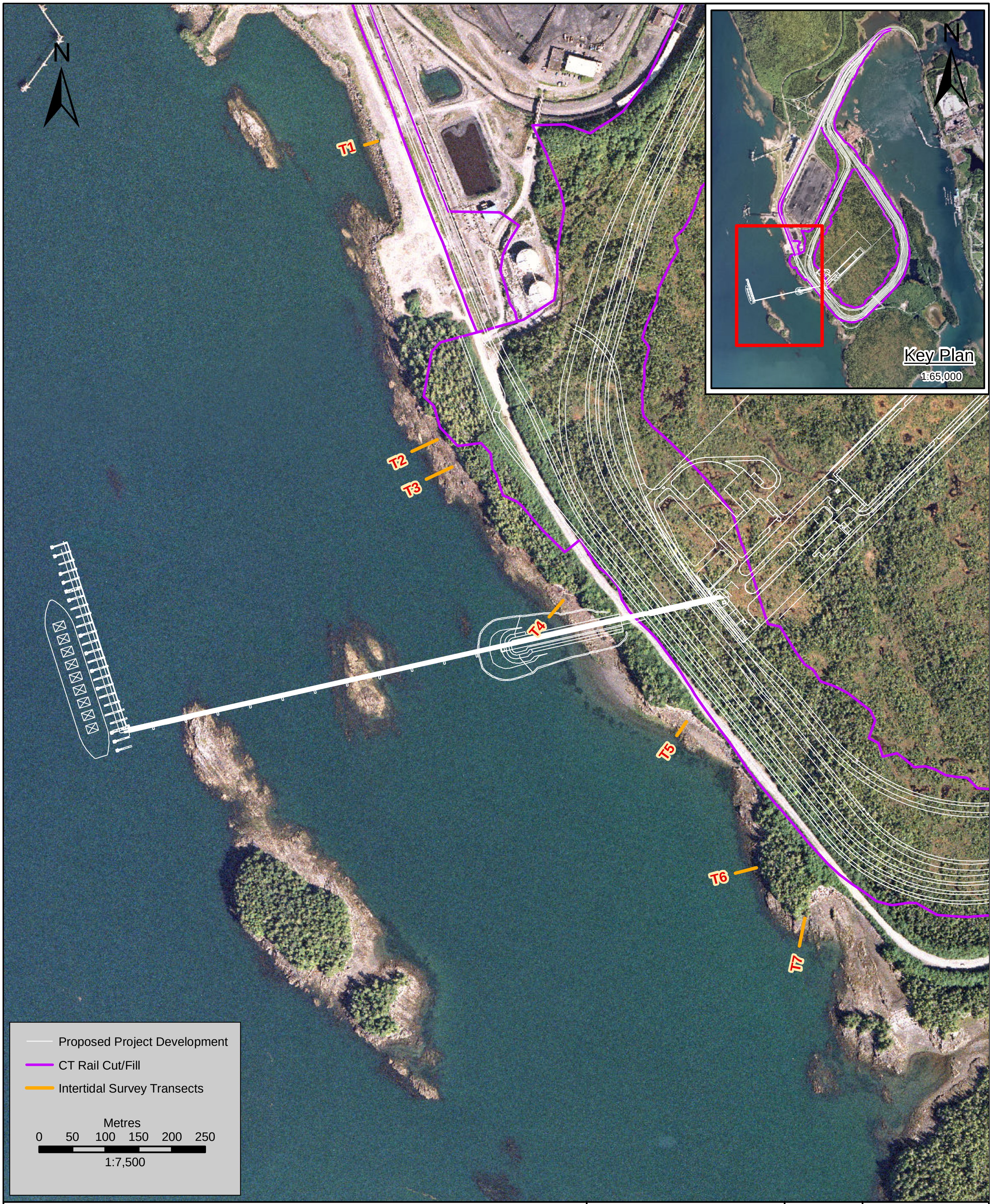

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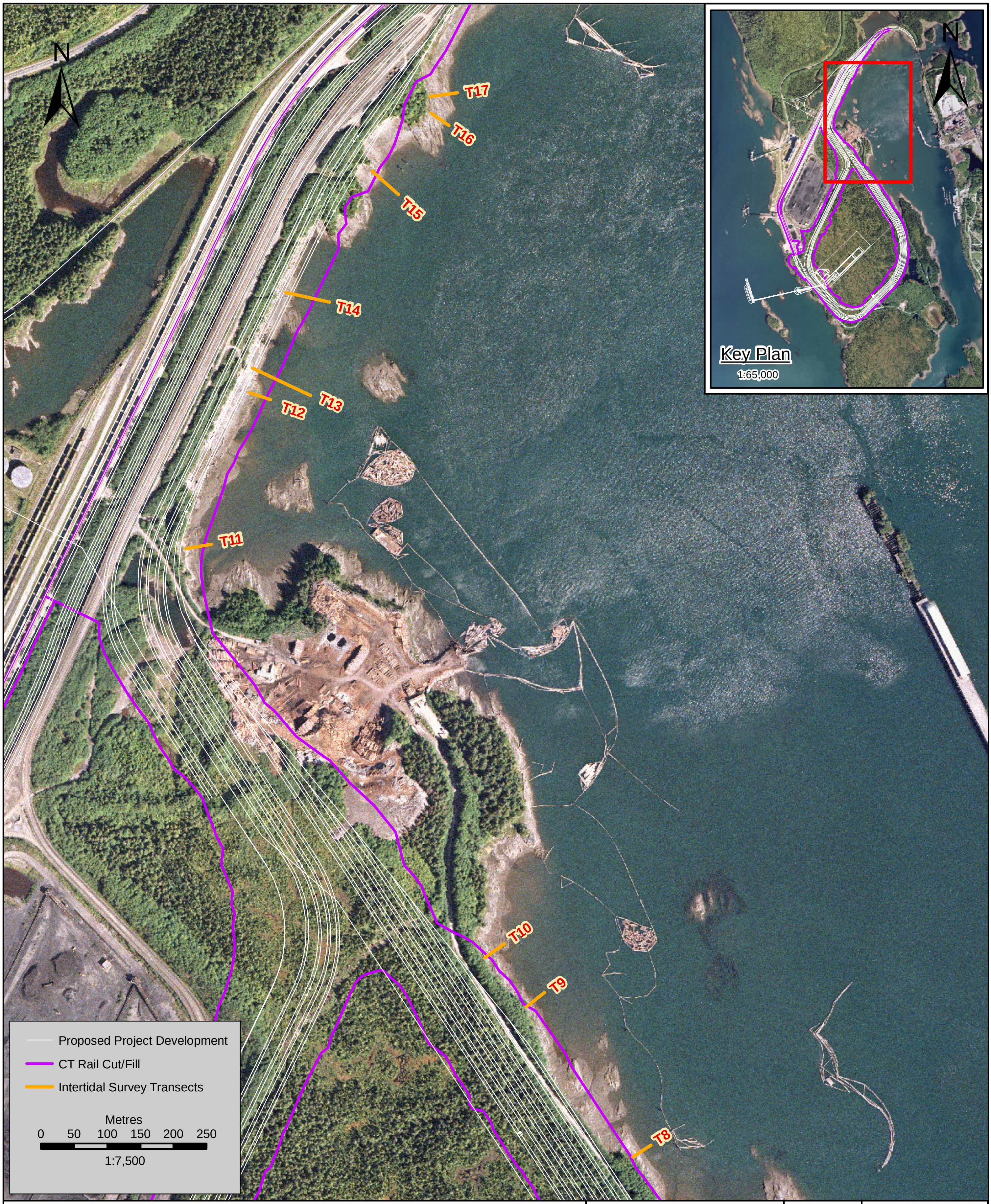

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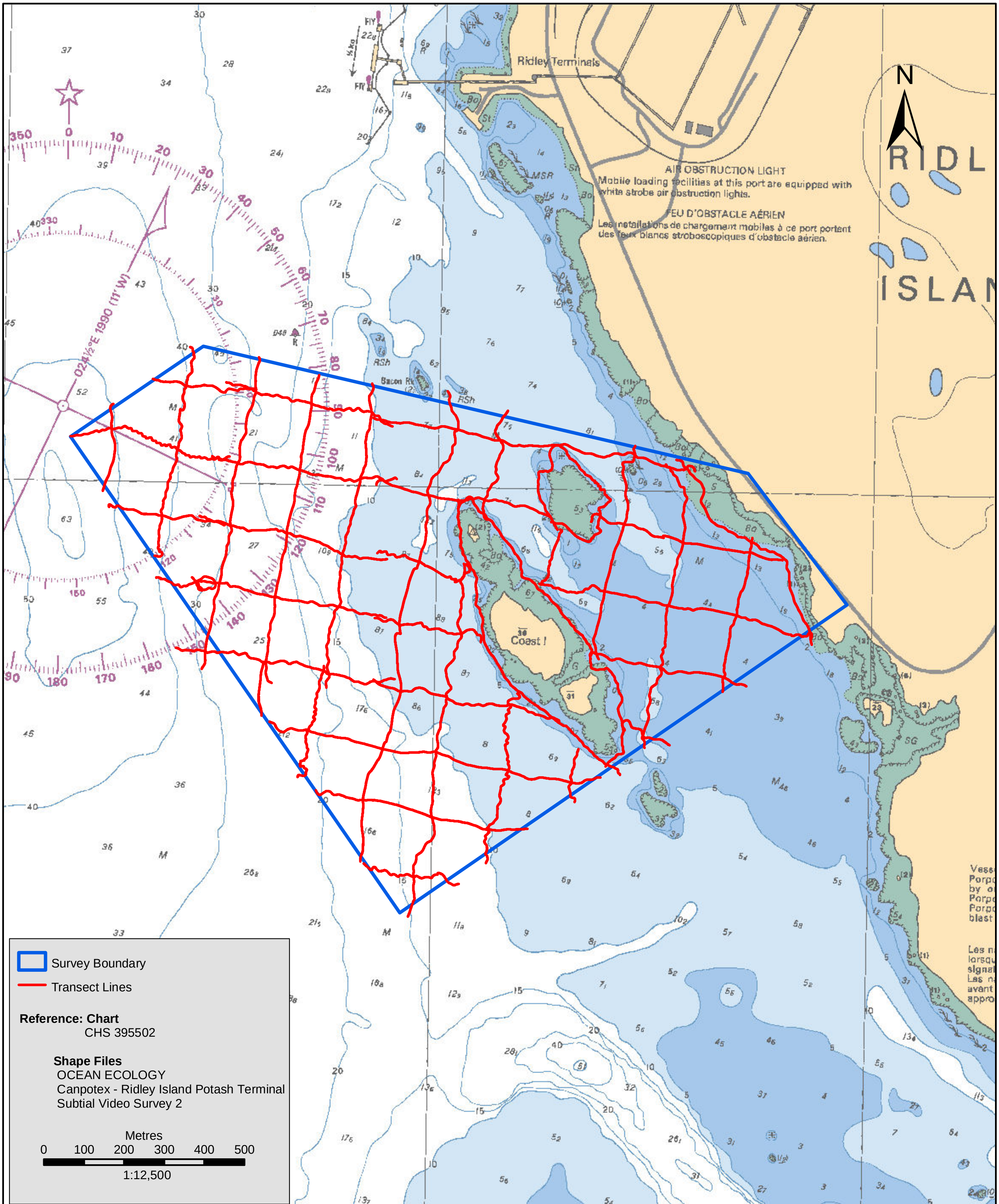

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SUBTIDAL VIDEO SURVEY LOCATION
AQUATIC ENVIRONMENT
RIDLEY ISLAND, BRITISH COLUMBIA

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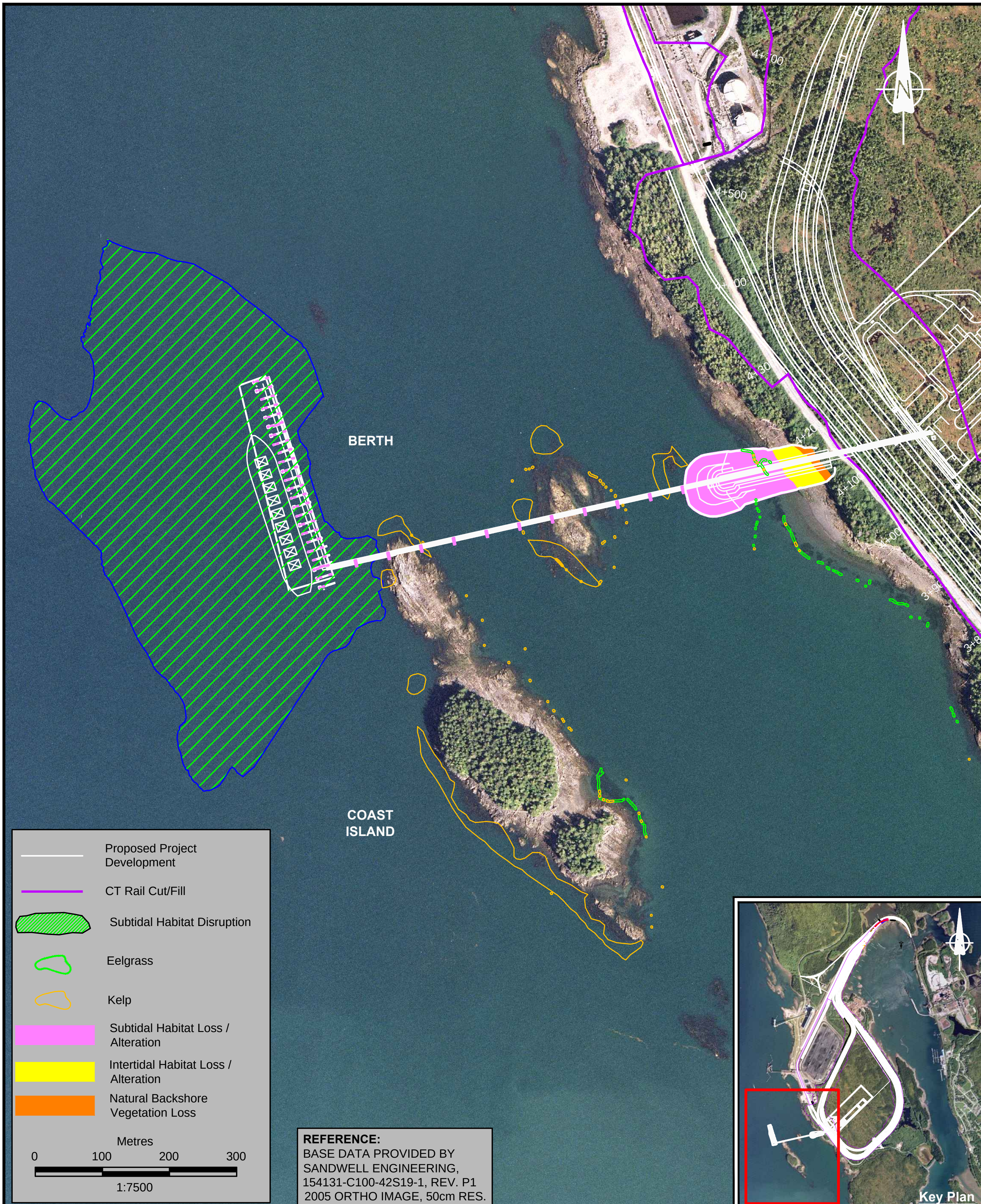

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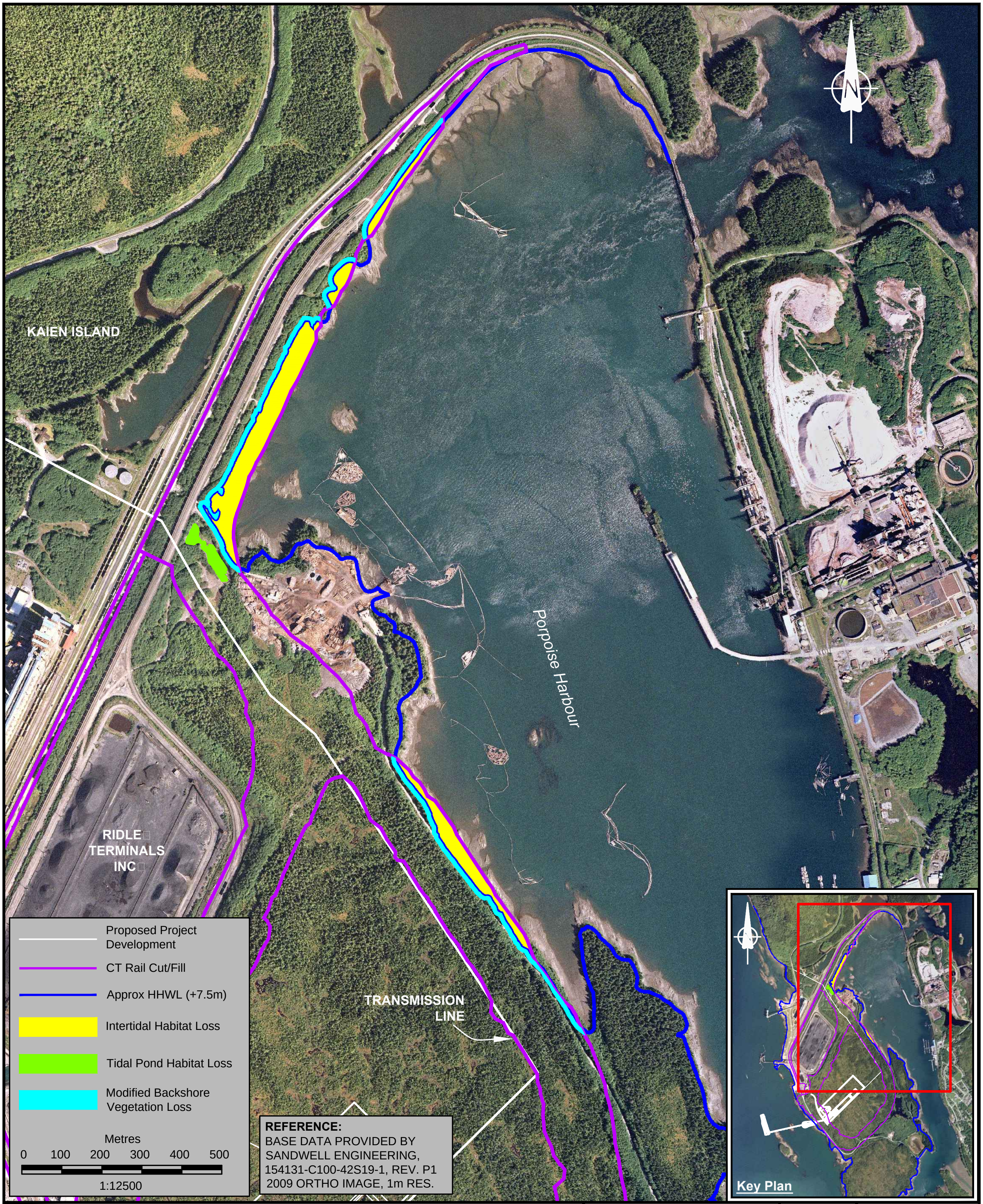

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13 HUMAN HEALTH ASSESSMENT

This section evaluates the potential effects of all phases of Project activities on the Human Health of the public. This includes potential health effects related to country foods, air quality, ambient noise and ambient light levels. Country foods include those foods that are trapped, fished, hunted, harvested or grown for subsistence or medicinal purposes, or obtained from recreational activities such as sport fishing and/or hunting. Project activities that result in increased chemical concentrations in the foods that people eat could have impacts on their health. Air Quality, Noise, and Ambient Light have been evaluated elsewhere in the EIS (Sections 7 through 9, respectively). Conclusions from these sections were incorporated into the assessment of effects of air quality, ambient noise and ambient light levels on Human Health.

Potential health effects to ecological receptors are discussed in Section 11 (Wildlife) and Section 12 (Aquatic Environment). Occupational health and safety for workers is not a part of this assessment, but is protected through implementation, monitoring and enforcement of occupational health and safety legislation, provincial regulations and company protocols. Potential health effects associated with Accidents and Malfunctions are discussed in Section 19. Effects on potable water are not assessed because there is no potable water on Ridley Island. All water on Ridley Island is drawn from Port Edward.

13.1 Scope of Assessment

Project activities such as dredging and marine facilities construction could alter local water and sediment quality, and air emissions from trains and vessels have the potential to alter ambient air quality. Project components and activities that alter ambient light and noise levels have the potential to result in disturbance to local people. This assessment examines the potential for related effects to Human Health resulting from these activities. Spatial boundaries for the assessment are the same as for the Air Quality LAA, in keeping with the largest relevant VEC boundary (see Section 3.5.2).

13.1.1 Regulatory/Policy Setting

The Public Human Health assessment was conducted to fulfill the requirements of the EIS Guidelines and to meet CEAA requirements to consider potential effects of the Project on:

- Human health
- Current use of lands and resources for traditional purposes by aboriginal persons.

The country foods and air quality health assessments were conducted under the framework of a human health risk assessment (HHRA), following established risk assessment methods endorsed by Health Canada, the Canadian Council of Ministers of the Environment (CCME), and the United States Environmental Protection Agency (US EPA).

Environmental quality guidelines used for characterization of chemical concentrations in environmental media include:

- CCME marine aquatic life Interim Sediment Quality Guidelines (ISQG)
- BC Ministry of Environment (MoE) and Health Canada Ambient Air Quality Objectives (AAQO)
- Canada-wide Standard for Respirable Particulate Matter ($PM_{2.5}$).

For potential effects from noise and light pollution, predicted Project levels were screened against relevant standards to evaluate health concerns (see Sections 8.1.1 and 9.1.1).

13.1.2 Key Issues

Key issues underlying the Public Human Health assessment include:

- Potential for Project activities (e.g., dredging) to affect marine country foods (and possibly terrestrial country foods through food chain transfer), by mobilizing contaminants if present
- Potential for air emissions (CACs and particulate materials) associated with the Project to degrade Ambient Air Quality, and have effects on Human Health
- Potential for Project components to alter ambient light levels, resulting in disturbance to local people in the area
- Potential for Project activities and components to increase ambient noise levels, resulting in noise disturbance to local people in the area.

Project activities involving potential chemical exposure were assessed using a risk-based approach (see Section 13.3.1 below). Scoping of these key issues (changes to country foods and air quality) was based on: 1) review of all Project activities that could potentially release chemicals to the environment or alter environmental quality; and, 2) assessment of the potential for human receptors to be exposed to these chemicals through consumption of country foods or inhalation of air contaminants. Light and noise interactions with Human Health were assessed following the standard EIS methodology used for other VECs (see Section 3).

The potential for Project activities to result in physical effects of smothering and direct mortality to aquatic resources is assessed in Section 12 (Aquatic Environment), and does not have a bearing on Human Health because quantity of country foods will remain unaffected due to the localized potential zone of effect.

Possible interactions between Project activities and Human Health are summarized in Table 13-1.

Table 13-1: Potential Environmental Effects to Human Health

Project Activities and Physical Works	Potential Effects to Human Health			
	Changes to Country Foods	Changes to Air Quality	Changes to Noise Levels	Changes to Ambient Light
Construction and Commissioning				
Temporary construction infrastructure (trailers, power, portable sanitary facilities, etc.)		✓	✓	
Site preparation (clearing and grubbing, site grading)		✓	✓	
Rail loop construction		✓	✓	
Onshore terminal construction (receiving, storage, reclaim and shiploading facilities, site services)		✓	✓	
69 kV Transmission line construction			✓	
Installation of Canpotex rail tracks		✓	✓	
Access road and overpass construction		✓	✓	
Dredging	✓		✓	
Marine Facilities Construction (causeway, trestle and berth)	✓	✓	✓	
Commissioning			✓	
Operations				
Potash Handling Operations (receiving, storage, reclaim and shiploading of potash)		✓	✓	✓
Arrival and departure of vessels		✓	✓	
Arrival and departure of trains		✓	✓	
Decommissioning				
Removal of site infrastructure (potash handling system/buildings)			✓	✓
Interaction of Other Projects and Activities in the Boundary for Assessment (potential for cumulative effects; see rankings below)				
Ridley Terminals Inc.	1	2	1	1
Prince Rupert Grain Ltd	1	2	1	1
Ridley Island Log Sort	1	0	0	0
Fairview Terminal (existing and II)	2	2	0	0
Quickload Terminals Prince Rupert Container Examination Facility	0	0	1	0
CN Aquatrain facility	1	0	0	0
BC Ferries and Cruise ship Terminal	1	2	0	0

NOTES:

Project Environmental Effects

Only Project – Environment interactions ranked as 2 in Table 3-4 are carried forward to this Table.

✓ Indicates that an activity is likely to contribute to the environmental effect

Cumulative Environmental Effects

Cumulative environmental effects were ranked as follows:

0 = Project environmental effects do not act cumulatively with those of other Projects and Activities

1 = Project environmental effects act cumulatively with those of other Project and Activities, but are unlikely to result in significant cumulative environmental effects **OR** Project environmental effects act cumulatively with existing significant levels of cumulative environmental effects but will not measurably change the state of the VEC

2 = Project environmental effects act cumulatively with those of other project and activities, and may result in significant cumulative environmental effects **OR** Project environmental effects act cumulatively with existing significant levels of cumulative environmental effects and may measurably change the state of the VEC

13.1.3 Selection of Measurable Parameters

Measureable parameters used in the Human Health assessment are described with accompanying rationale in Table 13-2.

Table 13-2: Measurable Parameters for Human Health

Potential Environmental Effect	Measurable Parameter(s) for the Environmental Effect	Rationale for Selection of the Measurable Parameter
Change to Country Foods	Qualitative assessment of metal and PAH uptake by fish from temporarily suspended marine sediment during dredging, as well as food chain transfer from fish to wildlife predators, and subsequent consumption of fish or wildlife by humans	Deeper sediment may have elevated chemical concentrations; existing sediment contaminants could be released to the water column during dredging, and be transferred to fish and to terrestrial country foods that feed on marine life. Consumption of these country foods could then pose a risk to humans.
Change to Air Quality	Concentrations of Criteria Air Contaminants (CACs; i.e., $PM_{2.5}$, SO_2, NO_x, CO) in air which may be compared to air quality standards	Air emissions from trains and vessels during Project operations may degrade ambient air quality and affect Human Health through inhalation.
Change to Ambient Light	Predicted ambient light levels based on CIE standards (for light trespass, glare, and sky glow).	Light emissions from Project infrastructure, vessels and trains may change ambient light levels, and cause disturbances to local residents
Change to Noise Levels	Predicted ambient noise based increased sound levels, changes to day, night and day to night sound levels, and public annoyance metrics.	Noise production during day and/or night may alter ambient noise conditions, and cause sleep disturbance, disruption to communications, and community annoyance.

13.1.4 Characterization of Residual Effects

The Human Health assessment characterizes Project effects using the seven criteria described in Table 13-3.

Table 13-3: Characterization Criteria of Residual Effects for Human Health

Criterion	Description
Direction	**Positive:** Condition is improving compared to baseline conditions **Neutral:** No change compared to baseline conditions **Adverse:** Negative change compared to baseline conditions
Magnitude	**Low:** Incomplete exposure pathway or no change predicted in uptake of Project-related contaminants of concern **Moderate:** Complete exposure pathway, and environmental stressor levels may result in exposures slightly above health-based guidelines. Effects offset by mitigation and management options. **High:** Complete exposure pathway and environmental stressor levels may result in exposures substantially above health-based guidelines
Geographical Extent	**Site-specific:** Effects restricted to Project area **Local:** Effects extend beyond the Project area but remain within the assessment area **Regional:** Effects extend beyond the assessment area
Duration	**Short-term:** Measurable for less than two years **Medium-term:** Measurable for more than two years but less than 20 years **Long-term:** Measurable for more than 20 years **Permanent:** Effects are permanent
Frequency	**Once:** Effect occurs once **Sporadic:** Effect occurs at sporadic intervals **Regularly:** Effect occurs on a regular basis and at regular intervals **Continuous:** Effect occurs continuously
Reversibility	**Reversible:** Effect is reversible if the exposure ceases **Irreversible:** Effect is not reversible after the exposure ceases
Ecological Context	**Undisturbed:** Area relatively or not adversely affected by human activity **Disturbed:** Area has been substantially previously disturbed by human development or human development is still present

13.1.5 Standards or Thresholds for Determining Significance

For Human Health, an effect was only deemed significant where a complete exposure pathway between contaminant(s) and humans exists, and where exposure concentrations are likely to result in Human Health effects. If stressor levels (i.e., chemicals, light levels, or noise) were greater than applicable health-based regulatory standards, and a pathway of exposure was identified, stressors were then carried forward for assessment of their potential to cause health effects. If stressor levels were lower than the regulatory objectives, then these factors were expected to have negligible effects to the public.

13.2 Baseline Conditions

Baseline data were collected for marine sediment (metals, PAHs) and for air quality (CACs). These results are discussed in detail in Sections 12 (Aquatic Environment) and 7 (Air Quality). Baseline data on noise and light levels, along with corresponding predictive model results for each component, are provided in Sections 8 (Noise and Vibration) and 9 (Ambient Light), respectively. Because noise and light were assessed using the standard EIS methodological framework used in the noise and light sections of this EIS (unlike country foods and air quality effects on humans which were assessed using a risk approach), data for noise and light were not repeated in this Human Health section.

Accumulation of metals is not anticipated in fish as a result of dredging (see Section 12 Aquatic Environment). Dredging may cause a short-term increase and redistribution of localized suspended sediments, the physical effects of which are considered in the Aquatic Environment assessment. However, because of the potential for redistribution of deeper sediment that may contain existing elevated contaminant levels from historical use, this pathway was investigated. If the alternate disposal site A is used, TSS will be decreased due to the use of a pipe network to dispose of dredgate.

Air emissions would be expected to have negligible effects on contaminant concentrations in water and sediment given the large surface area to volume ratio, tidal effects, and predicted air concentrations generally meeting air quality standards. However, baseline air quality data and predictive modeling were still used to evaluate health concerns via the inhalation pathway to humans.

As land use at Ridley Island is industrial, terrestrial baseline sampling (e.g., soils, vegetation, and wildlife tissue) was not conducted. Hunting and harvesting of vegetation for food is unlikely as access is prohibited due to the necessary security regime. Furthermore, Project-related air emissions to the terrestrial environment are not anticipated to adversely affect wildlife or vegetation tissue concentrations given the implementation of emission control and monitoring measures. While some terrestrial chemical contamination may already exist in the local study area, Project activities are not anticipated to appreciably add to this contamination.

There are no naturally occurring sources of drinking water on Ridley Island. All water is drawn from Port Edward's supply at Alwyn Lake. As a result there will be no project related effects on drinking water and therefore, no concerns with respect to human health.

A beach located on the southwest corner of Ridley Island has been used in the past as a recreational site, particularly by kayakers. This beach will not be affected by the Project, however, it should be noted that due to the port's necessary security regime, there is no public access to this beach via Ridley Island.

13.2.1 Potash

Potash consists of various potassium salts, most commonly potassium chloride, and is widely used as a fertilizer, but also in sport drinks and industrial processes. Like table salt, it is considered nontoxic at the concentrations that would be encountered and stable based on review of the

Workplace Hazardous Materials Information System (CAS #7447-40-7). It therefore does not pose a potential risk to local residents. Dust control measures (e.g., dust collectors equipped with baghouses, use of protective eyewear and other personal protective equipment [PPE] and containment measures) will also be in place during operations to minimize occupational exposure of workers and the environment to potash dust (potassium chloride acts as a skin or eye irritant). These measures will mitigate air transport of potash, and any fugitive potash would not be carried far, therefore there is no predicted exposure to residents situated several kilometres away.

13.2.2 Marine Sediment Quality

Baseline sediment quality conditions for the proposed dredge footprint are detailed in the Sediment Quality TDR and further discussed in Section 12 (Aquatic Environment). Results of baseline sampling conducted in the proposed dredge footprint for Disposal at Sea investigations are summarized below in Table 13-4 (surface sediment) and Table 13-5 (deeper sediment).

Parameters were screened using CCME sediment quality guidelines protective of marine aquatic life. A CCME ISQG (environmental concentration above which some adverse effects may be seen) was not available for nickel; therefore, the BC working sediment quality guideline was used. Other parameters did not have CCME or BC sediment guidelines. PCBs were non-detectable in all samples analyzed.

Table 13-4: Metal and PAH Concentrations (mg/kg) in Marine Surface Sediments

Parameter	N	CCME Guideline (ISQG)	Maximum Concentration	Mean (SD)	N < DL	N > Guideline
Metals						
Antimony	32	ng	<10	–	32	ng
Arsenic	32	7.24	15.2	11.5 (1.57)	0	32
Barium	32	ng	115	104 (5.55)	0	ng
Beryllium	32	ng	0.5	–	31	ng
Cadmium	32	0.7	<0.50	0.18 (0.047)	8	0
Chromium	32	52.3	33.7	30.8 (1.21)	0	0
Cobalt	32	ng	14.1	13.3 (0.42)	0	ng
Copper	32	18.7	50.1	43.6 (2.88)	0	32
Lead	32	30.2	<30	11.6 (2.38)	8	0
Mercury	32	0.13	0.082	0.061 (0.007)	0	0
Molybdenum	32	ng	<2.0	–	32	ng
Nickel*	32	30	31	28.6 (1.0)	0	4

Parameter	N	CCME Guideline (ISQG)	Maximum Concentration	Mean (SD)	N < DL	N > Guideline
Selenium	32	ng	<3.0	–	32	ng
Silver	32	ng	<2.0	–	32	ng
Thallium	32	ng	<1.0	–	32	ng
Tin (Sn)	32	ng	<5.0	–	32	ng
Vanadium	32	ng	86.3	81.3 (2.24)	0	ng
Zinc	32	124	108	100 (3.98)	0	0
PAHs						
Total PAHs	32	ng	0.328	0.044 (0.057)	24	ng
Acenaphthene	32	0.00671	<0.05	–	32	0
Acenaphthylene	32	0.00587	<0.05	–	32	0
Anthracene	32	ng	<0.05	–	32	ng
Benz(a)anthracene	32	0.0748	<0.05	–	32	0
Benzo(a)pyrene	32	0.088	<0.05	–	32	0
Benzo(b)fluoranthene	32	ng	<0.05	–	32	ng
Benzo(g,h,i)perylene	32	ng	<0.05	–	32	ng
Benzo(k)fluoranthene	32	ng	<0.05	–	32	ng
Chrysene	32	0.108	<0.05	–	32	0
Dibenz(a,h)anthracene	32	0.00622	<0.05	–	32	0
Fluoranthene	32	0.113	0.122	–	31	1
Fluorene	32	0.0212	<0.05	–	32	0
Indeno(1,2,3-,d)pyrene	32	ng	<0.05	–	32	ng
2-Methylnaphthalene	32	ng	0.085	0.031 (0.015)	27	ng
Naphthalene	32	ng	<0.05	–	32	ng
Phenanthrene	32	ng	0.083	0.031 (0.014)	27	ng
Pyrene	32	0.153	0.067	–	31	0

NOTE:

* BC working sediment guideline for nickel. A dash indicates that the mean was not calculable because all data were below the analytical detection limit.

N = number of sample

SD = standard deviation of the mean

ng = no guideline exists

Table 13-5: Metal Concentrations (mg/kg) in Marine Sediments at 2 m and 5 m Depth

Metal	N	CCME Guideline (ISQG)	Maximum Concentration	Mean (SD)	N < DL	N > Guideline
2 m Depth						
Antimony	12	ng	<10	–	12	ng
Arsenic	12	7.24	12	10.6 (0.99)	0	12
Barium	12	ng	133	117 (8.69)	0	ng
Beryllium	12	ng	0.53	0.337 (0.128)	8	ng
Cadmium	12	0.7	0.22	0.159 (0.023)	0	0
Chromium	12	52.3	32.3	31.3 (0.855)	0	0
Cobalt	12	ng	14.8	14.1 (0.442)	0	ng
Copper	12	18.7	46.9	44.5 (1.34)	0	12
Lead	12	30.2	10.9	5.23 (4.46)	6	0
Mercury	12	0.13	0.068	0.050 (0.007)	0	0
Molybdenum	12	ng	<2.0	–	12	ng
Nickel*	12	30	31.8	29.7 (0.96)	0	4
Selenium	12	ng	<3.0	–	12	ng
Silver	12	ng	<2.0	–	12	ng
Thallium	12	ng	<1.0	–	12	ng
Tin	12	ng	<2.5	–	12	ng
Vanadium	12	ng	87.3	83.6 (2.31)	0	ng
Zinc	12	124	107	103 (2.88)	0	0
5 m Depth						
Antimony	12	ng	<10	–	12	ng
Arsenic	12	7.24	13.4	10.7 (1.31)	0	12
Barium	12	ng	124	108 (9.66)	0	ng
Beryllium	12	ng	0.56	0.322 (0.13)	9	ng
Cadmium	12	0.7	0.21	0.168 (0.017)	0	0
Chromium	12	52.3	33.1	31.2 (0.97)	0	0
Cobalt	12	ng	16	14.3 (0.767)	0	ng
Copper	12	18.7	54.4	44.6 (3.5)	0	12
Lead	12	30.2	11.6	9.76 (0.86)	0	0
Mercury	12	0.13	0.082	0.053 (0.011)	0	0

Metal	N	CCME Guideline (ISQG)	Maximum Concentration	Mean (SD)	N < DL	N > Guideline
Molybdenum	12	ng	<4.0	–	12	ng
Nickel*	12	30	31.9	30.0 (1.11)	0	5
Selenium	12	ng	<3.0	–	12	ng
Silver	12	ng	<2.0	–	12	ng
Thallium	12	ng	<1.0	–	12	ng
Tin (Sn)	12	ng	<5.0	–	12	ng
Vanadium	12	ng	88.8	82.6 (3.19)	0	ng
Zinc	12	124	113	103 (4.24)	0	0

NOTE:

* BC working sediment guideline for nickel. A dash indicates that the mean was not calculable because all data were below the analytical detection limit.

N = number of samples

SD = standard deviation of the mean

ng = no guideline exists

Four contaminants of potential concern (COPC) for marine country foods were thus identified based on exceedance of available interim sediment quality guidelines (ISQG): nickel, arsenic, copper and the polycyclic aromatic hydrocarbon (PAH) fluoranthene. The utility of the ISQG values in risk assessment screening is limited because they were derived using sediment with multiple contaminants rather than single metals (Environment Canada 2010). Probable Effect Level (PEL) guidelines (the level for probable biological effects) provide more defensible and plausible levels for use in screening COPCs). Parameters that did not have sediment quality guidelines were not identified as COPCs during this stage of the assessment. Should specific concerns about parameters be identified or concentrations increase over time, these parameters could be assessed at that time.

Nickel concentrations were very slightly above the BC working sediment quality guideline (30 mg/kg) in four of 32 surface sediment samples, four of 12 samples collected from 2 m depth, and four of 12 samples collected at 5 m depth. There was no difference in nickel concentration among depths.

Concentrations of arsenic exceeded the ISQG of 7.24 mg/kg at all stations at all depths; however, all concentrations were well below the PEL guideline (41.6 mg/kg). As discussed with nickel above, there was no difference in arsenic levels among sediment depths.

The ISQG for copper (18.7 mg/kg) was exceeded at all stations at all depths, but no copper value higher than the PEL (108 mg/kg) was reported. Similar to nickel and arsenic, copper showed no difference in concentration with sediment depth.

Fluoranthene slightly exceeded the ISQG in one of 32 samples.

13.2.3 Air Quality

In air, the main COPCs include SO_2, NO_2, CO, PM_{10}, and $PM_{2.5}$. Brief summaries of the properties and potential health effects of these air contaminants are provided in the Air Quality assessment (Section 7). For the baseline case, all maximum predicted ground-level concentrations of NO_2, SO_2, CO, PM_{10}, and $PM_{2.5}$ were below applicable regulatory air quality objectives. A detailed explanation of these results is included in Section 7. The Air Quality assessment modeled air contaminant concentrations at a number of schools, hospitals and residences within the LAA (Air Quality TDR; see Figure 13-1 for location).

13.3 Environmental Effects Assessment

13.3.1 Assessment Methods

Potential Human Health effects resulting from Project activities related to chemicals (country foods and air quality) were assessed using a human health risk assessment (HHRA) framework. HHRA combines information about potential receptors with potential exposure pathways and identified hazards (i.e., toxicity) to determine the relative level of risk to humans. Assessment of country foods is also based on Health Canada's *Canadian Handbook on Health Impact Assessment*, Chapter 8: Food Issues in Environmental Impact Assessment (Health Canada 2004).

In general, the HHRA framework is composed of the following components:

- **Site Characterization:** A review and compilation of existing data and a summary of past activities.
- **Problem Formulation:** Identification of the environmental hazards that may pose a human or ecological health risk (i.e., chemical concentrations that exceed applicable guidelines), the potential receptors, and the relevant exposure pathways.
- **Exposure Assessment:** Qualitative or quantitative evaluation of the likelihood or degree to which the potential receptors will be exposed to the hazard.
- **Toxicity Assessment:** Identification of published, scientifically reviewed toxicity values for COPCs, against which potential exposures can be compared.
- **Risk Characterization:** Qualitative or quantitative assessment of the potential health risk of each hazard to each potential receptor, based on the degree of exposure.
- **Uncertainty Assessment:** Review of the assumptions and uncertainties associated with the risk estimation.
- **Recommendations:** If required, providing recommendations for mitigation and/or monitoring that would reduce the potential risk.

Potential Project effects on Human Health can be assessed based on the risk characterization, the magnitude of the predicted risk and the degree of uncertainty and conservatism in the assessment. For this Project, a simplified approach to the above framework was applied to each potential effect.

Changes to Country Foods

For marine country foods (effects related to dredging and marine facilities construction), baseline sediment quality was screened against CCME sediment quality guidelines protective of marine aquatic life. Those parameters that show exceedance of CCME guidelines protective of aquatic life in deeper sediment relative to shallow sediment were deemed COPCs. Those that showed no exceedance, or showed a similar chemical concentration through depths, regardless of exceedance of guideline, were not deemed a hazard as no increase in chemical concentrations in sediment were predicted for that parameter that could result in contaminant increase in fish. For terrestrial country foods, no hazard was identified if increases in chemical concentrations were not first identified in fish (i.e., to enable uptake through the food chain).

Changes to Air Quality

For air quality, predicted levels of CACs are developed using an air dispersion model incorporating climactic conditions, Project component emissions and ambient air quality data using the CALMET/CALPUFF model (Section 7) in accordance with BC MOE (2008) guidance. Any resulting exceedances of standards are discussed for each human receptor location. Where significant risk of CAC exposure is identified through an examination of land use and air modeling results, further assessment may be conducted. Resulting incremental non-carcinogenic mortality (based on Threshold Limit Values (TLVs) provided by Health Canada) and cancer risk (based on slope factors from Health Canada, where available) from each CAC may then be calculated by comparing baseline risk to risk for each Project phase.

Changes to Ambient Light

For ambient light health effects assessment, there are currently no regulations, guidelines, or policies in place within the Province of British Columbia that regulate the amount of obtrusive light being emitted from facilities. However, the Commission Internationale de L'Éclairage (CIE), also known as the International Commission on Illumination, has developed sets of maximum values for both light trespass and glare that should not be exceeded. These are based on current land use.

Changes to Noise Levels

For noise effects to Human Health, Health Canada's % Highly Annoyed (% HA) metric can be calculated to assess community annoyance related to increased noise levels. For the purposes of this assessment, a significant residual effect from noise is defined as an increase in the percent highly annoyed by greater than 6.5% after mitigation has been implemented. Changes from baseline to Project phase can also be evaluated, in relation to noise standards (BC Oil and Gas Noise Standards). This can be done for both day and night time periods.

13.3.1.1 Risk Assessment Evaluation Process

An HHRA describes the nature and magnitude of risk associated with exposure of humans to potential chemical hazards. For risk to exist, three critical elements must be present (see Figure below):

1. **Exposure**—A chemical or compound must be released to the environment in an available form in order to cause exposure to receptors.
2. **Receptors**—Receptors (humans) must be present, and linked to chemicals of concern through a transfer pathway relating to uptake from the environment.
3. **Hazard**—Chemical must have some adverse toxicological effect to the receptor (humans).

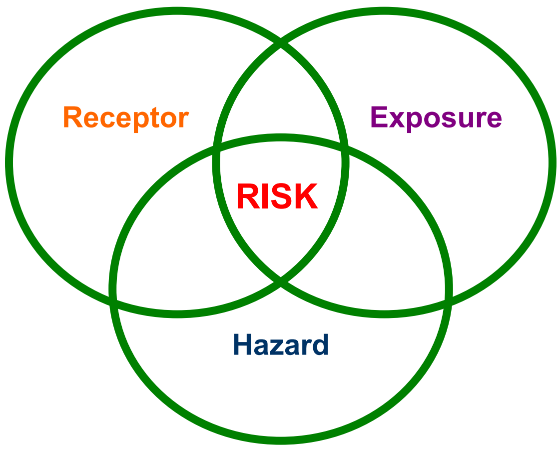


Figure: Key Elements of Human Health Risk Assessment (HHRA)

These three components (human receptors, human exposure pathways, and chemical hazards) are evaluated below. If any one of these components is missing, then no human health risk is predicted. Health risks are evaluated only where a receptor has a reasonable likelihood of exposure to a harmful chemical introduced into the environment as a result of a Project activity. Mitigation and management of chemical releases are examined if the potential exposure indicates the potential for effects.

13.3.1.2 Potential Human Receptors

Potential human receptors in the Project area include individuals engaged in traditional, subsistence, and recreational activities. The Project is located on federal lands within the industrially zoned Ridley Island, which is owned by the federal government and managed by PRPA. The Village of Port Edward is the nearest residential area in the Project vicinity, located approximately 3 km to the east. Prince Rupert is approximately 11 km north of the Project footprint.

Hunting, trapping and fishing (commercial, recreational, and sport) are carried out by residents and visitors in the Prince Rupert area. Some fishing activities occur within Prince Rupert Harbour. Recreational and subsistence fishing are permitted in the vicinity of the Project area, as long as fishing does not pose a navigational or safety hazard. A commercial fishing restriction/exclusion zone extends through much of Prince Rupert Harbour and encircles most of Ridley Island.

Five First Nations communities assert Aboriginal Rights to lands in the Ridley Island area:

1. Metlakatla Band
2. Lax Kw'alaams First Nation
3. Gitxaala Nation (formerly Kitkatla)
4. Kitselas Indian Band
5. Kitsumkalum Band.

13.3.1.3 Potential Human Exposure Pathways

The exposure pathway analysis determines the ways that people in the LAA may come into contact with contaminants. Human exposure pathways considered in this assessment include:

- Ingestion of fish that have taken up metals and PAHs from the marine environment
- Inhalation of emitted CACs from internal combustion engines used during construction and operations (vessels, trains) activities
- Exposure to increased light levels (light trespass, glare, sky glow) causing disturbance to quality of life and activities (e.g., sleep) of local residents.
- Exposure to increased noise levels (day, night, day to night shift) causing sleep or communication disturbance, annoyance of community members.

Potential exposure pathways are shown in Table 13-6.

Table 13-6: Potential Exposure Pathways for Human Receptors

Exposure Pathway	Rationale
Ingestion of marine fish	Dredging and port facility construction activities may elevate total suspended solids (TSS) and expose fish to increased metal and PAH concentrations in water and sediment. Consumption of contaminated fish tissues may pose a health risk to humans.
Inhalation of air contaminants	Inhalation of CACs emitted from Project may potentially pose a health risk to humans.
Exposure to increased light levels	Increased light transmission, glare and sky glow could be experienced by local people.
Exposure to increased noise levels	Increased noise levels could potentially cause sleep disturbance, disrupted communications or cause community members to become annoyed.

13.3.1.4 Potential Chemical Hazards

For a risk to exist, the chemical involved must have some adverse toxicological effect to the human receptor. Possible chemical hazards associated with the Project were detailed under Baseline conditions (Section 13.2) for the marine sediment and ambient air exposure pathways.

13.3.2 Changes to Country Foods Causing Human Health Effects

13.3.2.1 Potential Effects

Dredging and marine facilities construction activities may elevate TSS and expose fish to increased metal and PAH concentrations in water and sediment. Consumption of contaminated fish tissues may pose a health risk to humans. However, the use of a pipe network at Disposal Site A would act to minimize redistribution of sediment into the water column.

There are no anticipated effects of dredging on fish health (Section 12), nor on the health of wildlife that may ingest fish from the area, and other Project activities would have little or no effect on current sediment conditions. Benthic fish and shellfish are already exposed to the metal concentrations found through sediment depths (i.e., due to the uniform metals distribution). Therefore, no contaminant stressors are identified that could affect benthic communities. Pelagic fish are not anticipated to accumulate significant levels of metals as a result of short-term minor increases in TSS exposure (i.e., limited to hours to days depending on currents and particle sizes).

The rarity and low magnitude of exceedance of fluoranthene suggests negligible risk to marine country foods. Because pre-existing concentrations of metals did not vary with depth (Section 13.2.2), dredging deeper sediments to the surface would have no effect on future metal levels in water and sediment. Additionally, much of the metal found in sediment would not be bioavailable but would be bound to sediment media. Therefore, no risk pathway was identified with respect to an accumulation of these COPCs in marine biota.

Based on the sediment quality assessment, there were no pathways identified that link Project activities to marine country foods effects to humans. As a result, this potential effect was not carried further into a quantitative HHRA and baseline fish tissue chemistry sampling was not conducted as part of the country foods assessment. There are also technical challenges in confirming exposure of pelagic fish to specific contaminants released during dredging, given the high mobility of most fish species. This applies to both baseline conditions and potential effects of the Project.

13.3.2.2 Mitigation

Mitigation techniques proposed in Section 12 will be applied to minimize combined residual effects on the Aquatic Environment. A water quality monitoring program will be developed as required to verify protection of valued aquatic resources. Construction monitors on site would be present to ensure that there are no negative effects to the marine environment. Site and stormwater discharge would comply with BC MoE discharge permit limits. Treated sewage would meet performance standards of the system and BC MoE limits.

13.3.2.3 Residual Effects

Dredging and marine facilities construction activities may temporarily elevate TSS in a localized area, but are not predicted to have any effect on existing metal and PAH concentrations in water and sediment. In addition, the use of a pipe network at Disposal Site A would act to minimize redistribution of sediment into the water column.

Since there is no expected increase of contaminants in fish tissues, there will be no transfer of contaminants to terrestrial country foods (i.e., wildlife), and consequently there is no Human Health concern through ingestion of marine or terrestrial country foods. Residual effects to country foods are therefore considered neutral in direction (Table 13-8).

13.3.2.4 Determination of Significance

Since there were no identified residual effects to country foods, no significant effects to Human Health from changes to country foods are predicted.

13.3.3 Changes to Air Quality Causing Human Health Effects

13.3.3.1 Potential Effects

Emission of CACs to the surrounding airshed have the potential to result in adverse health effects to people that inhale them. Assessed CACs include Sulphur Dioxide (SO_2), Nitrogen Dioxide (NO_2), Carbon Monoxide (CO), particulate matter (PM) less than 10 microns (PM_{10}) and particulate matter less than 2.5 microns ($PM_{2.5}$). PM_{10} is often referred to as inhalable particulate matter. Similarly, $PM_{2.5}$ is referred to as respirable particulate matter. Potential health effects could include respiratory distress, asthma, bronchial irritation, and for people that are pre-disposed, concerns such as cardiac and pulmonary stress. In order to ensure protection of people's health, numerical ambient air quality standards for both short-term and long-term exposure have been provided in order to safely monitor and manage emissions and avoid health issues.

All maximum ground-level CAC concentrations for the Application Case (Baseline + Project) were below applicable national guideline levels in the local study area (Project fenceline; Table 13-7). The predicted 24-hour SO_2 concentration was virtually equal to the national AAQO at fenceline, and would be much lower at all human receptor locations. Maximum predicted concentrations are considered conservative as they are based on worst case emissions and meteorologic conditions, therefore the likelihood and frequency of these occurrences is considered extremely small. Therefore, predicted maximum SO_2 levels are not considered to pose a health risk to people in the local study area. Other CAC concentrations were also all well below air quality objectives at all sensitive receptor locations.

Predicted maximum NO_2, SO_2, and CO concentrations also showed no change, or increased very marginally, relative to baseline levels. Concentrations of volatile organic compounds (VOCs) from construction activities and locomotives accounted for only 0.2% and 0.7%, respectively, of regional VOC emissions. This indicates that VOCs are not a potential source of changes in air quality based on model results and sensitive receptors locations (Air Quality TDR). While 24-hour PM_{10} and $PM_{2.5}$ concentrations increased from baseline to the construction case (4- and 2-fold, respectively) at some sensitive receptor locations, these predicted values remained at least an order of magnitude lower than the air quality standards. These increases are therefore judged to be negligible in relation to Human Health air quality concerns. This PM increase is due largely to emissions produced by the berth dust collector.

Table 13-7: Predicted CAC Concentrations at Sensitive Receptor Locations for the Application Case

Receptor	Maximum Predicted Ground-level Concentration (µg m[3])										
	SO_2				NO_2			CO		PM_{10}	$PM_{2.5}$ [d]
	1-hour	3-hour	24-hour	Annual	1-hour	24-hour	Annual	1-hour	8-hour	24-hour	24-hour
Air Quality Objectives[a]	**450**	**375[b]**	**150**	**30**	**400**	**200**	**60**	**15,000**	**6,000**	**50[b]**	**30[c]**
Fenceline – Worst Case	442	259	80.7	4.08	174	128	47.2	964	430	74.7	21.8
Port Edward Elementary	20.4	15.9	6.4	0.23	113	55.6	0.94	32.0	19.3	5.07	2.01
Prince Rupert Closest Residence	92.2	82.9	12.6	0.74	119	74.9	4.35	260.7	131.0	2.31	1.74
Pineridge Elementary	61.0	43.1	10.0	0.55	105	40.2	2.40	161.6	71.5	1.76	0.97
Prince Rupert Regional Hospital	74.5	46.0	11.5	0.41	92.5	23.6	1.57	91.5	47.0	1.41	0.77
Roosevelt Park Elementary	85.2	51.5	11.0	0.35	87.7	20.3	1.32	68.9	38.8	1.36	0.74
Prince Rupert Middle School	69.4	51.8	11.2	0.25	85.9	15.0	1.00	50.2	28.8	0.99	0.57
First Nations Education	77.0	58.2	14.5	0.27	95.0	17.2	1.00	45.1	27.9	0.98	0.53
Discovery Child Care	84.6	46.5	21.3	0.32	83.9	25.4	0.93	37.7	23.3	1.08	0.52
Seniors Centre	84.2	53.5	14.1	0.27	85.1	19.1	1.13	52.2	35.4	1.17	0.58
Charles Hays Secondary School	83.8	57.1	27.4	0.32	83.7	32.5	0.91	35.0	22.2	1.08	0.57
Northwest Community College	85.0	50.7	14.2	0.27	85.3	19.3	1.12	51.3	35.1	1.19	0.56
Cedar Road Aboriginal Headstart Program	106	63.3	29.4	0.32	89.4	37.8	0.89	32.6	20.8	1.11	0.55
Berry Patch Child Care	185	69.9	14.1	0.22	105	20.7	1.02	43.9	31.7	1.11	0.58
Fellowship Baptist Nursery School	155	97.5	39.1	0.48	99.4	48.0	1.14	33.9	22.2	1.17	0.64
Kaien Senior Citizens Housing	159	99.7	46.0	0.58	100	56.2	1.31	36.3	23.7	1.24	0.72
Conrad Street Elementary	81.9	48.1	20.9	0.28	85.0	28.5	0.78	23.4	18.4	1.02	0.44
KIDS Daycare	74.2	47.1	17.7	0.27	83.8	27.5	0.74	26.1	18.3	1.00	0.44
Port Edward Elementary	20.4	15.9	6.4	0.23	113	55.6	0.94	32.0	19.3	5.07	2.01

NOTES:

[a] The most conservative of National Ambient Air Quality Objectives is shown

[b] BC Air Quality Objectives (no National Objective available)

[c] CCME (2000). Canada-Wide Standards for Respirable Particulate Matter ($PM_{2.5}$)

[d] 8th highest 24-hour ground-level concentration.

A dash indicates that no national air objective is available

13.3.3.2 Mitigation

Mitigation techniques proposed in Section 7 will be applied during each of the three Project phases to minimize combined residual effects on air quality. The most substantial mitigation is for PM and will require monitoring. Other mitigation includes ensuring equipment is properly maintained. A summary of these mitigation measures is included in Table 13-8.

13.3.3.3 Residual Effects

The predicted changes to ambient air quality discussed in Section 13.3.3.1 above are reflective of residual effects, as they incorporate best management practices and emission controls in the air model. The significance of these air quality effects is rated below.

13.3.3.4 Determination of Significance

Project-related CAC inputs (SO_2, NO_2, CO, PM) were all predicted to remain well below air quality standards, and most were not predicted to increase from baseline levels. Therefore there were no identified effects to Human Health from these constituents. Particulates could show a low magnitude increase of local geographic extent but levels would remain well below air standards. Air quality-related health effects were classed as reversible, with a moderate level of predictive confidence and high likelihood of occurrence of modeled concentrations (i.e. no health effects). During construction, emissions would be sporadic and of short duration, while during operations, emissions would be continuous and of longer duration.

It is also important to note that these effects will occur on water near the ships, or on land immediately adjacent to the property line on an isolated hillside. There are no human receptors that reside in these immediate areas; the closest community (Port Edward) being 3 km away. Predicted air quality at all human receptor points was predicted to meet all applicable air quality objectives.

No significant residual air quality effects to Human Health were predicted.

13.3.4 Changes to Ambient Light Causing Human Health Effects

13.3.4.1 Potential Effects

Potential effects of increased ambient light levels to local people relate to light trespass (direct brightening of naturally darker zones), glare/visual issues, and sky glow (indirect brightening of naturally darker zones). Exceedance of CIE standards for these three light attributes can lead to annoyance and reduction in quality of life to local residents.

No prolonged construction will be conducted during the night on the rail or road corridor. The plant and marine terminal will involve evening and possibly nighttime construction. The topography of the island provides a substantial barrier to visibility of lights emanating from the terminal. As a result, during the site preparation work, the use of mobile equipment equipped with headlights will not be visible from Port Edward apart from a small amount of sky glow. As the structures are erected, work lighting will provide somewhat greater sky glow, but will be largely obstructed from direct view by the topography.

Modeling of predicted light levels during operations indicates that there would be no effects to most local residents, with the potential for limited increase in light trespass, glare and sky glow mitigated by topography, use of sky dark fixtures, and cut-off design in areas where roads are within line-of-sight of residences.

Activities to be conducted during decommissioning are temporary and confined to the same general areas where the facilities will ultimately be located and operated. All activities will, however, be conducted to comply with standards in effect at the time of decommissioning.

13.3.4.2 Mitigation

Mitigation measures for effects on ambient light are presented in Section 9 (Ambient Light). A summary of these mitigation measures is included in Table 13-8. In general, construction Best Management Practices related to ambient light, such as shielding lights where possible and controlling light levels where activities are not occurring, can effectively mitigate potential adverse environmental effects on ambient light.

13.3.4.3 Residual Effects

Proper lighting during all phases of a Project is necessary for a safe and productive terminal, rail and utility corridor. With the use of mitigation and proper design, effects of light pollution on local residential quality of life will be minimal. Low level increases in light levels may be visible to some residents in the Village of Port Edward.

13.3.4.4 Determination of Significance

Effects were characterized as short-term and sporadic during construction, long-term and regular during operations (Table 13-8). However, as this is a partially developed industrial area, the environmental context weighs against having residual effects. Light-related effects were classed as reversible, with a moderate level of confidence and high likelihood of occurrence. It is expected that there could be some light from the Project observed in the Village of Port Edward, although the local topography, vegetation and design specifications will help to reduce this amount and therefore no significant adverse residual environmental effects of the Project on Human Health are predicted.

13.3.5 Changes to Noise Causing Human Health Effects

13.3.5.1 Potential Effects

Potential effects of increased noise levels include reduced ability to communicate, reduced sleep quality and quantity, and reduced quality of life. As there are no noise guidelines or standards in the Province of British Columbia directly applicable to the Project, Health Canada's approach to noise assessments was adopted. Health Canada's draft guidance on noise assessments for CEAA Projects (based on the US EPA) provides two assessment methods for projects that have construction periods lasting less than one year in duration. The first method assumes that if the average 24-hour sound level (day night average sound level (decibels); L_{DN}) for construction noise with mitigation exceeds 62 dBA then widespread complaints will be expected and considered a significant impact. The other method is based on calculating the percent highly annoyed (% HA) and comparing it to a threshold of 6.5% HA (including mitigation) for each Project phase. If, after mitigation has been applied, the % HA increases by 6.5% or more, it is considered a significant effect.

13.3.5.2 Mitigation

Predictive noise modeling (Section 8) indicated there will be no exceedance of Health Canada noise guidance. However, for the more sensitive receptors (e.g., the closer residences (<1 km) and Port Edward Elementary School), a combination of mitigation measures are recommended. These mitigation measures are discussed in the noise section and are summarized in Table 13-8.

13.3.5.3 Residual Effects

The sound pressure levels during construction at Port Edward are unlikely to cause more than brief annoyance during moments of particularly intensive activity; however, frequent (multiple daily occurrences) or sustained (periods of hours) exceedances are not anticipated. Construction equipment will be transient and thus not cause elevated noise levels at a stationary receptor for prolonged periods of time.

During construction, various Project activities and components were predicted to increase noise levels. The % HA metric values were below the Health Canada standard for both construction and operations, indicating that no Human Health effects from noise are predicted.

13.3.5.4 Determination of Significance

During construction, effects were classified as low magnitude, localized in extent, medium-term duration, and rare in frequency. The assessment was classed with a high level of confidence (based on model confidence) and high level of likelihood. No significant adverse residual environmental effects were predicted on health from construction noise activities.

During operations, the resulting sound pressure levels at the town of Port Edward will contain a contribution on the order of 24 to 26 dBA due to Canpotex activities. This level is likely to be lower than the background sound levels, and may not be perceptible for much of the time by residents of the town due to other background sounds. Effects during operations were classified as low magnitude, localized in extent, long-term in duration, and rare in frequency (Table 13-8). No significant adverse residual environmental effects on Human Health were predicted from noise activities.

13.4 Combined Effects and Overall Significance Determination

Potential contaminant-related effects of the Project on Human Health were examined using regulatory guidance and standards in comparison to predicted levels from Project activity. Due to the absence or minimal changes to ambient environmental conditions, a qualitative discussion of Human Health concerns was used in the assessment.

In summary, there were no predicted changes to marine sediment or country foods that would affect local people. Therefore there are no predicted country foods health risks.

Most air quality constituents were predicted to remain the same and meet all applicable air quality standards. Particulates (PM_{10} and $PM_{2.5}$) would show some increase from baseline but would remain ten times below levels associated with health concerns. Therefore, there are no predicted air quality-related effects to Human Health.

No significant adverse residual environmental effects to Human Health were identified in relation to Project-related changes in ambient light and noise levels.

The above three components (air quality, noise and light levels) were assessed in relation to overall Human Health. Given the lack of significant adverse residual environmental effects for any of these components, and the minimal changes to baseline conditions for some parameters (PM, light), the overall residual effect to local people was judged to be not significant (Table 13-8). Use of appropriate mitigation practices during construction and operations will ensure that air, light, and noise conditions meet objectives and protect the quality of life and the health of local residents.

Table 13-8: Summary of Project Residual Environmental Effects

Potential Residual Environmental Effects	Proposed Mitigation/Compensation Measures	Residual Environmental Effects Characteristics: Direction	Magnitude	Geographic Extent	Duration and Frequency	Reversibility	Ecological Context	Significance	Prediction Confidence	Likelihood	Recommended Follow-up and Monitoring
Potential for Changes in Country Foods to Affect Human Health											
Construction and Commissioning	▪ Waste water treatment ▪ Best management practices	N	–	–	–	–	–	N	M	H	Use of a qualified Environmental Monitor to oversee general construction and any other activities that could be disruptive to the Aquatic Environment
Operations		No effects anticipated									
Decommissioning		No effects anticipated									
Residual environmental effects for all Phases		N	–	–	–	–	–				
Potential for Changes in Air Emissions to Affect Human Health											
Construction and Commissioning	▪ Equipment maintenance ▪ Low sulphur fuel ▪ Dust suppressants ▪ Scheduling ▪ Minimize disturbance ▪ Erosion control structures ▪ Cover trucks ▪ Site paving if necessary	A	L	L	ST/S	R	D	N	M	H	During Operations: Particulate Matter monitoring at Project site.
Operations		A	L	L	LT/C	R	D				
Decommissioning		No effects anticipated									
Residual environmental effects for all Phases		A	L	L	LT/C	R	D				

Potential Residual Environmental Effects	Proposed Mitigation/Compensation Measures	Residual Environmental Effects Characteristics									Recommended Follow-up and Monitoring
		Direction	Magnitude	Geographic Extent	Duration and Frequency	Reversibility	Ecological Context	Significance	Prediction Confidence	Likelihood	
Potential for Changes in Ambient Light to Affect Human Health											
Construction and Commissioning	▪ Use of "dark sky" shielded luminaires for outdoor lighting ▪ Retain tree line directed to Port Edward ▪ Control outdoor light levels ▪ Centralized lighting control systems	A	L	L	ST/S	R	D	N	M	H	Use of a qualified Environmental Monitor to oversee general construction and any other activities that could be disruptive concerning light
Operations		A	L	L	LT/R	R	D				
Decommissioning		No effects anticipated									
Residual environmental effects for all Phases		A	L	L	LT/C	R	D				
Potential for Changes in Noise Levels to Affect Human Health											
Construction and Commissioning	▪ Avoid night-time construction activities on the east side of the island ▪ Internal combustion engines ▪ Near sensitive receptors the number of construction equipment in operation simultaneously will be reduced ▪ Proper maintenance of conveyors	A	M	L	ST/S	R	U	N	H	H	Complaint driven resolution plan.
Operations		A	L	L	LT/R	R	U				
Decommissioning		A	M	L	ST/S	R	U				
Residual environmental effects for all Phases		A	L	L	LT/R	R	U				

KEY

DIRECTION:
(P) *Positive*
(N) *Neutral*
(A) *Adverse*

MAGNITUDE:
(L) *Low*: changes in environmental stressor levels not expected, or would result in levels that are below health-based guidelines
(M) *Moderate*: changes in environmental stressor levels may result in exposures slightly above health-based guidelines. Effects will be offset through mitigation and/or compensation measures.
(H) *High*: changes in environmental stressor levels may result in exposures substantially above health-based guidelines. Exposure to these levels would be expected to result in Human Health effects.

GEOGRAPHIC EXTENT:
Use quantitative measure or:
(S) *Site-specific*: effects occur within the footprint of the Project facilities.
(L) *Local*: effects occur in the vicinity of the Project activity
(R) *Regional*: effects occur within the biophysical assessment area

DURATION:
(ST) *Short-term*: effects are measurable for <2 years
(MT) *Medium-term*: effects are measurable for 2 to 20 years
(LT) *Long-term*: effects are measurable for >20 years
(P) *Permanent*: effects are permanent

FREQUENCY:
Use quantitative measure, or:
(O) *Once*: effect occurs once
(S) *Sporadic*: effect occurs more than once at irregular intervals
(R) *Regular*: effect occurs on a regular basis and at regular intervals
(C) *Continuous*: effect occurs continuously

ECOLOGICAL CONTEXT:
(D) *Disturbed*: area has been substantially previously disturbed by human development or human development is still present
(U) *Undisturbed*: area relatively or not adversely affected by human activity

(N/A) *Not Applicable*

SIGNIFICANCE:
(S) *Significant*
(N) *Not Significant*

PREDICTION CONFIDENCE:
Based on scientific information and statistical analysis, professional judgment and effectiveness of mitigation
(L) *Low* level of confidence
(M) *Moderate* level of confidence
(H) *High* level of confidence

LIKELIHOOD:
Based on professional judgment
(L) *Low* probability of occurrence
(M) *Medium* probability of occurrence
(H) *High* probability of occurrence

13.5 Cumulative Effects Assessment

Air Quality

The cumulative effects assessment (CEA) Case for air quality-related Human Health effects includes emissions from the proposed Project in combination with the regional emissions as well as emissions from future publicly-disclosed Projects. There is one publicly-disclosed future project located within the assessment area: the Fairview II Project. Potential emissions from the China Paper Group Pulp Mill were not included in the air quality assessment due to the age of the infrastructure and the extended period of time the mill has been shut-down, which indicate that it is not economically feasible to restart the mill.

The ground-level concentrations (GLCs) of CACs at sensitive receptors were determined for the CEA Case. Detailed results for each of the sensitive receptors are presented in Section 6.5 of the Project Air Quality TDR. The results at each of the receptors were well below the applicable regulatory standards for all contaminants and averaging periods. As expected, the maximum predicted GLCs at the sensitive receptors generally increase, but only incrementally so, when comparing the CEA Case predictions to the Baseline Case and Application Case predictions for SO_2, NO_2, CO, PM_{10}, $PM_{2.5}$ and VOCs.

Cumulative effects include emissions of CACs from all existing and industrial sources and publicly-disclosed Projects in combination with the Project emissions. The CEA Case air quality dispersion modelling indicates that the addition of publicly-disclosed Projects in the assessment area do not have a substantial effect on maximum predicted ground-level concentrations of CACs. Also it is expected that the predictions are conservative, since maxima do not reflect typical human exposure scenarios. Therefore, combined cumulative residual effects of air quality to Human Health are considered to be not significant.

Light

There is potential for the Project to contribute to increased spillover light in the regional study area cumulatively with that light emitted from other facilities on the island. However, as a result of the Project’s design specifications and recommended mitigation measures, cumulative residual Human Health effects of additional light from the proposed Project are not expected to be substantial.

Noise

Noise from Project construction and operations is expected to overlap with Noise from the existing terminals and rail lines on Ridley Island to cause cumulative effects for nearby receptors. The residual effects from these existing facilities (Fairview Terminal Phase I) have been previously assessed by noise specialists, and are not considered to be significant. Cumulative effects between the Project and other large scale noise generating activities within the assessment area are not expected to occur or would be negligible due to the separation distances involved between the Project and other local Projects (i.e., the additive effect is expected to be minor and not significant). Therefore there are no cumulative residual effects from noise that would affect the local residents.

In summary, there are no significant adverse residual cumulative effects on Human Health based on evaluation of the proposed Project and existing/future Projects.

13.6 Follow-up Program

Routine construction monitoring during the dredging and building of marine components of the Project will form the basis of ensuring no impacts to local marine water and sediment quality that could result in chemical effects to biota and to human consumers of these country foods. Monitoring of discharge of site water would follow oil/grit separation and would meet discharge permit requirements. Discharge of treated sewage would comply with BC MOE limits and performance standards of the system. This monitoring strategy is discussed as part of the Aquatic Environment (Section 12).

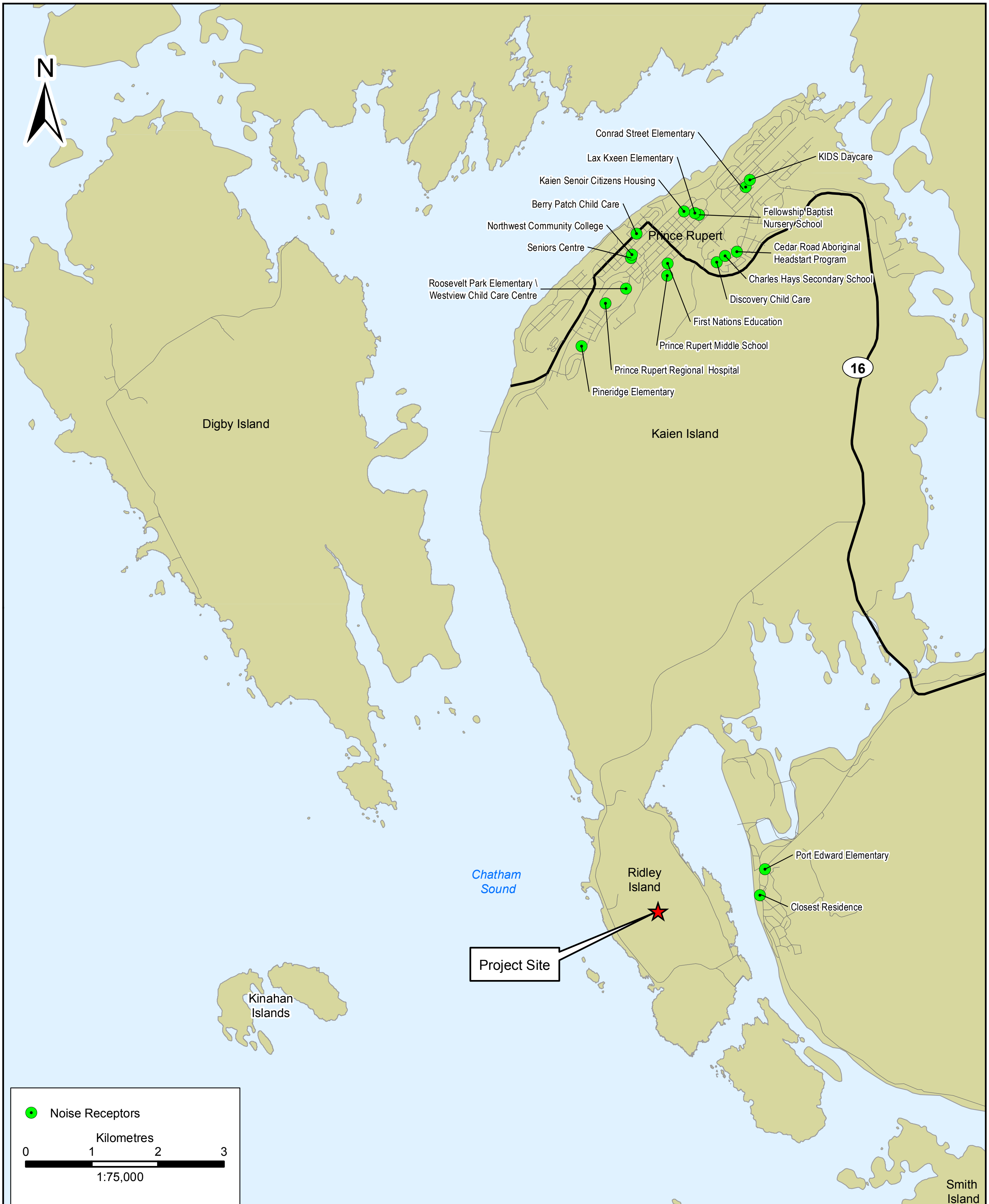
Critical to the avoidance of Human Health related effects from light and noise is the implementation of appropriate mitigation measures. The Proponent will provide a qualified Environmental Monitor to oversee general construction and any other activities that could be disruptive concerning light and noise. The Environmental Monitor will ensure that mitigation measures outlined in the EMP to minimize such disruptions are adhered to. Follow-up monitoring during all phases the Project will be on a complaint driven basis so specific light or noise issues can be addressed and resolved.

13.7 References

Environment Canada. 2010. FCSAP Ecological Risk Assessment Guidance. Prepared by Azimuth Consulting Group Inc. Draft – March 31 2010

13.8 Figures

Please see the following page.



R:\2010Stantec\123110264_Canpotex_Ridley_Island\gis\Figures\EIS\HumanHealth\123110264 Fig 13-1_ LocationOfSensitiveReceptors.mxd

Client: Canpotex / Prince Rupert Port Authority	Job No.:	123110264	Fig. No.: 13-1	Stantec
	Scale:	1:75,000		
	Date:	17-Oct-11		
LOCATION OF SENSITIVE RECEPTORS ENVIRONMENTAL ASSESSMENT RIDLEY ISLAND, BRITISH COLUMBIA	Dwn. By:	NP		
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14 ARCHAEOLOGICAL AND HERITAGE RESOURCES ASSESSMENT

Archaeological and Heritage Resources are a VEC based on the principles defined in the *Heritage Conservation Act* where "heritage value" is defined as "historical, cultural, aesthetic, scientific or education worth or usefulness of a site or object." As such, these resources have importance to the scientific, cultural, and public communities. Additionally, Archaeological and Heritage Resources are of importance to First Nations communities because they demonstrate the long-term use of their traditional territories and provide a physical link to their cultural history. Because of the potential for disturbance of archaeological resources, historical materials and traditional sites and materials during surface- and subsurface-altering activities related to the Project, these resources constitute a VEC.

14.1 Scope of Assessment

14.1.1 Regulatory/Policy Setting

Section 2(1) of the *Canadian Environmental Assessment Act* (CEAA) specifically refers to archaeological and heritage resources in the definition of "environmental effect":

> *"…any change that the project may cause in the environment, including … any effect of any change... on physical and cultural heritage, the current use of lands and resources for traditional purposes by aboriginal persons, or any structure, site or thing that is of historical, archaeological, paleontological or architectural significance…"*[6]

The CEAA *Reference Guide on Physical and Cultural Heritage Resources* (Canadian Environmental Assessment Agency 1996) details the kinds of considerations that are required for heritage resources. This guide defines a cultural heritage resource as "…a human work or a place that gives evidence of human activity or has spiritual or cultural meaning, and that has historic value".

There is no specific federal heritage legislation to further guide the management of heritage resources on federal lands. However, in British Columbia, archaeological and cultural heritage resources are managed in accordance with the legal requirements and conditions stemming from the provincial *Heritage Conservation Act* (HCA). "Archaeological resources" are defined as human work or places that give evidence of human activity predating 1846 and that have heritage value as defined by the Act. "Heritage resources" include all resources that are of historical, cultural, aesthetic, scientific or educational worth or usefulness as sites or objects of value to British Columbia, a community, or an Aboriginal people. Furthermore, the provincial Archaeology Branch has established standards, policies, and guidelines that guide the archaeological assessment process in BC. These standards, policies, and guidelines are followed in this assessment.

[6] In the assessment of Archaeological and Heritage Resources, the use of the term 'significance' in the context of a structure, site, or thing of archaeological significance, is in keeping with the use of 'significance' as defined by the BC Archaeological Impact Assessment Guidelines.

14.1.2 Key Issues

This section focuses on potential issues relating to Archaeological and Heritage Resources as presented in Table 14-1. These issues have been selected in consideration of the Project description (Section 2.0) and those Project-related effects that are considered to be substantive.

Potential environmental effects include the following:

- Destruction of culturally modified trees (CMTs)
- Disturbance or destruction of terrestrial archaeological or heritage sites
- Disturbance or destruction of intertidal archaeological or heritage sites.

The clearing of vegetation from the Project area prior to grading and construction activities would result in the destruction of CMTs, if present in the footprint.

Terrestrial archaeological or heritage sites, comprised of combinations of artifacts and features found on and/or within the ground, may be damaged or destroyed, if present in the footprint, by any development activities that involve disturbances to the ground surface or the displacement or compaction of sediments. Effects to archaeological sites related to the construction and commissioning of the Project may arise in relation to clearing and grubbing, site grading, and the installation of services. All of these processes have the potential to disturb, mix, and redeposit culture-bearing sediments, and to damage, disturb or destroy archaeological features and artifacts. The operation of the proposed facilities may also negatively affect archaeological sites located along the Ridley Island coastline, because the arrival and departure of vessels will create wake that may increase erosion of these sites by wave action. Finally, the eventual decommissioning of the Project facilities will involve the removal of site infrastructure by heavy machinery, which has the potential to cause adverse effects beyond those resulting from Project construction and commissioning, or operations.

Intertidal archaeological or heritage sites, if present in the footprint, may be damaged or destroyed by development activities that involve disturbances to the ground surface or the displacement or compaction of sediments within the intertidal zone. Potential effects to intertidal archaeological or heritage sites that relate to the construction of the Project may arise in relation to the construction of marine facilities such as the causeway, trestle, and berth. These processes have the potential to disturb, mix, and redeposit culture-bearing sediments, and to damage, disturb or destroy archaeological features and artifacts.

Dredging was given a rank of ‘1’ in Table 3-4. The potential exists that dredging in the subtidal area will disturb artifacts and heritage resources. However, based on recent research it is deemed unlikely that subtidal archaeological sites would be present in the area. Research on Late Pleistocene and Holocene relative sea level fluctuations in the Prince Rupert area indicates that relative sea levels were never more than 3.5 m below present in the area since the last glaciation (Eldridge and Parker 2007; Eldridge *et al.* 2008; McLaren 2008). This depth is significantly less than that of the area to be dredged.

Table 14-1: Potential Environmental Effects to Archaeological and Heritage Resources Associated with the Project

Project Activities and Physical Works	Potential Effects on Archaeological and Heritage Resources		
	Destruction of CMTs	Disturbance or destruction of terrestrial archaeological or heritage sites	Disturbance or destruction of intertidal archaeological or heritage sites
Construction and Commissioning			
Temporary Construction Infrastructure (trailers, power, sanitary facilities, etc.)		✓	
Site Preparation (Clearing and Grubbing, Site Grading)	✓	✓	
Rail Loop Construction		✓	
Onshore Terminal Construction (receiving, storage, reclaim and ship-loading facilities, site services)		✓	
69 kV transmission line Construction		✓	
Access Road and Overpass Construction		✓	
Marine Facilities Construction (causeway, trestle, and berth)		✓	✓
Operations			
Arrival and Departure of Vessels		✓	
Decommissioning			
Removal of Site Infrastructure (potash handling system/buildings)		✓	
Interaction of Other Projects and Activities in the Boundary for Assessment			
Ridley Terminals Inc.	✓	✓	✓
Prince Rupert Grain Ltd	✓	✓	✓
Ridley Island Log Sort	✓	✓	✓
China Paper Group Pulp Mill[7].	✓	✓	✓
Fairview Terminal (existing and II)	✓	✓	✓
PRPA Land Use Plan[8]	✓	✓	–

NOTES:

Project Environmental Effects

Only Project – Environment interactions ranked as 2 in Table 3-4 are carried forward to this Table. A ✓indicates that an activity is likely to contribute to the environmental effect

[7] Potential emissions from the pulp and paper mill will not be included in the air quality assessment due to the age of the infrastructure and the extended period of time the mill has been shut-down. Both facts indicated that it is not economically feasible to restart the mill.

[8] Due to the preliminary nature of the land use plan only cumulative effects associated with wildlife and vegetation will be assessed.

14.1.3 Selection of Measurable Parameters

Effects to Archaeological and Heritage Resources are framed with reference to measurable parameters. Measurable parameters facilitate quantitative or qualitative measurement of potential Project and cumulative effects, and provide a means to determine the level or amount of change to a VEC. The selected measurable parameters for the Archaeological and Heritage Resources VEC are outlined in Table 14-2 as functions of the potential effect.

Table 14-2: Measurable Parameters for Archaeological and Heritage Resources

Potential Project Effect	Measurable Parameter(s) for the Effect	Rationale for Selection of Measurable Parameter
Destruction of culturally modified trees (CMTs)	Risk of CMTs being destroyed	To ensure that any effects to CMTs are avoided or minimized where possible. Mitigate the loss of CMTs through appropriate data collection.
Disturbance or destruction of terrestrial archaeological or heritage sites	Risk of terrestrial archaeological or heritage resources being disturbed or destroyed	To ensure that any effects on terrestrial archaeological or heritage sites are avoided or minimized where possible. Mitigate the loss of terrestrial archaeological or heritage sites through appropriate data collection, potentially including systematic data recovery studies.
Disturbance or destruction of intertidal archaeological sites	Risk of intertidal archaeological or heritage resources being disturbed or destroyed	To ensure that any effects on intertidal archaeological or heritage resources are avoided or minimized where possible. Mitigate the loss of intertidal archaeological or heritage sites through appropriate data collection, potentially including systematic data recovery studies.

14.1.4 Characterization of Residual Effects

The terminology defined in Table 14-3 is used to describe residual Project effects.

Table 14-3: Characterization Criteria for Residual Effects on Archaeological and Heritage Resources

Criterion	Ranking/Description
Direction	**Positive:** Positive change compared to baseline status **Neutral:** No change compared to baseline status **Adverse:** Negative change compared to baseline status
Magnitude	**Low:** Effect is detectable but is limited to small portions of archaeological or heritage sites of low significance[1] or to portions of archaeological or heritage sites already substantially disturbed by previous developments **Moderate:** Affects small but intact portions of archaeological or heritage sites of moderate or high significance[1], or substantial, intact portions of archaeological or heritage sites of low significance[1] **High:** Affects substantial, intact portions of one or more sites of moderate or high significance[1] **NOTE:** [1] 'Significance' in this context is defined as per the BC Archaeological Impact Assessment Guidelines

Criterion	Ranking/Description
Geographical Extent	**Site-specific:** Limited to the Project footprint **Local:** Limited to Ridley Island **Regional:** Extending beyond Ridley Island
Frequency	**Once:** Effect occurs once. **Sporadically:** Occurs sporadically at irregular intervals **Rarely:** Effect occurs monthly **Frequently:** Effect occurs daily **Continuous:** Effect occurs continuously
Duration	**Short-term:** Measurable for less than one month **Medium-term:** Measurable for more than one month but less than two years **Long-term:** Measurable for the life of the Project
Reversibility	**Reversible:** Effects will cease during or after the Project is complete **Irreversible:** Effects will persist after the life of the Project
Archaeological Context	**Disturbed:** There are existing disturbances within the Project Footprint **Undisturbed:** There are no existing disturbances within the Project Footprint

14.1.5 Standards or Thresholds for Determining Significance

The significance of the Project's potential effects on Archaeological and Heritage Resources, including as-yet undiscovered archaeological and heritage resources, is assessed based on the criteria outlined in Table 14-3.

The significance of all identified archaeological or heritage resources will be assessed using the standards described in British Columbia's *Archaeological Impact Assessment Guidelines* (Archaeology Branch 1998). Potential Project effects to such sites will also be evaluated using criteria from these guidelines. Because there is no specific federal legislation to guide the management of Archaeological and Heritage Resources in federal environmental assessments, Provincial standards are followed. These standards include criteria to characterize project effects developed primarily for projects reviewable under the BCEAA, but they are very similar to those outlined in Table 14-3.

14.2 Baseline Conditions

14.2.1 Ethnographic Summary

The study area is located within the traditional territory of the Tsimshian Nation and is subject to a land claim currently being negotiated between the Tsimshian Nation and the governments of Canada and British Columbia.

The Tsimshian today includes seven member bands: Lax Kw'alaams, Metlakatla, Gitxaala (Kitkatla), Gitga'at (Hartley Bay), Kitasoo, Kitselas and Kitsumkalum. Lax Kw'alaams and Metlakatla are the two bands in closest proximity to Ridley Island and the proposed Project, although the Gitxaala First Nation has also expressed interest in the study area. Each of the Tsimshian member band areas consists of several reserves and/or settlements.

Traditional Tsimshian settlement involved a pattern of seasonal mobility. Typically, people gathered in large protected winter villages until dispersing to their traditional fishing sites in the early summer. Settlement was organised to exploit a number of seasonally and geographically restricted resources including salmon, halibut, eulachon, seaweed, tree cambium, bird eggs and various roots and berries. The Nass River eulachon grease trade was an important economic activity for the Tsimshian (Halpin and Seguin 1990).

The basic social unit in Tsimshian society was the 'house'. These were corporate matrilineages whose members, affines, and slaves occupied one or more dwellings. Each house had exclusive ownership of specific hunting, gathering and fishing sites. These were exploited under the guidance of the house chief—typically the man who bore the highest-ranking name in the house. House chiefs worked cooperatively with each other in matters of mutual interest to the village such as defence. Chiefs were themselves ranked to determine their respective rights in political and ceremonial events (Halpin and Seguin 1990).

14.2.2 Cultural History Summary

Ridley Island is located in the Northern sub-area of the Northwest Coast archaeological culture area.

Archaeological research in this sub-area has been relatively limited. Much of the work undertaken has been concentrated in the Prince Rupert harbour area and in Kitselas Canyon, approximately 125 km up the Skeena River. The prehistory of the northern Northwest Coast archaeological region can be divided into two distinct periods divided by the first appearance of shell middens on the mainland coast approximately 5,000 years ago. The Early period (10,000 to 5,000 years ago) is not yet represented in mainland north coastal sites although some material from the Paul Mason site in Kitselas Canyon dates to the transition between the Early and Recent period. Excavated Early period components are confined primarily to eleven sites in the Prince Rupert harbour area and two sites in Kitselas Canyon. All of the Prince Rupert harbour sites date from the Recent period (5,000 years ago to European contact) as does most of the Kitselas Canyon material.

A three period cultural sequence has been developed for the Recent Period for Prince Rupert Harbour (Ames 1984; MacDonald 1983; MacDonald and Inglis 1981). Prince Rupert III encompasses the period from 5,000 to 3,500 years before present (BP). Only four Prince Rupert sites have significant Prince Rupert III components. These components are associated with small shell middens, low artifact densities and diverse faunal assemblages suggesting a broad subsistence base with a strong emphasis on terrestrial resources. The basic tool kit shares a strong affinity to that of historic Tsimshian populations but is generally less complex. Bone and antler tools dominate although ground stone and cobble tools are also present. There is no evidence of large communal structures resembling ethnographic longhouses from this period, although small postholes, post molds and hearths indicate the presence of smaller domestic structures.

Prince Rupert II spans the period from 3500 to 1500 BP. At least 12 known sites have significant Prince Rupert II components. These components are associated with relatively thick, rapidly deposited shell middens and high artifact densities. Faunal assemblages associated with this period indicate a greater reliance on fishing and marine mammal hunting and a declining emphasis on land mammal hunting. Net weights and a third harpoon type are added to the tool kit during this period indicating the growing importance of marine resources. Stone adzes, chisels, bark shredders and bark peelers appear along with the bone and antler woodworking technology associated with Prince Rupert III. The appearance of a woodworking tool kit implies an expansion of the role of wood in the material culture. These tools also provide indirect evidence for the construction of larger domestic structures during this period. Prince Rupert II appears to coincide with major social changes involving rapid population growth and an expansion and intensification of the subsistence base. These changes are evidenced in part by a major burial complex, involving interment in middens, which terminates by the end of this period (Fladmark *et al.* 1990).

Prince Rupert I dates from 1500 BP to the historic period (ca. AD 1830). This period shows strong continuity with Prince Rupert II but is distinguished on the basis of several key cultural traits. Midden burials disappear from the archaeological record during the Prince Rupert I period, likely giving way to less archaeologically visible ethnographic burial practices including cremation. The rate of shell midden deposition appears to slow relative to the preceding period. This may indicate stabilization in population growth. Subsistence patterns appear to be relatively unchanged, although slight variations in hunting technology appear to reflect a decline in the importance of marine mammal hunting relative to fishing.

No archaeological materials recovered on the mainland north coast predate 5,000 years ago. The reason for this lack of early materials is not clear, particularly in light of much earlier sites located in the surrounding coastal areas. Fladmark *et al.* (1990) note several possible reasons for the absence of recorded early sites in the area. Early sites may be elevated and obscured by dense forest cover, missed due to the archaeological sampling techniques employed, or possibly not even present because the north coast was not inhabited at this time.

The ability to predict the location of early sites along this part of the coast is complicated by the poorly understood history of environmental changes and relative sea levels in the Late Pleistocene and Holocene. Data regarding relative sea levels are scarce, and relative sea levels varied considerably. For example, 10,000 years ago, sea levels in the Queen Charlotte Islands, which were not heavily glaciated, were approximately 30 m below present levels. By contrast, at the mouth of the Skeena River, sea levels were as much as 200 m above present levels at about the same time (Fladmark *et al.* 1990). Geological evidence indicates that the sea may have achieved its present level in the Skeena River Valley as early as 8,000 years ago. It is relatively certain that the mainland coast achieved sea level stability by at least 5,000 years ago and that this part of the north coast has unquestionably been continuously occupied since. The most recent, relevant relative sea level data indicate that relative sea levels were never more than 3.5 m below present in the area since the last glaciation (Eldridge and Parker 2007; Eldridge *et al.* 2008; McLaren 2008).

Hebda and Mathewes (1984) have argued that, while the modern outline of the coast may be 5,000 years old, the modern climax forest is unlikely to have become fully mature before 3,000 years ago. In a similar vein, Fladmark (1975) has argued that the stabilization of the mainland coastal sea level is the critical factor in the origin of the development of the area's rich salmon runs. The timing of these events roughly parallels changes in the archaeological record.

14.2.3 Archaeological and Heritage Site Types in the Region

14.2.3.1 Culturally Modified Trees

A CMT is defined as "A tree that has been altered by native people as part of their traditional use of the forest" (Archaeology Branch 2001).

The majority of CMTs recorded in the region are western red cedars, although other species such as western hemlock, yellow cedar, spruce and western yew have also been reported (Archaeology Branch 2001). Several types of CMTs have been recorded in the region, and may be present on Ridley Island.

Bark-stripped trees in coastal areas are usually red and yellow cedars exhibiting tapered or rectangular bark strips. Cedars were stripped to obtain their inner bark which is used to manufacture numerous items including ropes, baskets, mats, blankets, sacks, toweling and clothing such as cedar bark robes, aprons and hats (Archaeology Branch 2001). Relatively young trees with few branches at the base were preferred for the above purposes. A tapered bark-strip was removed by making a horizontal cut in the tree bark then pulling the bark away from the tree in long, narrow strips. The bark strip would taper until the bark would break away from the tree. Large rectangular bark-strips, usually 3 to 7 m long and 40 to 70 cm wide, were produced by a horizontal cut at top and bottom and were usually employed as roofing material. Smaller rectangular bark-strips may have been the result of stripping for inner bark on younger trees for specific bark lengths for items such as skirts or mats. Multiple bark strips were sometimes removed side by side from the same horizontal cut. Multiple stripping results in multiple peaks at the top of the scars. Separate bark strips would often be taken from the same tree at different times, resulting in some trees exhibiting multiple scars Once the strips were obtained, the inner bark would be separated from the outer bark and rolled up and bundled for transport. Cedar bark stripping for traditional purposes is still conducted in the region. Numerous bark-stripped CMTs have already been recorded on Ridley Island.

Planked trees are standing, wind-fallen or intentionally felled trees from which planks have been detached. Planked trees exhibit plank scars—flat, rectangular surfaces that are the result of plank removal. Remnant notches may be present at both ends of the scar because planks were normally removed after first notching the tree or log at the two ends of the anticipated plank, and then removing the plank with the aid of wood or antler wedges. The size of the scar reflects the size of plank removed. Long scars are commonly 10 m or more in length and between 1 and 2 m wide; short scars are generally under 4 m in length, and less than 1 m wide (Archaeology Branch 2001).

Canoe blanks are logs in the initial or intermediate stage of shaping into a canoe. A canoe blank has a shaped bow and/or stern. Other attributes of a canoe blank vary with the size and style of the canoe being manufactured, and the degree of completeness (*ibid*.).

Tested trees are standing trees with one or more rectangular holes chopped into their trunks (*ibid*.). These holes were made in order to assess the quality of the heartwood of the tree, and to ensure that it was not hollow. This would have been particularly important in selecting trees for canoes or planks.

Kindling removal trees are trees from which pieces of wood or bark are removed for use as kindling or fuel. These trees exhibit one or more kindling removal scars. These scars are highly variable, but usually take the form of chop marks and missing narrow pieces of wood. In coastal British Columbia, these have been found most commonly on cedar (*ibid*.).

14.2.3.2 Shell Middens

Shell middens are typified by the presence of shell remains from shellfish (e.g., clams, mussels, etc. discarded after consumption. Shell midden deposits vary from small pockets to very large sites many hundreds of metres long. They are usually found along or near the shoreline but can also be found inland, although no inland middens are presently known for the region. Shell middens are unique inasmuch as the shells neutralize the soil acidity, such that archaeological materials that usually degrade quickly are preserved. Shell middens also commonly contain charcoal, ash and burnt sediments, fire-broken rock and stone, bone and antler artifacts, and human remains. Shell middens vary considerably in size, context and contents, and may represent villages, seasonal campsites, short-term resource procurement sites or cemeteries.

14.2.3.3 Lithic Scatters

Lithic scatter sites consist of scatters of stone tools and/or flakes, the result of lithic raw material acquisition and tool production and/or tool maintenance. Isolated lithic artifact finds are included in this category. These sites lack structural remains and often reflect little diversity in their artifact assemblages, the result of less intensive and more specialized activities than reflected at village sites. They can reflect activities such as procurement and/or processing of food or raw materials. They may represent seasonal or short-term campsites, lookouts or various other activities.

Lithic scatter sites are frequently identified on the ground surface or in surface exposures, although such sites often also include buried components. Alternatively, lithic scatters may be entirely subsurface in their distribution.

In the study region, scatters of lithic artifacts are commonly found in the intertidal zone. While some of these artifacts were likely lost or abandoned on the beach, many of these sites are associated with shell middens located above the intertidal zone. It is commonly assumed that these scatters have eroded from the adjacent middens and subsequently been dispersed through wave action.

14.2.3.4 Petroforms

Petroforms are culturally produced rock or stone alignments, markers or structures. Petroforms are frequently functional in nature, such as fish weirs and tidal pounds, dams and canoe skids, but can be associated with human burials, such as cairns. Petroforms may also serve as territorial boundary markers.

Canoe skids or canoe runs are narrow swaths of shoreline from which cobbles and boulders have been removed to facilitate landing canoes and dragging them up the beach.

Fish traps are alignments of stones, sometimes augmented with wooden elements, which are built on beaches or in rivers and streams to capture fish stranded during an ebbing tide and/or attempting to ascend spawning streams.

Clam gardens or clam terraces are clam-rich beaches, formed through the removal of rocks from the intertidal zone to create a sandy beach. The removed rocks are piled into a ring along the low tide line to prevent the sandy beach matrices from eroding (Williams 2006). These anthropogenic features have only recently been recognized by archaeologists.

None have been formally recorded in the Prince Rupert area. However, two possible clam gardens have been tentatively identified in the vicinity (Eldridge and Parker 2007). One was identified at the Boardwalk site (GbTo-31) while the other was identified below the Dodge Island site (GbTo-18). An expert consulted regarding these features concluded that the Boardwalk Site feature was probably the result of tidal winnowing of deposits removed from a trench, such as a waterline. However, the second feature at the Dodge Island site was deemed to be a probable clam garden feature. More work is required to confirm this assessment, but if correct it is the first known clam garden on the North Coast (*ibid*.).

14.2.4 Previous Archaeological Research

The Prince Rupert Harbour area has a long history of human occupation and has been the focus of much of the archaeological research conducted on the northern Northwest Coast. Over fifty archaeological sites are located within a 10 km radius of the proposed Project terminal location. Seventeen heritage sites, including both archaeological and traditional use sites, have been identified on Ridley Island (Table 14-4 and Figure 14-1). All of these sites are either shell middens or CMTs.

Table 14-4: Recorded Archaeological and Heritage Sites on Ridley Island

Site	Type	Comments
GbTn-18	Shell midden and historic cabin	Midden was prehistoric and not temporally associated with the cabin; midden since completely destroyed.
GbTn-19	Shell midden	Largely or completely destroyed.
GbTn-35	CMT	n=5; undated. Site is located away from Project footprint.
GbTn-36	CMT	n=6; undated. Site is located away from Project footprint.
GbTn-38	CMT	n=8; undated. Site is located away from Project footprint.
GbTn-39	CMT	n=8; undated. Site is located away from Project footprint.
GbTn-40	CMT	n=1; undated. Site is located away from Project footprint.

Site	Type	Comments
GbTn-60 (includes **GbTn-2006-T4)**	CMT	n=7; includes two post-1846 AD features recorded previously as **GbTn-2006-T4**. The remaining five CMTs are undated but may pre-date 1846. The five CMTs that pre-date 1846 are located in the road, rail and utility corridor footprint.
GbTn-71	CMT	n=1; undated, but probably pre-dates 1846 (originally recorded as **GbTn-2008-T1**). Site is located in the road, rail and utility corridor footprint.
GbTn-72	CMT	n=1; undated, but possibly pre-1846 based on apparent modification by stone tools (originally recorded as **GbTn-2008-T2**. Site is located in the road, rail and utility corridor footprint.
GbTn-93	CMT	n=4; undated, but two of the four are presumed to pre-date 1846 based on observations regarding healing lobe growth, scar morphology, forest stand characteristics, and tree size Site is located in the road, rail and utility corridor footprint..
GbTn-95	CMT	n=2; undated, but presumed to pre-date 1846 based on observations regarding healing lobe growth, scar morphology, forest stand characteristics, and tree size. Site is located in the road, rail and utility corridor footprint.
GbTn-2006-T1	CMT	n=1; post-1846. Site is located away from Project footprint.
GbTn-2006-T2	CMT	n=2; post-1846. Site is located away from Project footprint.
GbTn-2006-T3	CMT	n=2; post-1846. Site is located away from Project footprint.
GbTn-2008-T3	CMT	n=4; post-1846. Site is located in the road, rail and utility corridor footprint.
GbTn-2008-T4	CMT	n=1; post-1846. Site is located in the road, rail and utility corridor footprint.

GbTn-19 was a moderately sized shell midden site located at the northwest corner of Ridley Island. Richard Inglis recorded it in 1974 (Brundsen and Eldridge 2008), noting then that the site had already been heavily disturbed, and recommended that salvage excavations be conducted as additional disturbances were anticipated. Salvage excavations of the site were conducted in 1978, and resulted in the discovery of over 100 artifacts and four human burials (May 1979). Radiocarbon dates indicated that the site was occupied between 2,945 and 1,740 BP (Brundsen and Eldridge 2008). The site has since been largely or completely destroyed by development.

Inglis also identified an additional shell midden site, **GbTn-18**, on the southwestern tip of neighbouring Kaien Island at the point where it joins the northern tip of Ridley Island at low tide. This site has also been completely destroyed by the construction of Ridley Island Road.

In 1982 and 1983, the Museum of Northern British Columbia conducted an intensive survey of coastal portions of Ridley Island to assess the potential for adverse effects to archaeological and heritage sites resulting from the proposed expansion of port facilities (Archer 1984). The survey was limited to areas within 100 m of the modern coastline (i.e., those areas with the highest potential to contain heritage sites). Five CMT sites were recorded, consisting of 28 CMTs overall. These were all located along the east and south shores of Ridley Island (**GbTn-35, -36, -38, -39** and **-40**). None of these CMTs have been directly dated.

GbTn-35 is located on a north-northwest trending peninsula along the east coast of Ridley Island. The site consists of five western red cedar (WRC) CMTs—one tapered bark strip, two rectangular bark strips, one chopped CMT, and one tree stump evidencing the removal of one or more planks.

GbTn-36 is situated on Gay Island, which is located immediately southeast of Ridley Island and is now artificially connected to Ridley Island. The site is comprised of six WRC CMTs from which planks have been removed.

GbTn-38 is located on the southeast shore of Ridley Island. Eight WRC CMTs, all bark-stripped, were recorded along a 150 m stretch of coastline. Four are rectangular bark-stripped CMTs, two are tapered bark-stripped CMTs, and two exhibit multiple bark strips.

GbTn-39 is located along the southeast coast of Ridley Island. Eight CMTs (seven WRC and one spruce) were identified along a 330 m stretch of coastline. All exhibit bark stripping. The spruce tree and five of the cedars exhibit rectangular bark strips; the remaining two cedars exhibit multiple bark-stripping scars.

GbTn-40, a single undated WRC bark stripped tree, is located on the southern tip of Ridley Island.

In 2006, an Archaeological Impact Assessment (AIA) of the then-proposed WestPac liquefied natural gas transshipment terminal (Streeter 2006) identified seven CMTs grouped in four CMT sites within the proposed project footprint. All of these CMTs were directly or indirectly dated, and all post-date AD 1846. As a result, these CMT sites were not formally registered with the Archaeology Branch, and have not been issued permanent site numbers. Instead, they are referred to by their temporary site designations.

GbTn-2006-T1 is a single, dead WRC kindling removal tree located approximately 800 m inland from the west coast of Ridley Island. Apparent axe marks suggest its recent age.

GbTn-2006-T2, consisting of two bark-stripped CMTs (one tapered, one lenticular in shape), is located on the west coast of Ridley Island.

GbTn-2006-T3, consisting of two bark-stripped CMTs (one tapered, one rectangular), is located on the west coast of Ridley Island, approximately 500 m northwest of **GbTn-2006-T2**.

GbTn-2006-T4 consists of two tapered bark-stripped cedar CMTs, one very clearly recent and the other cored and found to be approximately 100 years old.

Also in 2006, an Archaeological Overview Assessment (AOA) for developments proposed for Ridley Island, west of the existing coal ship loading facility (Cooper and Eldridge 2006) suggested that the study area had moderate potential to contain unrecorded CMTs, but had generally low potential for buried archaeological sites. A recommended AIA was completed in 2007, resulting in the recording of CMT site **GbTn-60** (Eldridge and Cooper 2007). **GbTn-60** is comprised of seven bark stripped cedar CMTs, six tapered and one rectangular. Two of the CMTs recorded as part of **GbTn-60** had already been recorded as site **GbTn-2006-T4** (see above). However, their generally large size suggested that they probably pre-date AD 1846, and they were registered with the Archaeology Branch.

In 2008, an AOA for the Prince Rupert Port Authority produced for the entirety of Ridley Island indicated that most of the island has low potential for archaeological and heritage sites of any kind. Nonetheless, areas of CMT potential were delineated by using air photos to identify areas of old growth forest and areas where cedar veterans may be present. Areas of low to high potential for archaeological sites were also identified, primarily within 100 m of the modern shoreline. However, a few inland areas were assessed as having moderate or high archaeological potential (Figure 14-2; Brunsden and Eldridge 2008).

In September, 2008, I.R. Wilson Consultants Ltd. (now Stantec) developed a chance find protocol in anticipation of geotechnical testing proposed for the Project. This document briefly summarizes the most common kinds of archaeological sites found on Ridley Island, and provides instructions to development personnel regarding how to proceed and who to contact if archaeological materials are encountered.

In early October, 2008, I.R. Wilson Consultants Ltd. monitored geotechnical backhoe testing along the proposed road, rail and utility corridor, and related brush- and timber-clearing activities. No archaeological deposits were identified during the monitoring of the geotechnical testing. However, four CMT sites were identified, consisting of seven CMTs overall. Two sites likely pre-date AD 1846 and were recorded with the Archaeology Branch. The remaining two sites post-date AD 1846 and are identified only by their temporary site numbers. All four sites were avoided by subsequent brush- and timber-clearing activities. These CMTs have not been reported on prior to this report.

GbTn-71 is located on the west coast of Ridley Island. It is comprised of a single tapered bark-stripped CMT. While this CMT was not directly dated, the depths of the healing lobes around the scar support the assertion that it is likely pre-AD 1846 in age.

GbTn-72 is located approximately 300 m inland of the east coast of Ridley Island. It is comprised of a single tested cedar CMT. As tool marks are consistent with the use of stone tools, not metal ones, this CMT is presumed to pre-date AD 1846.

GbTn-2008 T3, located on the west coast of Ridley Island immediately southeast of **GbTn-71**, consists of four bark stripped cedar CMTs.

GbTn-2008 T4, located on the east coast of Ridley Island near the north end of the island, consists of a single bark stripped cedar.

In late 2008, an AIA of terrestrial infrastructure planned in relation to the NaiKun Wind Energy project (Hall *at el*. 2009) resulted in the discovery of two new CMT sites. This study included the assessment of a transmission line right-of-way proposed for the south and east coasts of Ridley Island.

GbTn-93, consisting of four cedar CMTS (two bark-stripped and two kindling removal trees) is located along the east coast of the northern portion of Ridley Island. Observations regarding scar morphology, tree size, and forest stand characteristics suggest that the two tapered bark stripped CMTs likely pre-date AD 1846 (*ibid*.).

GbTn-95 is comprised of two standing tapered bark stripped cedars located on the eastern side of Ridley Island. The site is located along a pond created by a dyke built to support the Ridley Island ring road. Hall *et al.* (2009) infer that these CMTs pre-date AD 1846, based upon observations regarding healing lobe growth, scar morphology, forest stand characteristics and tree size.

As part of the geotechnical testing for the Project, core samples were extracted from submarine contexts off the west coast of Ridley Island in the summer of 2009, principally along the proposed trestle route. Four vibracore samples were extracted for archaeological purposes from underwater contexts shallow enough to have been sub-aerial or intertidal during the mid-Holocene low-stand in relative sea levels. These cores were analysed by I.R. Wilson Consultants Ltd. by wet-screening through 1/8 inch (3 mm) mesh but no archaeological deposits or materials were identified.

In 2010, Stantec (formerly I.R. Wilson Consultants Ltd.) conducted archaeological reconnaissance and monitoring to ensure that CMTs were not affected by the clearing of vegetation required to provide access for drilling equipment, or by the geotechnical borehole testing program conducted for the proposed Canpotex Potash Export Terminal.

Initial reconnaissance and monitoring was conducted in mid-March, 2010. Borehole drilling equipment access was achieved by constructing corduroy roads approximately 7.5 m in width. Subsequent borehole testing required the clearing of a space approximately 12 m in diameter at each testing location. All proposed corduroy road and borehole testing locations were visited ahead of and/or during the clearing of vegetation. The monitoring and inspection found no CMTs within the impact zones associated with proposed borehole testing or related access routes. In addition, the potential for CMTs in the areas was deemed to be low.

Fieldwork also found that most of the areas proposed for borehole testing consisted of water-saturated muskeg, except along the island’s coastal fringe. Intervening forested areas were typically moderately-undulating and poorly-drained. As the majority of the locations proposed for geotechnical testing were situated away from the coast of Ridley Island, there was generally low potential for buried archaeological deposits in the areas to be drilled. However, as five proposed borehole locations (boreholes BH-15 to BH-19) were assessed as having moderate to high archaeological potential, archaeological monitoring of these borehole tests was recommended.

Archaeological monitoring during drilling of boreholes BH-15 to BH-19 was carried out in late May 2010. No archaeological materials were identified, and no additional CMTs were noted. However, a small pocket of probable shell midden was identified in the west-central portion of Ridley Island in a road-cut exposure along the Ridley Island ring road. The stratigraphy of the identified deposit implies that it has likely been displaced and redeposited at this location by previous road construction or related earth-moving activities. Proposed Project developments will not further affect this pocket of midden.

Most recently, an AIA specific to the proposed Canpotex terminal footprint was completed (Hutchcroft 2011). The Project area was divided into terrestrial and intertidal areas. The intertidal survey was conducted by a three person crew, including two First Nations representatives, with individual crew members spaced at 5 to 10 m intervals, as depicted in Figure 14-3 (this figure also illustrates transect coverage from previous fieldwork within the entire Project footprint). During the 2011 AIA, one area of scattered surface shell was tested but no archaeological deposits or materials were encountered. No surface or subsurface cultural deposits or remains were encountered within the intertidal area. The terrestrial survey was conducted by three crew members individually spaced at 5 to 20 m intervals. Most of the terrestrial portion was found to be moderately undulating and saturated with water, although one small, flatter and slightly elevated landform was identified between the road and the beach. Five shovel tests were placed across this landform with no cultural deposits or remains identified. The entire terrestrial portion of the Project area was found to be characterized by a muskeg environment with some areas of standing water. The ground is predominantly flat with some small rises that are as poorly drained as the surrounding terrain. Forest cover is predominantly dwarf red cedar and pine forest where growth has been hindered by extremely high levels of ground moisture. No CMTs were identified during the survey.

The northern end of Coast Island and the low lying rock between Coast Island and Ridley Island will accommodate the offshore component of the Project. These areas have little to no soil development but were intensely surveyed during this AIA for rock art and other surface remains. No cultural remains were identified.

No archaeological sites were found in conflict with the proposed Canpotex terminal footprint and this portion of the Project area is concluded to have low archaeological potential.

In summary, several field studies have determined that, except for the portions of seven CMT sites identified in the vicinity of the proposed rail, road and utility corridor (Table 14-4), the Project footprint has low potential for any additional archaeological sites.

14.3 Effects Assessment

14.3.1 Assessment Methods

Information gleaned from the literature review, from Provincial archaeological and heritage site records, from previous field studies and from the Project-specific AIA was used to predict potential Project effects on archaeological and heritage resources.

The effects assessment discusses how Project activities might negatively affect archaeological and heritage resources (baseline conditions). Measures designed to minimize Project effects on archaeological and heritage resources are identified.

The following documents were used to help guide the assessment:

- The *Canadian Environmental Assessment Act* Reference Guide on Physical and Cultural Heritage Resources
- British Columbia Archaeology Branch's Archaeological Impact Assessment Guidelines.

Any effects remaining following mitigation (residual effects) are carried forward to the combined effects and cumulative effects assessment.

14.3.2 Destruction of Culturally Modified Trees

14.3.2.1 Potential Effects

During site preparation activities (e.g., clearing and grubbing, site grading), potential Project effects on Archaeological and Heritage Resources will include the destruction of CMTs. Fifteen CMT sites, consisting of 53 individual CMTs, have been identified on Ridley Island. Of these, seven CMT sites consisting of 18 CMTs are located near the proposed Canpotex terminal footprint and could be affected by development of the road, rail and utility corridor. These sites are **GbTn-60**, **GbTn-71**, **GbTn-72**, **GbTn-93**, **GbTn-95**, **GbTn-2008-T3**, and **GbTn-2008-T4**. Of the 18 CMTs, 11 are estimated to be pre-1846 AD in age.

It is possible that unrecorded CMTs will be encountered within the Project footprint. In the unlikely event that this occurs, work affecting these features will cease until the trees can be properly assessed by a consulting archaeologist.

14.3.2.2 Mitigation

Wherever possible, known or as-of-yet undiscovered CMTs occurring within the Project footprint will be avoided. As detailed in Section 14.2.4, there are no known CMTs within the Canpotex terminal footprint although several in adjacent areas have been recorded including 18 within the road and rail corridor. In situations where CMTs cannot be avoided, mitigation measures will focus on their complete, systematic recording. Specifically, this will involve:

- If stem round samples are to be collected, removal of the CMT will be monitored by a crew comprised of a professional archaeologist and a local First Nations representative to ensure that the stem-round samples are properly collected for CMT dating purposes.
- Where necessary, level II recording as outlined in the CMT Handbook (Archaeology Branch 2001) including the direct dating of CMTs by stem-round sampling.

14.3.2.3 Residual Effects

In the unlikely event that CMTs are found in conflict with proposed clearing and construction activities, residual effects will be adverse, low to moderate in magnitude, and site-specific in extent (Table 14-5). While the effects will occur only once, their duration will be long term and they will be irreversible. Given that there have been substantial previous disturbances to the Project area and the general area of Ridley Island, and since many of the forested portions of Ridley Island have already been logged (Brunsden and Eldridge 2008), it is likely that these effects will occur in a disturbed archaeological context.

14.3.2.4 Determination of Significance

The potential for development to conflict with unidentified CMTs is low. As a result, the probability of significant adverse residual effects associated with unrecorded resources is extremely low. With the implementation of the proposed mitigation measures, none of the information regarding traditional aboriginal forest use will be lost. Therefore, residual Project effects on CMTs are considered to be not significant (Table 14-5).

14.3.3 Disturbance or Destruction of Terrestrial Archaeological or Heritage Sites

14.3.3.1 Potential Effects

Archaeological studies have not identified any terrestrial sites within the Project footprint; however, it is still possible that such sites are present and could be damaged or destroyed by Project activities. Terrestrial archaeological and heritage sites include such resources located wholly or partially above the high tide line, excluding CMTs (which are discussed above). These sites may be evident on the ground surface or may be completely buried. Two terrestrial archaeological sites, **GbTn-18** and **GbTn-19**, have been recorded on Ridley Island. Both of these are shell midden sites located on the northwest coast of the island, outside of the Project footprint. Both of these sites have been largely or completely destroyed as a result of previous development.

Archaeological and heritage sites are non-renewable resources and are susceptible to alteration, damage and destruction by many types of development-related activities. For the scientific community, the value of these resources is not measured in terms of individual artifacts but rather in the information that is derived from the interrelationships of the individual artifacts and features, their spatial relationships and their context. The removal or mixing of sediments containing archaeological deposits results in the permanent loss of information fundamental to the understanding of these resources.

Project-related construction activities with the potential, however low, to affect terrestrial archaeological or heritage sites include clearing and grubbing, site grading and installation of services (see Table 14-1 for a complete list). Additionally, the removal of site infrastructure during decommissioning may affect terrestrial archaeological or heritage sites. These activities have the potential to affect terrestrial archaeological or heritage sites because they involve the disturbance or displacement of soils and sediments that may contain archaeological materials.

Activities related to the operations phase of the Project that may affect terrestrial Archaeological and Heritage Resources include the arrival and departure of vessels. Wave action created by vessel traffic may result in increased erosion of shoreline terrestrial archaeological or heritage sites.

In the unlikely event that a terrestrial archaeological or heritage site is identified within the Project footprint during ground altering activities, work affecting these sites will cease until they can be properly assessed by a consulting archaeologist.

14.3.3.2 Mitigation

Chance find protocol will be provided to the construction foreman to enable identification of any archaeological or heritage sites in the unlikely event that one is discovered. If a site is identified and it is in conflict with proposed Project activities and physical works, the preferred mitigative measure will be avoidance of these sites through Project redesign. Where site avoidance is not feasible or practical, adverse Project effects to significant terrestrial archaeological and heritage resources may be mitigated through a program of systematic data recovery (SDR). SDR studies are tailored to the project and to the archaeological and heritage sites in question, and commonly involve:

- Scientific excavation and recovery of some or all portions of the sites to be affected
- Collection and analysis of artifacts, faunal remains, botanical remains, and other archaeological remains
- Collection and processing of carbon samples for dating
- Completion of other appropriate specialized analytical processes (e.g., geochemical analyses of stone tools, blood residue analysis, etc.)
- Cataloguing of all collected artifacts and their subsequent curation in an approved facility.

Project conflicts with less significant terrestrial archaeological or heritage resources may also be mitigated through a program of archaeological monitoring carried out during development.

Where SDR is carried out, a detailed final report will be completed to ensure that the collected data and the results of all analytical processes are available to other archaeologists and First Nations. A copy of the report will also be submitted to the Archaeology Branch.

14.3.3.3 Residual Effects

Archaeological studies have not identified any terrestrial sites within the Project footprint. If terrestrial archaeological or heritage resources are unexpectedly identified in conflict with Project construction, operations or decommissioning activities, residual effects will be adverse, low to high in magnitude, and site-specific in extent (Table 14-5). While the effects will occur only once, their duration will be long term, and they will be irreversible. Because there have been substantial previous disturbances to the Project area and to Ridley Island generally, these effects may occur in a disturbed or an undisturbed archaeological context.

14.3.3.4 Determination of Significance

A Project-specific AIA has been completed with no terrestrial sites found. The potential for development to conflict with unidentified archaeological sites is low. As a result, the probability of significant adverse residual effects associated with unrecorded resources is extremely low. However, in the unlikely event that such sites are identified during development, effects will be mitigated through avoidance, systematic data recovery (where appropriate) and/or archaeological monitoring of development. Residual Project effects on terrestrial Archaeological and Heritage Resources are therefore judged as not significant (Table 14-5).

14.3.4 Disturbance or Destruction of Intertidal Archaeological or Heritage Sites

14.3.4.1 Potential Effects

Project construction activities may result in disturbance to or destruction of archaeological and heritage sites located in the intertidal zone. These activities include construction of the proposed marine facilities—the causeway and trestle—which may involve the disturbance or displacement of artifacts or features discovered within the intertidal zone.

Intertidal sites include all archaeological and heritage sites located wholly or partially within the intertidal zone. These sites are typically visible on the surface and may include lithic scatters and petroforms such as canoe skids, fish traps, and clam gardens. Like terrestrial archaeological and heritage sites, intertidal archaeological and heritage sites are a non-renewable resource, are susceptible to alteration, and may be damaged or destroyed by many types of development-related activities. The value of these resources lies in the information that is derived from the interrelationships of the individual artifacts and features, their spatial relationships, and their context. The removal or mixing of sediments containing archaeological deposits or the displacement of artifacts or features results in the permanent loss of information fundamental to the understanding of these resources.

Although no intertidal archaeological or heritage sites were identified during the 2011 AIA, it is possible, but highly unlikely, that unrecorded sites may be encountered. In the unlikely event that such sites are identified within the intertidal component of the Project footprint during ground altering activities, work affecting these sites will cease until they can be properly assessed by a consulting archaeologist.

14.3.4.2 Mitigation

A Project-specific AIA was conducted to provincial standards, as defined in the Province's *Archaeological Impact Assessment Guidelines* (Archaeology Branch 1998). This AIA included a careful survey for archaeological and heritage sites within the intertidal zone fronting the terminal footprint along the west side of Ridley Island. No sites were identified. This survey was carried out at low tide.

Chance find protocol will be provided to the construction foreman to enable identification of any archaeological or heritage sites in the unlikely event that one is discovered. If a site is identified and it is in conflict with the Project during development, the preferred mitigative measure will be avoidance of these sites through Project redesign. Where site avoidance is not feasible or practical, Project effects to intertidal Archaeological and Heritage Resources will be mitigated through systematic data recovery and/or detailed documentation of exposed features, as appropriate. Systematic data recovery studies are tailored to the project and to the archaeological and heritage sites in question. For intertidal Archaeological and Heritage Resources, systematic data recovery will likely involve:

- The adoption of wet site procedures using high-pressure hoses and a wet-screening process
- Mapping of the distributions of artifacts and features
- Surface collection of artifacts
- Detailed recording of intertidal features
- Systematic data recovery, as discussed in Section 14.3.2.2.

14.3.4.3 Residual Effects

No intertidal archaeological or heritage sites have been identified in the Project footprint. If intertidal archaeological or heritage resources are identified in conflict with Project construction activities, residual effects will be adverse, low to high in magnitude, and site-specific in extent (Table 14-5). While the effects will occur only once, their duration will be long term, and they will be irreversible. Because there have been substantial previous disturbances to the Project area and to Ridley Island generally, these effects may occur in a disturbed or an undisturbed archaeological context, depending on location.

14.3.4.4 Determination of Significance

A Project-specific AIA has been completed with no intertidal archaeological or heritage sites found. The potential for development to conflict with unidentified archaeological sites is low. As a result, the probability of significant adverse residual effects associated with unrecorded resources is extremely low. However, in the unlikely event that such sites are identified during construction and commissioning, effects will be mitigated through avoidance, systematic data recovery and/or detailed documentation. Residual Project effects on intertidal Archaeological and Heritage Resources are therefore judged to be not significant (Table 14-5).

14.4 Combined Effects and Overall Significance Determination

Results from Project-specific and previously completed archaeological studies on Ridley Island indicate that there are no terrestrial or intertidal archaeological or heritage sites within the Project footprint; however, 18 CMTs have been identified in possible conflict with the proposed road, rail and utility corridor. The potential for development to conflict with unidentified archaeological sites is low. As a result, the probability of significant adverse residual effects associated with unrecorded resources is extremely low. In the unlikely event that unrecorded sites are identified within the Project footprint during ground altering activities, residual effects are summarized in Table 14-5.

Mitigation techniques will be applied during each of the three Project phases to minimize residual effects on Archaeological and Heritage Resources. With the use of the proposed mitigation measures (i.e., completion of systematic data recovery studies and/or archaeological monitoring where unexpected Project effects cannot be avoided), none of the information regarding traditional aboriginal, terrestrial and intertidal use within the Project footprint will be lost. Project effects on CMTs, terrestrial and intertidal archaeological and heritage sites are therefore considered to be not significant.

Table 14-5: Assessment of Effects on Archaeological and Heritage Resources

Potential Residual Environmental Effects	Proposed Mitigation and Compensation Measures	Residual Environmental Effects Characteristics: Direction	Magnitude	Geographic Extent	Duration/ Frequency	Reversibility	Archaeological Context	Significance	Prediction Confidence	Likelihood	Recommended Follow-up and Monitoring
Effect 1: Destruction of CMTs											
Construction and Commissioning											
Preparation (Clearing and Grubbing, Site Grading)	▪ Avoidance of CMTs within or adjacent to the Project footprint where possible ▪ Equipping construction foremen with Chance Find Protocol ▪ Systematic recording, including stem-round collection, of all CMTs identified within the Project footprint	A	L/M	S	LT/O	I	D	N	H	L	None required unless undiscovered resources are identified during the construction phase
Effect 2: Disturbance or Destruction of Terrestrial Archaeological or Heritage Sites											
Construction and Commissioning											
Temporary Construction Infrastructure (trailers, power, sanitary facilities, etc.) Site Preparation (Clearing and Grubbing, Site Grading) Rail Loop Construction Onshore Terminal Construction (receiving, storage, reclaim and shiploading facilities, site services) 69 kV transmission line Construction Installation of Canpotex Rail Tracks Access Road/Overpass Construction Marine Facilities Construction (causeway, trestle, and berth)	▪ Equipping construction foremen with Chance Find Protocol ▪ Systematic recording of identified archaeological and heritage sites ▪ Additional mitigation by systematic data recovery and/or archaeological monitoring of development where warranted	A	L/H	S	LT/O	I	D or U	N	H	L	None required unless undiscovered resources are identified during the construction phase

Potential Residual Environmental Effects	Proposed Mitigation and Compensation Measures	Residual Environmental Effects Characteristics									Recommended Follow-up and Monitoring
		Direction	Magnitude	Geographic Extent	Duration/ Frequency	Reversibility	Archaeological Context	Significance	Prediction Confidence	Likelihood	
Operations											
Arrival and Departure of Vessels	▪ Systematic recording of identified archaeological and heritage sites ▪ Additional mitigation by systematic data recovery where warranted	A	L/H	S	LT/O	I	D or U	N	H	L	None required unless undiscovered resources are identified during the operations phase
Decommissioning											
Removal of Site Infrastructure (potash handling system/buildings)	▪ Systematic recording of identified archaeological and heritage sites ▪ Additional mitigation by systematic data recovery and/or archaeological monitoring of activities where warranted or appropriate	A	L/H	S	LT/O	I	D or U	N	H	L	None required unless undiscovered resources are identified during the decommissioning phase
Effect 3: Disturbance or Destruction of Intertidal Archaeological or Heritage Sites											
Construction and Commissioning											
Marine Facilities Construction (causeway, trestle, and berth)	▪ Equipping construction foremen with Chance Find Protocol ▪ Systematic recording of identified archaeological and heritage sites ▪ Additional mitigation by systematic data recovery and/or archaeological monitoring of development where warranted	A	L/H	S	LT/O	I	D or U	N	H	L	None required unless undiscovered resources are identified during the construction phase

KEY

DIRECTION:

(P) *Positive*: positive change compared to baseline status.

(N) *Neutral*: no change compared to baseline status.

(A) *Adverse*: negative change compared to baseline status.

MAGNITUDE:

(L) *Low*: effect is detectable but is limited to small portions of archaeological or heritage sites of low significance or to the portions of archaeological heritage sites already substantially disturbed by previous developments.

(M) *Moderate*: affects small but intact portions of archaeological or heritage sites of moderate or high significance, or substantial, intact portions of archaeological or heritage sites of low significance.

(H) *High*: affects substantial, intact portions of one or more sites of moderate or high significance.

GEOGRAPHIC EXTENT:

(S) *Site-specific*: limited to the Project footprint.

(L) *Local*: limited to the LAA.

(R) *Regional*: extending beyond the LAA.

DURATION:

(ST) *Short-term*: measurable for less than one month.

(MT) *Medium-term*: measurable for more than one month but less than two years.

(LT) *Long-term*: measurable for the life of the Project.

(P) *Permanent*: Effects are permanent.

FREQUENCY:

(O) Occurs *once*.

(S) Occurs *sporadically* at irregular intervals.

(R) Occurs on a *regular* basis and at regular intervals.

(F) Occurs *frequently*

(C) *Continuous*.

REVERSIBILITY:

(R) *Reversible*: effects will cease during or after the Project is complete.

(I) *Irreversible*: effects will persist after the life of the Project.

ARCHAEOLOGICAL CONTEXT:

(U) *Undisturbed*: there are no existing disturbances within the LAA.

(D) *Disturbed*: there are existing disturbances within the LAA.

PREDICTION CONFIDENCE:

Based on scientific information, professional judgment and effectiveness of mitigation

(L) *Low* level of confidence

(M) *Moderate* level of confidence

(H) *High* level of confidence

LIKELIHOOD:

Based on professional judgment

(L) *Low* probability of occurrence

(M) *Medium* probability of occurrence

(H) *High* probability of occurrence

SIGNIFICANCE:

(S) *Significant*: Project effects are unavoidable, and, even after mitigation measures are employed, cannot be adequately compensated for.

(N) *Not significant*: Where Project effects occur, they can be effectively mitigated though appropriate data collection

N/A *Not Applicable*

14.5 Cumulative Effects Assessment

Other projects in the LAA are known to have resulted in the loss or disruption of terrestrial and intertidal archaeological sites. Based on our assessment no such loss or disturbance is expected to occur as a result of the Project. However, eighteen CMTs have been identified as being in conflict with the road and rail corridor and will likely be lost. Prior to the removal of any CMT, it will be systematically recorded including collection of a stem round. As a result of this mitigation measure, there will be no significant loss of archaeological or heritage resources and therefore no residual effects. Though other projects may have affected this resource in the past, the lack of residual effects associated with the current Project means there is no potential for cumulative effects.

14.6 Follow-up Program

Due to the low probability that a previously unidentified archaeological or historical site will be found within the Project footprint it has been concluded that there is no need for follow-up. However, if a site is identified, archaeological monitoring and/or SDR studies will be completed. These studies may be implemented for a variety of specific Project construction and construction-related activities, as discussed in Section 14.3, and will ensure compliance with provincial heritage legislation if archaeological or heritage resources are discovered.

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14.8 Figures

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Client: Canpotex / Prince Rupert Port Authority	Job No.:	123110264	Fig. No.: 14-1	Stantec
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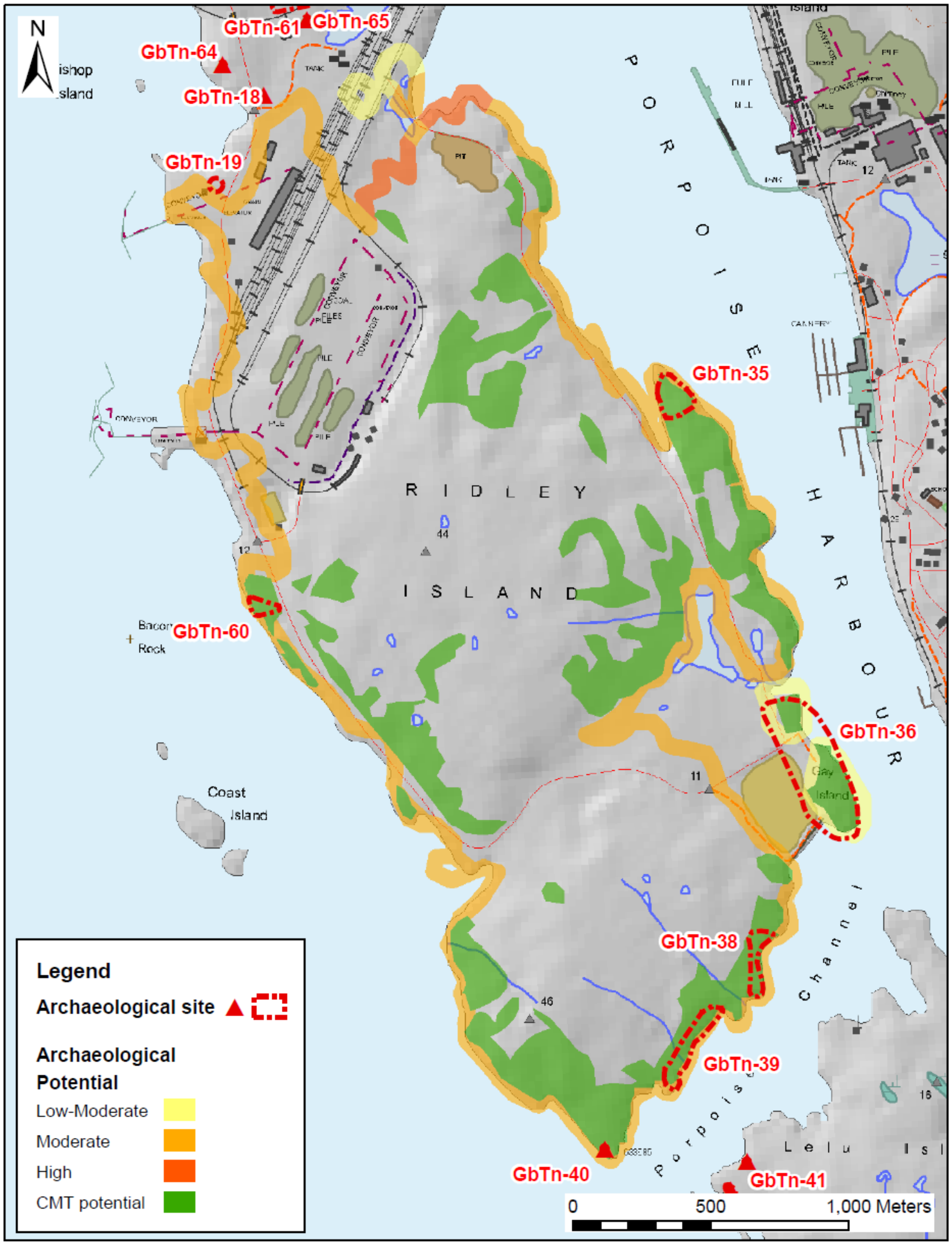
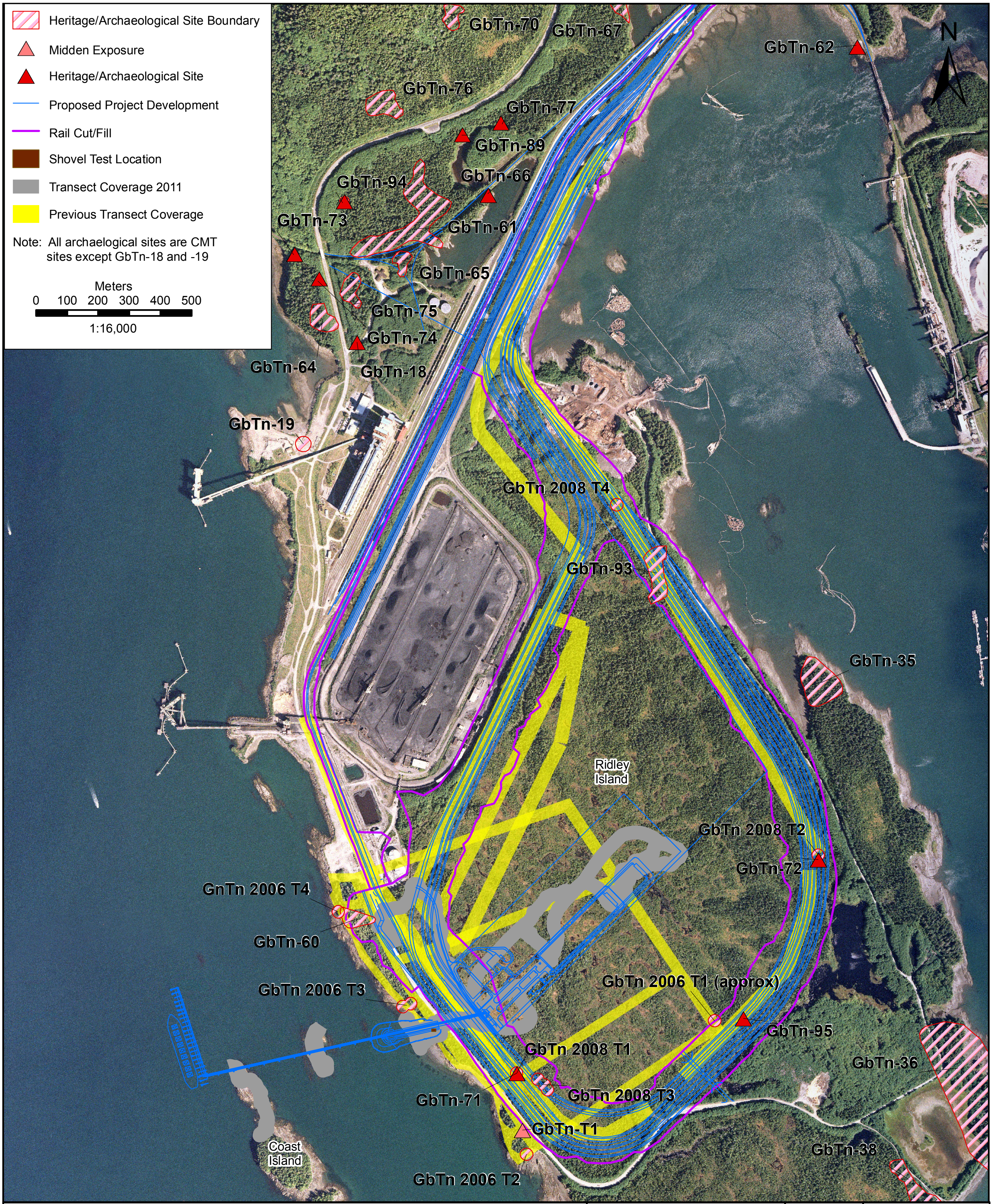
	Date:	14-Sep-11		
RECORDED ARCHAEOLOGICAL SITES ON RIDLEY ISLAND CANPOTEX AND PRINCE RUPERT PORT AUTHORITY RIDLEY ISLAND, BRITISH COLUMBIA	Dwn. By:	TC		
	App'd By:	SPK		



Source: Brunsden and Eldridge, 2008

Figure 14-2: Evaluation of the Archaeological Site Potential of Ridley Island, 2008



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Client: Canpotex, Prince Rupert Port Authority	Job No.: 123110264	Fig. No.: 14-3	Stantec
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AIA/AOA TRANSECT COVERAGE IN THE PROJECT FOOTPRINT CANPOTEX AND PRINCE RUPERT PORT AUTHORITY RIDLEY ISLAND, BRITISH COLUMBIA	Dwn. By: TC		
	App'd By: SPK		

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15 FIRST NATIONS CURRENT USE ASSESSMENT

This section provides an overview of First Nation communities and known related land and resource use within the Project's environmental assessment spatial boundaries, as well as a discussion of potential Project-related environmental effects on these resources. Other aspects of land and resource use are considered separately in the following VEC Sections: Aquatics (Section 12); Human Health (Section 13); Archaeology and Heritage Resources (Section 14); and Navigation (Section 16).

The Project spatial footprint is located within the claimed traditional territory of the Tsimshian Nations. Five Tsimshian First Nation communities claim Aboriginal Rights and/or interests in the Prince Rupert Harbour area to Kitaelas Canyon. These are:

1. Metlakatla First Nation (MFN)
2. Lax Kw'alaams First Nation (LFN)
3. Gitxaala Nation (GN)
4. Kitselas Indian Band (KIB)
5. Kitsumkalum Band (KB).

For the purposes of this report, the five Aboriginal groups named above will be referred to as the "Tsimshian" when referred to as a whole.

The information presented within this chapter is limited to publically and readily available Traditional Use (TU) information at the time of writing, and conclusions are based on that data as well as the professional judgment of the Project team. The First Nations communities have not made TU information directly available to the study team at the time of this writing despite requests by the project teams for this information.

15.1 Scope of Assessment

15.1.1 Regulatory/Policy Setting

Consultation with First Nations communities about land and resource use is an important consideration for the Project environmental assessment. The Project footprint lies within the claimed traditional territories of the MFN and the LFN, which are situated in the vicinity of Prince Rupert; however, the GN has also expressed interest in the area. The Project spatial footprint also lies within the area where KIB and KB may have Aboriginal Rights and interests. Potential environmental effects of the Project on these groups' claimed traditional territory, including current use of land and marine resources for traditional purposes is considered. Current use for traditional purposes refers to contemporary First Nations hunting, fishing, trapping and gathering activities for subsistence and use of lands and resources for social and ceremonial activities ("Traditional Current Use"). Selection of First Nations Traditional Current Use addresses the requirements under Section 16.1 of the CEAA to: 1) consider community knowledge and Aboriginal traditional knowledge in the EA process; 2) meets the requirements of Project Scoping Document; and, 3) addresses the CEAA definition of “environmental effect”, which includes “the current use of lands and resources for traditional purposes by Aboriginal persons.”

The Crown has a duty to consult any potentially affected First Nations where a decision may affect Aboriginal rights and interests, including resource use, to which they are entitled. The scope of the duty to consult varies depending on the nature and strength of the First Nations’ rights and interests affected and the potential effects of the proposed development on those rights and interests.

Often First Nations people hold information about traditional and current hunting, trapping, fishing, gathering, and other land uses that can meaningfully contribute to Project-related research and the environmental assessment process. First Nations can expect to be closely involved in Project planning where their traditional lands, communities, people, and culture may be affected.

A First Nations consultation process is ongoing with participation by the Project proponents (see Section 5.2 for details). The goals of this consultation process are:

- Identify First Nations concerns and interests related to the Project
- Address identified concerns and interests within the context of Project planning, assessment and design
- Provide Project mitigation where necessary, to address the adverse project impacts.

The Tsimshian have been informed of and have had the opportunity to participate in the Project’s consultation program and meetings with government representatives responsible for the environmental assessment process. This includes participation in the government led Working Groups. These opportunities will continue throughout the environmental assessment review process in addition to the consultation activities that are currently underway or planned. First Nations will also be consulted on the follow-up program (see Section 5.2, Consultation).

The PRPA and Canpotex are committed to ongoing consultation with the five identified First Nations, and to providing meaningful and effective opportunities for the First Nations to engage in the environmental assessment process. On July 8, 2011, requests were made to the First Nations to complete traditional use studies. To date no studies have been provided to the study team.

15.1.2 Key Issues

Activities associated with the Project may affect First Nations Traditional Current Use in the following ways:

- Project spatial boundary is located in an area subject to land claims and Traditional Use exists
- The Project may result in changes in access to traditional terrestrial and marine resources (navigation), and/or changes in the quality of those resources
- The Project may result in changes to culturally significant areas.

15.2 Baseline Conditions

The following section focuses on the publicly and readily available Tsimshian land and resource use information within the context of the Project location in the traditional territory of the MFN, LFN, GN, KIB and KB. It describes the baseline conditions within the defined spatial boundaries. As indicated in Section 3.4.2.1, the LAA consists of Ridley Island and along the shipping lane between Ridley Island and the pilotage station on Triple Islands. The RAA is the approximate boundary of the claimed traditional territory of the Tsimshian Nation extending south to Kitasoo, north to the mouth of the Nass River, and up to the Skeena River just east of Terrace. Where the marine environment is considered to be within a spatial boundary, available information on navigation will be provided.

Traditional Use/Traditional Knowledge (TU/TK) studies are the preferred means for determining past and current use of land and resources in a specific area. These studies can also be structured to gather information on other First Nations interests in the Project Area, concerns about a Project and to propose potential mitigation measures for Project effects.

While previous TU studies have been conducted for the MFN, Lax Kw'alaams, Gitxaala, Kitselas, and Kitsumkalum, almost all of the information from these studies was not available to the Project Team, despite requests for these studies. A copy of one final report of a study conducted by the Lax Kw'alaams as part of the BC Ministry of Forests (MOF) TU Program was available, but the maps showing specific TU sites were not and the report does not contain site specific information. Other Tsimshian groups also completed TU studies through the MOF program; however information from each of these studies is protected by an Information Sharing Agreement that limits the availability of the information to Provincial Government agencies. Other project-specific TU/TK studies have likely been produced by one or more of the Tshimshian groups considered in this document, but were not available to the Project Team at the time of writing, despite requests for such studies.

Canpotex is currently discussing options for TU/TK studies with the Gitxaala, Metlakatla and Lax Kw'alaams. Canpotex will consider information from these studies and incorporate it where possible into management plans.

In the absence of these studies, the baseline conditions for First Nations current uses for traditional purposes for this Project is described using the following information sources:

- Literature review:
  - Publically and readily available ethnographic and ethnohistoric literature. A large volume of materials related to Tsimshian culture and resource use is held at various archives and libraries that were not readily accessible at the time of writing and were therefore not reviewed.
  - Publically and readily available academic treatments of traditional and contemporary First Nations land use.
- Data collected and maintained by Aboriginal Affairs and Northern Development Canada (AANDC).

15.2.1 First Nation Territories, Communities, and Settlements

At the time of contact with Europeans, the Tsimshian people consisted of a number of linguistically and culturally related groups living along the banks and tributaries of the Skeena and Nass Rivers, as well as in the inlets and islands between these rivers' estuaries (as far south as Milbanke Sound). Their habitat included the coast, islands and river basins on both sides of the coast range region (Halpin and Seguin 1990; Garfield 1966).

The Tsimshian are commonly divided into three or four groups based on region and language. When divided into four groups the divisions are typically described as follows (Halpin and Seguin 1990):

1. **Coast Tsimshian** (on the lower reaches of the Skeena River and its adjacent coast; includes KIB, K, LFN and MFN)
2. **Southern Tsimshian** (on the southern islands and coast; includes Gitxaala)
3. **Nisga'a** (on the Nass River)
4. **Gitxsan** (upper reaches of the Skeena River and its tributaries, above the canyon at Kitselas).

Sometimes only three divisions are used. Under this classification the Nisga'a and Gitxsan are two distinct groups, but the Tsimshian form one large group (sometimes referred to as the Tsimshian proper or Coast Tsimshian) (Garfield 1966).

The Tshimshian language is distinct and not related to any other language of North America (however, a controversial theory asserts that Tsimshian is from a northwestern stock called Penutian). Therefore, while there are linguistic differences between the three or four Tsimshian groups, they are similar enough to be from the same language family (Halpin and Seguin 1990; Garfield 1966). The Coast Tsimshian language is Sm'algyax.

The culture and social organization of the Coast Tsimshian owes much of its complexity to the prolific salmon and eulachon runs which formed the economic basis of their lives and allowed for the amassing and redistribution of wealth often associated with a stable and secure food source. According to Anderson (2006), salmon "was the core economic resource for their opulent culture" which led to their "elaborate material culture and artistic traditions".

Eulachon was also an extremely valuable food and trade item for the Tsimshian, second only to salmon in importance. Certain studies have indicated that the Tsimshian trade in eulachon oil (or "grease") brought them great wealth. Some authors have held that Eulachon grease was so prized and renowned that trade routes called "grease trails" were used to widely distribute the product. These trails were used for other purposes, but the transport of eulachon grease was their primary function. Some of the trails were even developed into roads and highways. It is estimated that at least 23 major grease trails were used before and after contact with Europeans (Patterson 2005; Garfield 1966; Halpin and Seguin: 1990). We note that the Coast Tsimshian ancestral trade in eulachon grease was found recently by the Supreme Court to be "a limited ancestral trade in eulachon grease" (Lax Kw'alaams Indian Band v. Canada (Attorney General), 2011 SCC 56, para 32).

Other resources the Tsimshian have traditionally had access to include: seals and sea lions, shellfish, fish roe, several varieties of white fish and sea vegetables. They also had access to the land animals and plants on the islands and mainland in their territories (Anderson 2006).

The Coastal Tsimshian seasonal round was dictated by the seasonal runs of salmon, eulachon and herring. Sites used by the Tsimshian during their annual round included winter villages, eulachon fishing villages, summer villages, stopover sites, seaweed camps, hemlock and cedar gathering sites, hunting and fishing camps, burial sites, and defensive sites.

The winter was often a festive time, and much of the year's entertaining, dances and feasts took place from November to February. Potlatches were exclusively held in the winter. The coldest months of the year were also spent weaving, carving, gambling and storytelling. In February, March or April (before the ice broke) most people living in the winter villages moved to the Nass River to catch, dry or process the eulachon into oil on site. Once the eulachon was preserved people returned to their winter villages to store it (Garfield 1966; Halpin and Seguin 1990).

In the spring and summer food was gathered and preserved for trade, feasts and for sustenance throughout the winter months. Seal and sea-lion hunting were carried on throughout the year, although the majority of these species were taken during the spring and summer.

In the spring house groups moved to fishing villages on the lower Nass. May was a busy month as people moved to seaweed camps to:

- Gather and dry seaweed
- Fish and process halibut
- Gather herring spawn from eel grass, kelp or branches submerged in water
- Collect the inner bark of red cedar for weaving
- Collect the cambium of several species of trees for food.

Also in May, or early June, salmon started to run, and various species would continue to run through to October. Sea gull and oyster catcher eggs were gathered in early June. In the summer the Tsimshian moved to other fishing villages and gathered abalone during low tides, gather plants and pick berries.

Fall was another busy time as people worked hard to preserve salmon for the winter months. Once the salmon was prepared, hunting for the following game took place: deer, elk, seal, sea lion, sea otter, mountain goat, mountain sheep, bear, porcupine, raccoons, eagles, marmots, caribou, moose, mountain lion, hare, lynx, swan, geese, ducks and other waterfowl. While winter hunting was occasionally practiced, the greatest amount of time was spent collecting shellfish in and around the winter villages (including cockles, clams and mussels) (Garfield 1966; Halpin and Seguin 1990).

Before the settlement of European fur traders in their territories, Coastal Tsimshian winter villages were typically located on coastal beaches or alongside rivers. Garfield (1966) points out that there were about 25 of these villages in the nineteenth century noted by Europeans observers. However, Patterson (2005) states that there were 10 winter villages (and an additional eight seasonal villages) in Venn Passage (also known as Metlakatla Passage) of Prince Rupert Harbour alone.

Tsimshian house groups were compromised of matrilineal relatives. These house groups owned distinct territories and controlled the resources of the territories. A number of house groups comprised a local group which occupied a single permanent winter village (also referred to as a tribe). Territories shared by an entire village included shellfish beds and trading routes. Each house group also had seasonal villages and camps they used when travelling on trade routes and other trails, and when harvesting resources as part of the seasonal round (Garfield 1966; Anderson 2006; Halpin and Seguin 1990).

Ten separate groups of Coast Tsimshian had winter villages around the lower reaches of the Skeena River. This area is rich in archaeological evidence, particularly in the area in and around Prince Rupert Harbour, which has evidence of about 5,000 years of occupation. Once the Hudson's Bay Company established Fort Simpson at the site of what is now Port Simpson in 1834, nine Coast Tsimshian groups (the tenth being non-existent or absorbed into another group by 1834) moved their villages to the areas in and around the fort. Missionary William Duncan reported that there were 140 Tsimshian houses around Fort Simpson in 1857, with a total population of approximately 2,300 individuals. The nine groups later split into the Lax Kw'alaams (Port Simpson) and Metlakatla Bands (Halpin and Seguin 1990).

The historic Southern Tsimshian village of the Gitxaala was abandoned somewhere between 1860 and 1887 when its citizens followed Duncan to the mission village of Metlakatla, which he established to remove his Tsimshian congregation from what he considered to be the bad influences of the settlers at Fort Simpson. However, 27 Gitxaala people left Metlakatla in 1887 when following a disagreement with his church, Duncan moved his congregation once again, this time to a site in Alaska that was called New Metlakatla. In the meantime, the 27 Gitxaala returned to their own territory and established the present community of Kitkatla. To this day there are Tsimshian descendants living at New Metlakatla (Halpin and Seguin 1990).

Two other groups of Coast Tsimshian are the KIB and KB, who are sometimes referred to as Canyon Tsimshian. The KIB occupied two winter villages on either side of the Kitselas Canyon while the KB lived to the west of the KIB near the mouth of the Kitsumkalum River (Halpin and Seguin 1990).

Each winter village typically had populations of less than 100 individuals, but may have been as many as 500 people in some cases. Once Europeans began settling in the area and the Tsimshian moved their winter villages to be closer to Fort Simpson, many former winter villages became seasonal villages for fishing, hunting and plant gathering. The new winter villages were usually camps that had previously been used for seasonal resource gathering (Anderson 2006).

Although European explorers are first recorded in the Tsimshian territory in the 1770s, the first people of European descent did not settle in the area until the establishment of Fort Simpson (present day Port Simpson) in 1834. Various enterprises were later set up in the area, including freighting, trading, a fish saltery and a cannery. During this time the Tsimshian economy absorbed huge quantities of trade goods and Chiefs vied for exclusive trading rights, and sought to control access to their interior trading partners. In the 1860s the Tsimshian participated in the Cariboo gold rush by transporting people and their freight up the Skeena.

Few non-natives actually lived in Tsimshian territory until additional canneries were built in the early 1870s in the areas around the Nass and Skeena Rivers. At first the Tsimshian were the primary workforce, but later Chinese and Caucasians were brought in for seasonal work. This influx of strangers into their territories resulted in tensions and the government began establishing Indian Reserves and began allowing pre-emptions to settlers of European descent (Anderson 2006). This change eventually resulted in the series of events that led to the social and economic setting of Tsimshian people today.

15.2.2 Community, Social, and Economic Setting

The information contained in this section was almost exclusively gathered from internet sources. The amount and types of available information varies with each community; therefore, there is more information provided here for some communities than others.

MFN, KIB, and KB are part of the Tsimshian First Nations Treaty Society (TFNTS). LFN and GN were formerly part of this treaty group until 2004; however, they withdrew from the process after talks were suspended. LFN later re-entered the treaty process represented by the Allied Tribes of the Lax Kw'alaams (BCTC 2011). The GN currently does not participate in the BC Treaty Process.

15.2.2.1 Metlakatla First Nation

MFN is a small community located at Metlakatla Pass, 5 km west of Prince Rupert, on the Tsimshian (Tsimpsean) Peninsula (MARR 2011). Traditionally this was the site of the winter village for the tribes of the Lower Skeena. In 1862, an Anglican lay minister, William Duncan, established an Anglican mission which served as a central meeting place for the local tribes. By 1879 the population of MFN grew to about 1,100; however, by 1983 those numbers had dwindled to about 117 (Metlakatla First Nation 2010). Recent statistics show that with a registered population of 837, there are only 99 people living on-reserve at Metlakatla for a total of about 89% of the population living off-reserve (AANDC 2011). However, it has been noted that a large majority of those members living off-reserve live in Prince Rupert, within Metlakatla traditional territory (Metlakatla First Nation 2010).

There is limited Statistics Canada (2006) data available for the Metlakatla First Nation. In 2006, there were 30 private dwellings occupied by residents, of which 25 (83%) were owner-occupied. The majority of housing (83%) was constructed before 1986, and 33% of the dwellings required major repairs. Labour force activity revealed a 28.6% unemployment rate in Metlakatla compared to the provincial average of 6% (Statistics Canada 2006). The three top job sectors that employed MFN members participated in at the time of the 2006 census are public (53.66%), "other" (19.51%) and fisheries (17.07%) (Skeena Native Development Society 2006).

MFN is part of the Tsimshian First Nation Treaty Society for its treaty negotiations with the British Columbia Treaty Commission (BCTC). They are currently in Stage 4 of the 6-stage process (BCTC 2011).

The Metlakatla Governing Council is the representative government of the Metlakatla people. It is comprised of an elected chief and six councilors who serve three-year terms. The council serves as the governing body for the band and as an administrative unit for social services (Metlakatla First

Nation 2010). The council also oversees nearly 3,500 ha of land on 16 reserves. In December 2003, the MFN signed an agreement with the Province for $1.725 million in revenue sharing and access to 210,000 cubic meters of timber (MARR 2011). In 2004, MFN engaged in the preliminary stages of development for a strategic land and resource management plan and in 2006 signed the North Coast Land and Resource Management Plan with participating stakeholders. Later they negotiated and signed the Land and Resource Protocol Agreement with the Province of British Columbia and the Coastal First Nations to provide for land use planning agreements across Central and North coast BC (Metlakatla First Nation 2010).

A Forest Consultation and Revenue Sharing Agreement (FCRSA), providing a First Nation community with economic benefit based on harvesting activities in their traditional territory, was signed by the MFN and the Province on April 26, 2011. The Agreement recognizes MFN interests within their traditional territory and is intended to assist in achieving stability and certainty in forest resource development on Crown lands within the claimed traditional territory of the MFN and provides for a revenue sharing contribution of $241,550 (MARR 2011).

The Metlakatla Fisheries Program (MFP) is responsible for overseeing marine resource activity (assessing and reviewing management plans, policies and regulations including environmental and habitat protection) in Metlakatla territory and for administering the Aboriginal Fisheries Strategy agreements with the Department of Fisheries and Oceans. As of 2010, the MFP was responsible for research and monitoring of abalone, food social ceremonial fisheries (salmon, halibut, clams), roe on kelp, bird by-catch, crab, impact of remediation efforts for salmon habitat on the Ecstall River, and eulachon survey on the Ecstall River. In 2010, MFN began working on a Metlakatla Marine Use Plan to help inform stewardship and marine development activities in the Metlakatla area (Metlakatla First Nation 2010).

The Metlakatla Development Corporation (MDC) is the business arm of the Governing Council. The MDC was established in 1989 and overseas the communities economic activity including: the Metlakatla Ferry Service, Seashore Charters, Grassy Bay Services, North Co-Corp, Commercial Marine Harvest, the First Nations Training and Development Centre, and the Islander Hall (Metlakatla First Nation 2010).

15.2.2.2 Lax Kw'alaams First Nation

Lax Kw'alaams is located at Port Simpson, approximately 30 km northwest of Prince Rupert (MARR 2011). In 1834, a Hudson's Bay Company trading post was established at Fort Simpson (present day Port Simpson). In 1836, after a devastating smallpox epidemic that reduced the Tsimshian population by about 80%, Anglican missionary William Duncan moved approximately 350 Tsimshian people from Fort Simpson to establish a mission at Metlakatla (Lax Kw'alaams Band 2011). Recent statistics show that of the registered population of 3,394, there are 728 people living on-reserve, for a total of about 80% living off-reserve (AANDC 2011). Statistics Canada (2006) census information revealed that in Lax Kw'alaams there were 229 private dwellings occupied by residents in 2006, of which 220 (96%) were owner-occupied. No additional data was available for this community. In 2006 unemployment in Lax Kw'alaams was listed at 73.3%. Of the Lax Kw'alaams member participating in the labour force, 57.89% were employed in the public sector, 30.08% in fisheries and 9.77% in "other" (Skeena Native Development Society 2006).

LFN is negotiating independently with the BCTC in the treaty process. They are currently in Stage 2 of the 6-stage process (BCTC 2011). LFN initially entered the treaty process with the six other bands of the Tsimshian Tribal Council in 1994. After treaty negotiations were suspended in 2004 and LFN were subsequently excluded from the group process, LFN submitted a separate Statement of Intent which was accepted by the BCTC in 2005 (MARR 2011).

LFN`s elected council consists of a Chief Councilor, Deputy Chief and 10 councilors whose terms are not to exceed four years. Chief and Council manage nearly 11,900 ha of land on 78 reserves (MARR 2011). Band administration oversees available jobs from band businesses, trades, fisheries, forestry, education, port development, Ridley terminals, containment fisheries, the PNG development corporation, and the Lax Kw'alaams resort centre (Lax Kw'alaams Band 2011).

In May of 2003, Lax Kw'alaams was involved in the Tsimshian Accord which received provincial and federal funding of $737,352 to support cruise-ship tourism opportunities and development of a shellfish aquaculture business. In October 2003, LFN signed a forestry accommodation agreement with the Province, giving the First Nation access to 650,000 cubic meters of timber and $6.85 million in shared revenue over five years. In September 2005, the Province paid $3.1 million to the Coast Tsimshian Resources Limited Partnership (the LFN business entity) for the return of harvesting rights totaling 120,782 cubic meters in Tree Farm License #1 in northwestern BC (MARR 2011). Currently, Coast Tsimshian Resources LP holds three forest tenures in northwest British Columbia with an Allowable Annual Cut of over 550,000 cubic metres. Additionally, LFN owns a large fish processing plant which is run by the band (Lax Kw'alaams Band 2011).

15.2.2.3 Gitxaala Nation

GN is located in Kitkatla on Dolphin Island, near Porcher Island, on BC's north coast (Gitxaala Nation 2011). Recent statistics show that with a registered population of 1,835, there are only 449 people living on-reserve, for a total of about 88% living off-reserve (AANDC 2011). Statistics Canada (2006) census information revealed that in 2006 there were 75 private dwellings at Kitkatla, 17 of which were occupied by residents in 2006. In 2006 unemployment in Kitkatla was listed at 80.17%. The top three job sectors that Gitxaala members were employed in at that time were public (63.93%), fisheries (27.87%) and "other" (4.92%) (Skeena Native Development Society 2006).

In September 2004, Gitxaala First Nation signed an agreement with the Province for $3.985 million and access to 375,000 cubic meters of timber (MARR 2011).

Gitxaala Environmental Monitoring (GEM) is an agency representing the interests of the GN in matters pertaining to the environmental assessment process. GEM has been or is currently involved with environmental assessments for the Fairview Port expansion, NaiKun Wind Farm, and Enbridge Northern Gateway and other projects including Banks Island North Wind Farm and Mount McDonald (Rupert Peace Power) Wind Farm. Additionally, GEM is involved with the production of a Gitxaala Use and Occupancy Study for the NaiKun Wind Farm (GEM 2011).

15.2.2.4 Kitselas Indian Band

The main village of KIB First Nation is located at Kitselas, on the Skeena River, east of Terrace (MARR 2011). Recent statistics show that with a registered population of 554, there are only 266 people living on-reserve for a total of about 46% living off-reserve (AANDC 2011). Statistics Canada (2006) census information revealed that in Kitselas (Kshish Reserve # 4), there were 14 private dwellings, seven of which were occupied by residents in 2006. However, between 2005 and 2011, Kitselas Nation built 63 homes which enabled the return of approximately 252 band members (Kitselas 2011), and almost doubled the on-reserve population in six years. 2006 census statistics provided by the Skeena Native Development Society (2006) show that Kitselas had a 60% unemployment rate that year. At that time employed KIB members were primarily employed in the public (64/58), "other" (20.83) and forestry sectors (10.42).

KIB participate in treaty negotiations through the Tsimshian First Nation Treaty Society. They are currently in Stage 4 of the 6-stage process (BCTC 2011).

KIB Chief and four Council members are elected every two years and provide guidance and governance to the Kitselas Administration as well as answering to the Committee to Council on matters of community importance (Kitselas 2011). They also oversee approximately 1,100 ha of land on nine reserves. In January 2004, KIB and KB signed an agreement with the Province of BC for $1.2 million and $1.59 million of revenue sharing, respectively, and a direct invitation from the Minister of Forests to jointly apply for a forest license of 300,000 cubic meters. A Forest Consultation and Revenue Sharing Agreement (FCRSA), providing a First Nation community with economic benefit based on harvesting activities in their traditional territory, was signed by KIB and the Province on April 26, 2011. This provides for a revenue sharing contribution of $170,937 (MARR 2011). KIB, along with 35 other signatory Bands across Canada, is involved with the Framework Agreement on Land Management (1996). This agreement allows for exclusive management of Reserve lands and resources independent of the Crown (Kitselas 2011).

KIB have developed a National Historic Site in the Kitselas Canyon consisting of four long houses with artifacts and totem poles and an interactive, interpretive trial. Regular tours of the site are available between June and September. KIB also make their community hall available to rent (Kitselas 2011).

15.2.2.5 Kitsumkalum Band

Kitsumkalum is located 5 km west of Terrace, in northwestern BC (MARR 2011). In 1895, there were 66 people officially registered at Kitsumkalum and 98 were on the Band list of 1916 (McDonald 1990). Recent statistics show that with a registered population of 677, there are 219 people living on-reserve at Kitsumkalum for a total of about 70% living off-reserve (AANDC 2011). It is noted that most of the population lives within the greater traditional Kitsumkalum territory, but also in Prince Rupert, Port Edward and other areas of Canada (Kitsumkalum First Nation 2011). Information collected in 2006 by Statistics Canada indicates that in Kitsumkalum there were 85 private dwellings occupied by residents in 2006, of which 70 (82%) were owner-occupied. Sixty-five percent of the dwellings were constructed before 1986, and 35.3% of the dwellings required major repairs. Labour force activity revealed a 28% unemployment rate in Kitsumkalum, compared to the provincial average of 6% (Statistics Canada 2006). However, the Skeena Native Development Society (2006) reported that there was a 50.42% unemployment rate in the community of Kitsumkalum in 2006. The society also reported that of the employed KB population at that time, 51.32% were employed in the public sector, 28.95% in the "other" sector and 10.53 in fisheries.

KB are part of the Tsimshian First Nation Treaty Society for their treaty negotiations. They are currently in Stage 4 of the 6-stage process (BCTC 2011).

KB administration consists of six Councilors elected every two years and one Chief Councilor elected under separate ballot. KB administration provides for municipal services and delivery of social, educational, and developmental programs (Kitsumkalum Band 2011). Additionally, the council oversees nearly 561 ha of land on three reserves. In January 2004, KIB and KB signed an agreement with the Province for $1.2 million and $1.59 million of revenue sharing, respectively, and a direct invitation from the Minister of Forests to jointly apply for a forest license of 300,000 cubic meters. A Forest Consultation and Revenue Sharing Agreement (FCRSA), providing a First Nation community with economic benefit based on harvesting activities in their traditional territory, was signed by the KB and the Province on May 11, 2011. The Agreement recognizes KB interests within their traditional territory and is intended to assist in achieving stability and certainty in forest and/or range resource development proposed within the claimed territory. This provides for a revenue sharing contribution of $222,448 (MARR 2011).

The Kitsumkalum Economic Development Office (EDO) was established to provide recommendations on First Nation economic development including the promotion of local, entrepreneurial business ventures. Some of these include the House of *Sim-oi-ghets* arts and crafts gift shop, hall rental, Kitsumkalum Tempo Gas Bar, Rock Quarry Sales, Boat launch and RV Park, and Kalum Ventures Ltd (Kitsumkalum First Nation 2011).

15.2.3 Tsimshian Traditional Land and Resource Use Activities

15.2.3.1 Land Ownership

As described in Section 15.2.1, house groups organized on matrilineal lines owned and controlled resources of distinct territories. Use of these territories traditionally came under the direction of the hereditary chiefs and spokesmen, and certain authors note exclusive ownerships of the territories were recognized (Anderson 2006; Halpin and Seguin 1990). Anderson (2006) notes that with territorial ownership came the rights to:

- Exclude others
- Use and allocate resources
- Alienate their own title in extreme circumstances, such as compensation to avoid war
- Incorporate a related group into their village
- Share resources in return for pay.

Generally, a Tsimshian person who did not belong to a group could enter the exclusive territories only with the consent of the hereditary chiefs and spokesmen. Individuals who married-in attained rights to live upon and use territories belonging to the house into which they had married. The Tsimshian attempted to assert their concept of ownership when their territories began to be settled by non-natives. For example, they tried to exclude canneries from harvesting their fish and “demanded payment for allowing fishing in their streams (Anderson 2006; Halpin and Seguin 1990).

While house groups had seasonal villages and camps, permanent winter villages were occupied by a number of house groups (also referred to as a tribe). The Coast Tsimshian had summer villages on the lower Skeena River and winter villages around the Prince Rupert Harbour area. Ownership of these sites was recognized (Anderson 2006; Halpin and Seguin 1990). The boundaries of larger tribal territories could be marked by an entire watershed inland, and include seasonal villages, camps and resource harvesting sites on the coast (Anderson 2006).

House groups also controlled access to resources. Fishing sites were under the control of the houses and managed by Chiefs. Each house controlled several different fishing stations to ensure each had access to all five salmon species found in Tsimshian waters. This system helped ensure that people did not starve if one species’ run failed. Women harvested berries in their house territories. House chiefs also granted permission to use hunting territories (Halpin and Seguin 1990).

The tribal level of organization controlled other types of resource sites, such as shellfish beds and trading partnerships. These trading partnerships were well established and controlled, and were sometimes exclusive monopolies; however, groups could pay tribute to join a trading party (Anderson 2006).

15.2.3.2 Resource Use

This assessment is based on readily available data at the time of writing and, given the absence of Project-specific TU or TK studies from interested First Nations, is necessarily limited. While area-specific TU information may be available in ethnographic notes in archives and libraries in Canada and the United States, the research of these sources is beyond the scope of this review. In the absence of this information (and Project-specific TU/TK studies), a supplemental review of key ethnographic and archaeological sources was conducted. It is recognized that absence of available information does not necessarily indicate absence of use. Consultation with interested First Nations, including confirmation of potential interests, is ongoing. Refer to Section 5.2 for a consultation plan for anticipated engagement activities with interested First Nations.

Ridley Island lies off the south end of Kaien Island on which the city of Prince Rupert is located. Between Ridley Island and the mainland to the east are the protected waters of Porpoise Harbour. To the west are the semi-open waters of Chatham Sound, with Hecate Strait beyond. This section provides a review of villages and resource use in the Prince Rupert Harbour area.

The Tsimshian used the north end of Ridley Island prehistorically as a marine resource harvesting site. This area was primarily a winter village site with at least some people occupying it year-round. Remains of mussel, native oyster, rock scallop, chiton, welk, cockle, horse clam, little neck clam, butter clam, and sea urchin, a variety of fish species including salmon, herring, dogfish, cod, halibut and eulachon, and sea mammal have been found at the site.

A map provided in a report with unknown authorship written on behalf of LFN and MFN depicts Ridley Island as a "CMTs, Planks, Bark harvesting area." In MacDonald's (2009) discussion of the various early maps of the Prince Rupert Harbour, he noted that William Duncan provided the first maps of the harbour "which detailed the use of a number of sites along the Kaien Island shoreline between the Fairview Co-op site and Ridley Island". Duncan also provided sketches dated to circa 1862 of the indigenous uses of resources in the area.

Culturally modified trees (CMTs) are any trees having evidence of human modification. More specifically, CMTs are trees that have been modified by aboriginal people for traditional purposes such as removal of bark or wood for traditional building materials. Provincial guidelines suggest most CMTs should be recorded as traditional use sites unless they pre-date AD 1846. There are 15 CMT sites recorded on Ridley Island. Many of these are dated to, or presumed to date to, periods prior to 1846 and are discussed in Section 14: Archaeological and Heritage Resources.

It is unknown if the practice of shellfish and tree harvesting continues in practice presently on Ridley Island. According to an AOA (Cooper and Eldridge 2006) and an AIA (Eldridge and Cooper 2007) conducted by Millennia, shellfish and other marine resources are not currently abundant on the intertidal zones around Ridley Island. This is surmised to be due to the Island's close location to the freshwater outflow of the Skeena River resulting in poorly suited habitat for many of these resources.

First Nations have traditionally utilized the waters around Ridley Island for fishing resources, but the exact locations of these areas were not known at the time of writing. TU/TK studies focusing on the areas around Ridley and Triple Islands would likely yield more information on site types and locations.

As part of the protection of existing shipping lanes within the Harbour, the PRPA has established a Fishing Exclusion Zone, which includes the waters around Ridley Island. Harvesting of resources is restricted within the Fishing Exclusion Zone in the following ways (PRPA 2008):

- Fishing activities with the use of nets, traps or floats are restricted within the inner Prince Rupert Harbour within 100 m of any berth, jetty, float, or other structure used by watercraft.
- Approval from the Authority is required for fishing within the inner Harbour, and if approval is granted, nets must be attended at all times after they are deployed.
- Crabbing is not permitted anywhere in the Harbour that could constitute a navigational or safety hazard.
- Shellfish harvesting is prohibited within 300 m of industrial municipal and sewage treatment plant outfall discharges and within 125 m of marinas, wharves, finfish net pens, float homes or other floating living accommodation facilities, including live aboard boats (DFO 2008).

The Fishing Exclusion Zone currently in place does not preclude recreational or subsistence fishing, particularly with a line and hook. Recreational or subsistence fishers can obtain permits from the PRPA to fish within the inner harbour if the fishing does not interfere with navigation.

15.2.4 Known Heritage Sites

In addition to the sites discussed above in Section 15.2.3.2 ancient accounts describe settlements in the area between the mouths of the Skeena and Nass Rivers. The earliest villages recorded are at Gadu, or Ganax, an area which includes present day Kaien Island, Digby Island, and the mainland and islands in Metlakatla Pass, and the ancient settlement of Tsaos on Stephens Island.

Seventeen heritage sites, including both archaeological and traditional use sites, have been identified on Ridley Island. All of these sites are either shell middens or culturally modified trees (CMTs). CMTs that have the potential to be affected by the proposed Project are described below.

15.2.4.1 Culturally Modified Trees

Post-1846 CMTs with the potential to be impacted by Project development include GbTn-2008-T4 (see Archaeological and Heritage Resources, Section 14), GbTn-2006-T1 (Streeter 2006), GbTn-2008-T3 (see Archaeological and Heritage Resources, Section 14), and GbTn-60 (Eldridge and Cooper 2007). GbTn-2008-T4, located on the east coast of Ridley Island near the north end of the island, consists of a single bark stripped cedar. GbTn-2006-T1 is a single, dead western red cedar kindling removal tree located approximately 800-m inland from the west coast of Ridley Island. Apparent axe marks suggest its recent age. GbTn-2008-T3, located on the west coast of Ridley Island, consists of four bark stripped cedars. GbTn-60, located on the west coast of Ridley Island is a site consisting of seven CMTs, two of which have post-1846 features.

15.2.5 Land Use Planning and Objectives

MFN, along with other First Nations on the northwest coast of BC (Gitga'at, Haida, Haisla, Heiltsuk, Kitasoo/Xaixais First Nations, Old Massett Village Council, and Skidegate Village Council), has signed a General Protocol Agreement on Land Use Planning with the Province of BC. This agreement recognizes the commitment of all parties to work together to resolve land use conflicts and implement interim measures to provide First Nations with cultural and economic benefits arising from land use decisions. The Port is under federal jurisdiction; as such, the PRPA, an agent of the federal Crown, is committed to maintaining dialogue with the appropriate First Nation communities on PRPA's prospective land use plans.

15.3 Effects Assessment

15.3.1 Assessment Methods

This section discusses the potential effects on First Nations current uses for traditional purposes of the Project area as identified in the literature sources available for review at the time of writing. The effects assessment involves a discussion of how Project activities might adversely affect First Nations Current Traditional Use (baseline conditions). Measures designed to minimize Project effects on First Nations Current Traditional Use will be identified. Any effects remaining following mitigation (residual effects) will be carried forward to the combined effects and cumulative effects assessment.

The following documents will be used to help guide the assessment:

- The *Canadian Environmental Assessment Act*
- Considering Aboriginal traditional knowledge in environmental assessments conducted under the *Canadian Environmental Assessment Act – Interim Principles.*

15.3.2 Changes to Current Traditional Use Patterns

Vegetative resources (e.g., bark, berries) will be affected and will either be removed or inaccessible in the immediate Project area. Freshwater and marine resources (e.g., fish, shellfish) will also be affected or inaccessible. However, the general availability of First Nations traditional resources in the areas adjacent Project area are not expected to diminish and alternative locations to carry out traditional activities exist nearby. It is expected that members of nearby First Nations communities will be able to reasonably continue any traditional resource use activities; however, locations of these activities may change to areas which are outside of the Project footprint, at least temporarily (i.e., until post-construction in some instances).

15.3.2.1 Potential Effects

Construction and Commissioning

Project construction activities have the potential to alter or destroy vegetation, wildlife, and marine resources and heritage sites which could in turn affect First Nation Current Traditional Use. However, limited wildlife exists on Ridley Island and access for hunting is currently limited by the PRPA for safety reasons and, to the extent impacts exist, mitigation measures will be implemented to limit effects on wildlife and vegetation that may be of cultural importance to First Nations for traditional harvesting activities.

Access to the Project site and immediate marine area will be restricted, limiting access by the Coast Tsimshian to this part of their claimed traditional territory. Construction activities will involve restriction of access to terrestrial and near shore marine habitats for First Nation resource users. Disruptions are expected to occur in all locations of development and access to these areas will continue to be prohibited. Mitigation measures identified for Archaeological and Heritage Resources (see Section 14) will minimize any adverse effects.

On-shore site preparation involves removal of vegetation and creates new forest edges along the outer perimeter of the Project area. Vegetation clearing will result in the loss of plants, herbs, or berries that may have been traditionally harvested by First Nation communities. Invasive plant incursions often coincide with the creation of forest edge habitat and can threaten local herb and shrub plants. In-water marine dredging and disposal activities may lead to mortality of inshore fish and invertebrates as a result of sedimentation and potential sediment smothering. No intertidal archaeological or heritage sites were identified during a recent AIA of the Canpotex Potash Export Terminal (Hutchcroft, 2011). It is unlikely that an unrecorded site would be encountered.

Operations

The effects of the Project operation will be similar to those for construction with potential disruption of access and traditional use of Tsimshian claimed traditional territory. Regular facility operations and maintenance and repairs to dock facilities have the potential to affect First Nations Traditional Current Use during the Operations phase. This will also occur as a result of the Fishing Exclusion Zone in effect within 100 m of a jetty or where it may directly interfere with shipping navigation.

Decommissioning

The Terminal is expected to be a permanent facility; that is, it is expected to be in use until a time it is deemed necessary to be decommissioned. However, in the event that the Terminal is decommissioned, a Decommissioning Plan will be prepared and all activities associated will be conducted in accordance with applicable regulations of the time, including requirements for consultation with First Nations. All decommissioning activities are expected to be contained within the Project footprint. If the Terminal is decommissioned, it could lead to an increase in the availability of resources for traditional use purposes.

15.3.2.2 Mitigation

Mitigation for the loss or disturbance of culturally significant areas in the Project development area are presented in the Section 14 (Archeology and Heritage Resources) and includes information from Archaeological Impact Assessments to identify and describe archaeological sites. In cases where Project activities cannot avoid CMTs, stem round samples will be collected and recorded prior to CMT removal. In the unlikely event that intertidal heritage sites are identified within the Project footprint, work affecting those areas will cease until a qualified archaeologist and the First Nations are consulted. Avoidance of such a site is the preferred mitigative measure. Where this is not feasible or practical, mitigation will follow a detailed plan of systematic data recovery (described in Section 14).

Other mitigation strategies include:

- A marine habitat compensation plan to offset any loss of fish habitat.
- Vessels will remain within designated shipping lanes.
- Where possible traditional use plants will be used for replanting.
- Canpotex and the PRPA have offered accommodation to compensate for loss of access to the project site.
- Offset loss of wildlife habitat through development of a wetland compensation plan as determined through consultation with CWS.

15.3.2.3 Residual Effects

Potential Project effects to First Nations Traditional Current Use during construction, that may exists, are expected to be continuous while the duration of the effect is expected to be medium term as the effects will be measurable throughout the construction phase. The effects during construction are amenable to mitigation measures described above and the residual effects are predicted to be limited and reversible.

During operations, potential Project effects to First Nations Traditional Current Use are expected to generally be low in magnitude and site specific. The duration of potential residual effects is anticipated to be long-term and will occur on a regular basis as part of Terminal operations. The effects are amenable to mitigation measures described above and the residual effects are predicted to be limited and reversible.

It is recognized that the Tsimshian First Nations may have methods for determining the significance of the residual environmental effects on First Nation Traditional Current Use. Potentially affected First Nations will have an opportunity to review and comment on the environmental assessment including potential effects on resources important for traditional use and proposed mitigative and monitoring strategies. These comments, in discussion with the proponents and relevant government agencies, will be considered during preparation of the comprehensive study report, development of mitigation and monitoring programs and environmental management planning.

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16 NAVIGABLE WATERS ASSESSMENT

16.1 Scope of Assessment

Navigable waters are defined as any body of water capable of being navigated by any type of floating vessel for the purpose of transportation, recreation or commerce (Transport Canada 2010 Internet site). Navigable Waters has been selected as a VEC because Project activities have the potential to interfere with the public's right to navigate. This assessment describes potential Project effects as well as mitigation measures and measures taken at the planning stage to avoid or reduce effects to Navigable Waters. These include the identification of navigational protection zones and a marine communications strategy.

16.1.1 Regulatory/Policy Setting

The *Navigable Waters Protection Act* (NWPA) protects the public's right to navigate, and regulates the construction of works that may infringe on this right. The NWPA is administered by Transport Canada and applies to all navigable waters in Canada. It requires that formal approval from Transport Canada be obtained prior to the construction of works in navigable waters; this includes construction of wharves, docks, piers, dams, booms, bridges, overhead cables or pipelines. Formal approval is issued by a Navigable Waters Protection Program officer on behalf of the Federal Minister of Transport.

Approval is subject to a satisfactory review of the final design and development plan for structures by the Contractor. As part of the approval conditions, a Marine Communication Plan is outlined in the Letter of Understanding. This plan addresses construction-related navigation issues, including: the methodology and timing of construction works and the development of protocols for communicating navigational safety information with the public.

16.1.2 Key Issues

The key issue underlying the assessment of Navigable Waters is compliance with Section 5 of the NWPA (concerning navigational safety and right-of-way) as it applies to all navigable waterways within the LAA (i.e., navigable waters between the project site and the pilot station at Triple Islands; see Section 3.5.2 and Figure 16-1).

The three potential environmental effects (and their associated indirect effects) identified for this assessment include:

1. Physical interference:
    - Resulting from any associated activities (e.g., dredging, pile driving, blasting, alteration of water bed and/or water banks)
    - Resulting from any ancillary and temporary works (e.g., cofferdams, detours, fencing, or temporary bridges)
    - Resulting from lighting at the terminal

- Resulting from any temporary closures or disruption of the navigational channel to marine traffic during construction.

2. Change in vessel traffic:
    - Including increased vessel traffic associated with construction and operation of the Project
    - Including the effect of increased shipping activity on regional shipping patterns, commercial/fishing and sport/recreational activities.
3. Change in shoreline and depth:
    - Wake from vessels travelling to and from the Canpotex terminal and presence of the jetty potentially causing shoreline physical disturbances.

Table 16-1 provides a summary of how potential environmental effects may result from interactions between Project activities and Navigable Waters.

Table 16-1: Potential Environmental Effects to Navigable Waters Issues Associated with Project

Project Activities and Physical Works	Potential Environmental Effects		
	Physical interference	Change in vessel traffic	Change in shoreline and depth
Construction and Commissioning			
Dredging	✓	✓	
Marine Facilities Construction (causeway, trestle and berth)	✓	✓	
Disposal at Sea	✓	✓	
Commissioning	✓		✓
Operations			
Arrival and Departure of Vessels		✓	✓
Interaction of Other Projects and Activities in the Boundary for Assessment (potential for cumulative effects; see rankings below)			
Ridley Terminals Inc.	2	2	0
Prince Rupert Grain Ltd	2	2	0
Fairview Terminal (existing and II)	0	2	0
CN Aquatrain facility	0	2	0
BC Ferries and Cruise Ship Terminal	0	2	0

NOTES:

Project Environmental Effects

Only Project – Environment interactions ranked as 2 in Table 3-4 are carried forward to this Table. A check mark (✓) indicates that an activity is likely to contribute to the environmental effect.

Cumulative Environmental Effects

Cumulative environmental effects were ranked as follows:

0 = Project environmental effects do not act cumulatively with those of other Projects and Activities

1 = Project environmental effects act cumulatively with those of other Project and Activities, but are unlikely to result in significant cumulative environmental effects OR Project environmental effects act cumulatively with existing significant levels of cumulative environmental effects but will not measurably change the state of the VEC

2 = Project environmental effects act cumulatively with those of other project and activities, and may result in significant cumulative environmental effects OR Project environmental effects act cumulatively with existing significant levels of cumulative environmental effects and may measurably change the state of the VEC

Effects Not Considered Further

Changes in Shoreline and Depth

Potential changes to the shoreline and depth in the area near the new jetty and berth have been identified as a possible issue for navigation. Such changes could occur if the shoreline or depth in shallow waters is altered by physical processes affecting sediment deposition or erosion to a point where vessels could no longer navigate. Changes in physical processes could result from: 1) the presence of a new jetty structure; and, 2) vessel wake.

The shoreline in the Project location is predominantly bedrock with areas of boulder, cobble, and gravel. It is generally exposed to moderate wave action (see Section 17.1). This type of substrate is unlikely to be eroded or affected by physical processes or vessel wake to the point where sediment accumulation would prevent existing navigation around the jetty during construction and operations. The area where vessels will be active during berthing operations will be dredged to provide suitable clearance for vessels. During berthing, the vessels will be relatively far away from the shoreline (over 900 m away), which will minimize wake reaching the shoreline. Only small vessels are anticipated to have access to these shallow waters under current conditions. Such vessels are unlikely to be impacted by small changes in depth that may occur in shallow water near the shoreline and jetty. Therefore, this effect is considered not significant and is not carried further in the assessment.

16.1.3 Selection of Measurable Parameters

Measureable parameters used to facilitate the assessment of potential effects on Navigable Waters are listed in Table 16-2.

Table 16-2: Measurable Parameters for Navigable Waters

Environmental Effect	Measurable Parameter(s) for the Environmental Effect	Rationale for Selection of the Measureable Parameter
Physical interference	Change in travel route/distance Change in lighting Interference with navigational aids	▪ Increases in this parameter will result in associated increases in time or costs for users ▪ Lighting at the terminal may also interfere with navigation ▪ Interference with existing navigational aids will pose safety concerns for navigation

Environmental Effect	Measurable Parameter(s) for the Environmental Effect	Rationale for Selection of the Measureable Parameter
Change in vessel traffic	Perceived potential interference with navigational use from transit and berthing of up to 150 large vessels (escorted by four tugs each) every year within LAA	▪ Increased vessel traffic may affect existing navigation use. ▪ Interference with existing use will pose safety concerns for users

16.1.4 Characterization of Residual Effects

Terms that will be used to characterize residual effects are provided in Table 16-3.

Table 16-3: Characterization Criteria for Residual Effects on Navigable Waters

Criterion	Description
Direction	**Positive:** condition is improving compared to baseline use of Navigable Waters **Neutral:** no change compared to baseline use of Navigable Waters **Adverse:** negative change compared to baseline use of Navigable Waters
Magnitude	**Low:** measurable effects to use of Navigable Waters anticipated in low-use areas **Moderate:** measurable effects to use of Navigable Waters anticipated in moderate-used areas **High:** measurable effects to use of Navigable Waters anticipated in high-use areas
Geographical Extent	**Site-specific:** effects restricted to area within the marine Project footprint **Local:** effects extend beyond the Project footprint but remain within the LAA **Regional:** effects extend into the RAA
Frequency	**Once:** effect occurs once **Sporadic:** effect occurs sporadically at irregular intervals throughout construction or operation of the Project **Regularly:** effect occurs on a regular basis and at regular intervals throughout the Project **Continuously:** effect occurs continuously
Duration	**Short-term:** effects are measurable for days to months **Medium-term:** effects are measurable for months to 2 years **Long-term:** effects are measurable for >2 years but are not permanent **Permanent:** effects are permanent
Reversibility	**Reversible:** effects will cease during or after the Project is complete **Irreversible:** effects will persist after the life of the Project
Ecological Context	**Undisturbed:** local assessment area is relatively unaffected or not adversely affected by human development **Disturbed:** local assessment area has been substantially previously disturbed by human development or human development is still present

16.1.5 Standards or Thresholds for Determining Significance

For the purpose of this assessment, an effect is significant if there is a high probability of long-term effects on the navigational use of the LAA for a large proportion of users.

16.2 Baseline Conditions

This section provides an assessment of baseline conditions for Navigable Waters within the LAA (Figure 16-1). It identifies and quantifies (where possible) known navigational use by commercial, recreational and First Nation vessels. Conditions discussed with the Navigable Waters Protection Division are identified.

16.2.1 Sources of Information

Effects on navigation will be most apparent in the waters west of Ridley Island where navigation may be affected by construction of the jetty and increases in vessel numbers will be more apparent because they are no longer in shipping lanes or open water. For this reason, information collection focused on this area. Baseline navigation in this area was determined through a review of available literature, government websites and databases, and consultation with various stakeholders. Data sources reviewed include:

- GeoBC—Coastal Resource Information Management System (CRIMS; GeoBC 2010, Internet site)
- Fisheries and Oceans Canada (DFO)—MAPSTER (DFO 2010, Internet site)
- Prince Rupert Port Authority website (Prince Rupert Port Authority 2010 Internet site)
- Alaska Marine Highway System (State of Alaska 2010, Internet site)
- Port Edward Harbour Authority (Port Edward Harbour Authority 2010, Internet site)
- Transport Canada (Transport Canada 2009 Internet site).

Various stakeholders were also interviewed to supplement available data and help identify potential concerns (Table 16-4). Information collected included:

- Number and type/size of vessels used
- Type of marine-related business
- Whether they navigate within 1 km from the west coast of Ridley Island and use the area between Coast Island and Ridley Island
- Expected changes in frequency of transits within that area
- Perceived interference from the presence of an additional jetty along the west coast of Ridley Island
- Number of annual transits within the Prince Rupert Port boundaries
- Expected changes in frequency of transits within PRPA waters
- Perceived interference from current level of marine traffic

- Perceived interference of an additional 130 to 150 vessels (escorted by two to four tugs) transiting through southern PRPA waters every year.

Stakeholders interviewed were from various user groups, including nature tour operators, fishing charters, harbour and marina managers, ferry and water taxi operators, marine towing companies and fishers. Consultation with other key stakeholders involved with navigation in the area included BC Ferries, Canadian Coast Guard (CCG), BC Pilots, Council of Marine Carriers, and the PRPA.

Table 16-4: Stakeholders Consulted on Navigation

Stakeholder (contact)	User Group	Date	Consultation Activity
Prince Rupert Adventure Tours (Debbie Davis)	Nature tours and water taxi operator	July 12, 2010	Phone interview
Skeena Kayaking (Joe Paolinelli)	Nature tours operator	July 9, 2010	Phone interview
Albacore 2 Marine Charters (Dave Anderson)	Nature tours operator	July 13, 2010	Phone interview
Thunder 1 Adventures (Doug Emery)	Fishing charters	July 14, 2010	Phone interview
BC Style Fishing Charters (Jeff Carlson)	Fishing charters	July 9, 2010	Phone interview
Northern Bounty Fishing Charter (Kevin Wiley)	Fishing charters	Sept 10, 2010	Phone interview
Bill Mounce	Multi-use (professional mariner, fisher, charter operator and shellfish farm owner)	Nov 3, 2010	Phone interview
Smith Marine (Mike Stevenson)	Marine towing	Sept 10, 2010	Phone interview
Wainwright Marine (Chrystal Hillier)	Marine towing	July 12, 2010	Questionnaire
Small Craft Harbours – Port Edward and Prince Rupert (Rick Hill)	Small Craft Harbour management	July 13, 2010	Phone interview
Prince Rupert Yacht Club (Nicole Boulton)	Pleasure crafts	July 13, 2010	Phone interview
Alaska Marine Highway System (Murray Sheppard)	Ferry operator	July 13, 2010	Phone interview
Area “A” crab association (Dan Edwards)	Crab fishers	Nov 3, 2010	Phone interview
Area “B” crabbing (Bryan Rusch, DFO)	Crab fishers	Nov 10, 2010	Phone interview

16.2.2 Navigational Activities in the LAA

Several marinas, docks, jetties, wharves and terminals are located within the LAA. For this section, navigational activities have been divided into three categories:

- Large commercial traffic
- Other commercial traffic
- Pleasure crafts and recreational use.

16.2.2.1 Large Commercial Traffic

Vessel traffic along the shipping route between the pilot station at Triple Islands and Prince Rupert is considered relatively light compared to other ports along the coast (Table 16-5). Large commercial traffic generally includes coal, grain, pellet, wood chip and wax carriers, container ships, cruise ships, logs and tankers. Commercial vessels currently use the following port facilities:

- Atlin Terminal
- Northlands Terminal
- Fairview Terminal North (FVN) and South (FVS)
- Prince Rupert Grain (PRG) Terminal
- Ridley Terminals Inc. (RTI).

Most of these facilities are located along the Prince Rupert waterfront and the west coast of Ridley Island. Large vessels for loading logs use anchorages in the inner harbour as opposed to a terminal.

Table 16-5: Summary of Vessel Calls along the West Coast of North America

Port	Vessel Calls 2008/2009
Prince Rupert	321
Metro Vancouver	2,791
Los Angeles	2,191
San Francisco	33
Stockton	172
Long Beach	5,117
Oakland	1,928
Seattle	1,212
Tacoma	1,227
Portland	501

Within the next four years, one or two large ships (e.g., commercial, coal, grain, container and cruise ships) per day, or approximately 410 to 598 per year, are projected to use PRPA waters. Numbers are expected to increase to approximately 1,017 vessels by 2017 (Table 16-6), mainly as a result of the planned expansion of the Fairview Terminal (Gary Paulson, pers. comm., 2011).

Table 16-6: Past Vessel Calls | Call Projections for Large Vessels within Prince Rupert Port

Terminal/Type	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
RTI – Coal	70	68	61	107	125	125	150	150	166	240	240
PRG – Grain	112	65	84	87	90	90	90	90	90	90	90
Inner Anchorages (logs)	16	13	18	27	32	37	37	37	37	37	37
HPI– Wood Pellets	6	7	17	24	0	0	0	0	0	0	0
FVN – Liquid Wax	4	2	4	4	4	6	6	6	6	10	10
Northlands Terminal – Cruise	44	47	23	25	25	8	15	25	50	50	50
FVS – Container	9	79	104	106	130	200	234	260	300	300	300
Canpotex Potash										70	130
Other									25	125	125
Total	**261**	**281**	**311**	**380**	**406**	**466**	**532**	**568**	**728**	**893**	**967**

BC Ferries offers year-round service from Prince Rupert to Haida Gwaii and south through the Inside Passage to Port Hardy. Ferries between Prince Rupert and Port Hardy travel every other day in the summer (June – September) and six to eight times per month in the winter. In 2010 this resulted in a total of 103 trips. Ferries between Prince Rupert and Haida Gwaii travel six days per week in the summer and three days per week in the winter. In 2010 this resulted in a total of 157 trips. In addition, the Alaska Marine Highway System runs ferries to and from Alaska between May and October. Ferry arrivals/departures for 2010 resulted in a total of 142 trips. The winter schedule is reduced to about two ferries per week.

Two cruise ship terminals currently service Prince Rupert: Northlands terminal, which accommodates large cruise vessels up to 300 m in length, and Atlin Terminal, which accommodates private yachts and smaller cruise ships. Cruise ships are berthed for six to ten hours, during which time up to 2,500 passengers can disembark and visit Prince Rupert and the surrounding communities. Atlin Terminal is located next to the Prince Rupert Rowing and Yacht Club and currently handles small explorer-class ships.

Cargo vessels and cruise ships as well as some ferries follow the shipping lane between the pilot station at Triple Islands and the port. Every ship that is over 350 gross tons is subject to compulsory pilotage from Triple Island. The Alaska Marine Highway System ferries enter PRPA waters from the north and leave to the south through a route between Digby Island and the Kinahan Islands (Figure 16-1).

16.2.2.2 Other Commercial Traffic

A search for vessels registered out of Prince Rupert (including suspended registrations) on the Transport Canada website (Transport Canada 2009 Internet site) found a total of 355 fishing vessels, 36 barges and 39 tugs. Several vessels registered in other regions are also likely to use the area commercially. Several companies based in the area provide other vessel-based commercial services, including nature tours, water taxis, and fishing charters (see Table 16-4).

Statistics on the number of small to medium-sized vessels are not available for the Prince Rupert area. Numbers of clients using the local small craft harbours were obtained from the Small Craft Harbour Authority for 2009 (Table 16-7). Commercial fishing vessels make up about half of the client records at the local harbours. Total commercial fishing visits recorded at all three harbours averaged 217 per month and 2,600 annually.

Of the users interviewed in this category (Table 16-4), seven out of nine (78%) navigate the waters within 1 km from Ridley Island. Of these, four out of seven (57%) occasionally or frequently use the waters between Coast Island and Ridley Island. The route between Coast and Ridley islands serves as a partially sheltered route during inclement weather and a shortcut while transiting between Port Edwards and Prince Rupert; however, it is restricted to small vessels due to its shallow water depths. The number of annual transits along this route reported by individual stakeholders ranged from 12 to 50 transits per year (~5 to 50% of their annual transits within PRPA waters). All other users interviewed require deeper waters and use the route offshore from Coast Island. None of the users interviewed felt that the current level of traffic interferes with their navigation.

A number of crab fishing licenses are issued in the port area (currently 13 in Area “B” located along the southern coast of BC between the northern end of Vancouver Island and the Alaskan border). Some crab fishing takes place offshore from Coast Island but most of it occurs southwest of the PRG terminal and in southern port waters (Bryan Rusch, pers. comm., 2010). Crab fishers tend to avoid setting traps in the main shipping routes.

Table 16-7: Vessel Numbers* at Small Craft Harbours in Prince Rupert and Port Edward in 2009

Small Craft Harbour	Approximate Daily Maximum Capacity	Vessel Type	Monthly Average Number of Vessels*	Total Annual Number of Vessels
Rushbrook – Prince Rupert	280	Commercial Fishing Recreational	65 111	773 1,334
Fairview Dock – Prince Rupert	250	Commercial Fishing Recreational	85 37	1,024 449
Porpoise Harbour – Port Edward	350	Commercial Fishing Recreational	67 73	803 875
Totals		**Commercial Fishing**	**217**	**2,600**
		Recreational	**221**	**2,658**
		Overall	**438**	**5,258**

NOTE:

* Vessel numbers do not reflect how long the vessels stayed in the area and at the harbour; >60% of fishing vessels are transient. Numbers represent vessels counted every time they berth at a harbour, which can be several times a year for certain vessels. The harbours are busiest during summer months.

16.2.2.3 Pleasure Crafts and Recreational Use

Several recreational users navigate through PRPA waters. Recreational activities in the area include fishing, tourism (wildlife and scenic tours) and boating (small pleasure crafts). There are currently no statistics available on small crafts using the Port boundaries but several recreational vessels use the various small craft harbours in the area (Table 16-7; average of 221 monthly recreational uses logged in 2009). The Prince Rupert Yacht Club has approximately 70 to 80 recreational vessels per day year-round (maximum of 105 vessels; Nicole Boulton, pers. comm., 2010). Vessels range in size from 3 to 25 m or more. The local fleet is comprised of about 70 vessels while additional vessels are considered transients (Nicole Boulton, pers. comm., 2010). According to the Transport Canada website, a total of 68 pleasure crafts are registered out of Prince Rupert (Transport Canada 2009 Internet site).

Kayaking routes shown in the CRIMS database (GeoBC 2010, Internet site) suggest that kayaking occurs in the area, offshore from the proposed Canpotex jetty location. Based on interviews with nature tour operators, Ridley Island does not appear to be a prime kayaking destination.

First Nation groups in the area use port waters primarily for fishing and recreational use. No statistics are currently available on vessel use by First Nation groups in the area. Traditional use studies have been requested, but have not been completed to date. Additional information on First Nation use of the waters between the Project site and Triple Islands are included in the Current Use section (Section 15).

16.3 Effects Assessment

16.3.1 Assessment Methods

The assessment of effects to navigable waters involved review of available baseline information and consultation with potentially affected marine user groups. The potential effects identified were:

- Physical interference
- Change in vessel traffic.

16.3.2 Physical Interference

During construction, a new jetty and berth will be built along the shoreline. Construction activities will include dredging at the jetty and disposal at sea. Nearshore recreational navigation along the west coast of Ridley Island near the Project site may be affected by the presence of the new berth and access trestle, construction equipment and vessels. During operations, small crafts capable of using the shallow waters between Ridley and Coast Islands will be required to detour around the jetty and travel on the seaward side of Coast Island. Lighting at the terminal may also interfere with navigation. At decommissioning, the berth and access trestle will remain in place; therefore, potential physical interference from the structure will remain after decommissioning.

16.3.2.1 Potential Effects

Four of the nine commercial stakeholders interviewed (small to medium vessels) indicated that they use shallow waters between Ridley Island and Coast Island for 5 to 50% of their transits. This route has been described as a shortcut by some users and is primarily used in inclement weather when the tide is sufficiently high to allow transit. Therefore, the effects of jetty construction and operation on navigation are anticipated to be limited to some tugs, fishing vessels and small pleasure crafts that use the sheltered waters behind Coast Island. Pleasure crafts are assumed to include kayaks, canoes and skiffs, as the main navigational route for larger crafts is found further offshore of the existing jetties along Ridley Island, and in deeper waters. The main effect of the Project to navigation for these users will be a change in travel route in shallow nearshore waters in order to detour around the jetty and Coast Island. This change could increase travel time and cost, and increase exposure over a ~1 km section during inclement weather. Based on measurements of the route inside and outside Coast Island, it is anticipated that the potential increase in travel distance will be less than 250 m per transit.

The jetty will be equipped with dark sky shielded fixtures to reduce possible interference from lighting. Concerns over background lighting potentially interfering with navigation were discussed with Transport Canada, Environment Canada and the CCG. No concerns were identified at this stage. Additional recommendations on lighting the terminal and berthing structures provided through consultation and the NWPA Marine Referral process will further reduce this potential effect. Interference with aids to navigation due to construction of new terminals can often be mitigated with installation of aids on the new structure.

16.3.2.2 Mitigation

Mitigation measures will be used to ensure that vessels are aware of construction activities in the area and protection zones (no-go areas) will be identified and communicated if required. Measures to reduce lighting interference with navigation and navigational aids will also be implemented based on recommendations provided during the environmental assessment and NWPA Marine Referral process. Mitigation measures will include:

- A marine communication plan
- Protection zones during construction
- Use of dark sky shielded fixtures where possible without affecting human safety
- Installation of navigational aids on the new structure where required
- Updated navigational charts showing the jetty location.

16.3.2.3 Residual Effects

The proposed terminal site is located within a port where similar facilities and vessel traffic are approved activities. Mitigation measures such as the implementation of the marine communication plan and protection zones will limit potential residual effects of physical interference by providing users with advance notice of on-going construction and alternative routes. Mitigation measures associated with lighting and navigational aids will further reduce potential residual interference with navigation. Residual adverse effects caused by physical interference will be of low magnitude (limited to a few users of shallow nearshore areas), site-specific (i.e., at or near the jetty location and Coast Island), and sporadic based on known use (e.g., area mostly used during rough weather). The structure and possible interference will last from construction to decommissioning. At decommissioning, the jetty and berth structure will be left in place and lighting will be reduced. Therefore, the residual effects are expected to be long-term and permanent. The Project is located in an industrial area where several other jetties exist along the shoreline. Therefore, the Project is considered to be in a disturbed ecological context.

16.3.2.4 Determination of Significance

Based on the assessment, the potential residual effects will be limited to a small proportion of users and occur over a small spatial scale. Therefore, the probability of affecting the long-term navigational use of the Project area for a large proportion of users and over a large spatial extent is considered to be low. The Project residual effects related to physical interference are thus predicted to be not significant.

16.3.3 Change in Vessel Traffic

Vessel traffic is anticipated to increase in the LAA during construction of the jetty structure and associated dredging and disposal at sea. Support vessels (e.g., cranes, tug boats, drill rig, vibro-hammer excavator and dredger) will be required during construction for pile driving, dredging and dispose of dredge material.

During operations, vessel traffic through PRPA waters, and between Triple Islands and the terminal, will increase by up to 150 large vessel escorted by two to four tugs every year. Project-related vessel traffic will stop after decommissioning.

16.3.3.1 Potential Effects

Vessel traffic within the LAA is considered to be low compared to other large ports on the west coast. All interviewees indicated that current vessel traffic did not interfere with their navigation. They also did not perceive that the predicted number of transits associated with vessel operations will affect their navigation provided that they use radar during foggy conditions and that Project vessel activities are communicated over the maritime radio.

16.3.3.2 Mitigation

All shipping will be conducted following the rules of shipping established by Transport Canada under the *Canada Marine Act* and in compliance with the requirements of the CCG. Shipping within port waters will also comply with the PRPA Operations Regulations and rules of shipping established by the Port under the *Canada Marine Act*.

PRPA has the authority to monitor ships about to enter or within the waters of the Port of Prince Rupert, to establish traffic control zones, request information, and impose conditions under which a traffic clearance is to be granted. All marine vessel traffic entering, within, or leaving the Port is managed by PRPA, CCG Marine Communication and Traffic Services, and the Pacific Pilotage Authority. Any vessels over 350 gross tons will require pilotage, as per PRPA standard practices and procedures.

In addition to following these rules, practices and procedures, during construction, the proponent will implement:

- Protection zones (the no go zone around a vessel)
- A marine communication plan.

16.3.3.3 Residual Effects

Potential residual effects on Navigable Waters related to changes in vessel traffic will be low in magnitude given the:

- Relatively low level of vessel traffic between the pilotage station at Triple Islands and the Project site and low perceived level of potential interference by other users
- Relatively small number of additional vessels transiting to and berthing at the terminal (i.e., maximum of 150 additional vessels, each with two to four tugs, every year) during operations
- Standard practices and procedures to be followed by large vessels in the area
- Additional mitigation measures implemented during construction and described above.

During construction, these potential effects are anticipated to be site-specific (at and near the jetty area), medium-term (less than two years) and to occur occasionally. The effects will be reversed when construction ends as construction vessel traffic will cease.

During operations, potential effects are anticipated to be regional (i.e., along the navigational route from Triple Islands through PRPA waters and near the jetty) but long-term (throughout the life of the Project). Vessel transits and berthing will occur on a regular basis but will stop after decommissioning; therefore, the effects will be reversible. Vessel activities and potential residual effects associated with Project construction and operations occur in an area considered as disturbed because other vessel traffic exists there already.

16.3.3.4 Determination of Significance

Based on the assessment, the potential residual effects will be limited to a small number of vessels navigating through PRPA waters near the Project site during construction and minimal vessel transits through the RAA during operations. Therefore, the probability of affecting the long-term navigational use for a large proportion of users and over a large spatial scale is considered to be low. The Project residual effects related to changes in vessel traffic are thus predicted to be not significant.

16.4 Combined Effects and Overall Significance Determination

The LAA is currently subject to a relatively low level of vessel traffic. The proposed Project will build a structure that will cause low levels of interference with nearshore navigation and navigational aid, medium-term increase in vessel traffic during construction and longer-term vessel traffic increase during operations (Table 16-8). Based on interviews performed and this assessment, there are no substantial navigational concerns associated with the presence of the proposed jetty or increased vessel traffic within PRPA waters. Given the standard practices and protocols for large vessels and the additional mitigation measures proposed, the probability of the Project affecting long-term navigation within port waters for a large proportion of users and over a large spatial extent is considered to be low. In conclusion, residual effects of the Project on Navigable Waters are predicted to be not significant.

Table 16-8: Summary of Project Residual Environmental Effects on Navigable Waters

Potential Residual Environmental Effects	Proposed Mitigation and Compensation Measures	Residual Environmental Effects Characteristics									Recommended Follow-up and Monitoring
		Direction	Magnitude	Geographic Extent	Duration/ Frequency	Reversibility	Ecological Context	Significance	Prediction Confidence	Likelihood	
Effect 1: Physical Interference											
Construction and Commissioning											
Dredging and Disposal of Sediment Marine Facilities Construction (causeway, trestle and berth) Commissioning	▪ Marine communication plan ▪ Protection zones ▪ Use of dark sky shielded fixtures where possible without affecting human safety ▪ Installation of navigational aids on the new structure where required ▪ Updated navigational charts showing the jetty location	A	L	S	P/S	R	D	N	H	L	None required
Effect 2: Change in Vessel Traffic											
Construction and Commissioning											
Dredging and Disposal of Sediment Marine Facilities Construction (causeway, trestle and berth)	▪ Marine communication plan ▪ Protection zones	A	L	L	MT/O	R	D	N	H	L	None required
Operations											
Arrival and Departure of Vessels	▪ Standard procedures will be followed by vessels entering the port	A	L	R	LT/R	R	D	N	H	L	None required

KEY

DIRECTION:

(P) *Positive*: condition is improving compared to baseline habitat quality or population status

(**N)** *Neutral*: no change compared to baseline habitat quality or population status

(A) *Adverse*: negative change compared to baseline habitat quality or population status

MAGNITUDE:

(L) *Low*: measurable effects to use of navigable waters anticipated in low use areas

(M) *Moderate*: measurable effects to use of navigable waters anticipated in moderately used areas

(H) *High*: measurable effects to use of navigable waters anticipated in highly used areas

GEOGRAPHIC EXTENT:

(S) *Site-specific:* effects restricted to the Project site (i.e., Project footprint)

(L) *Local*: effects extend beyond the Project site but remain within the assessment area

(R) *Regional*: effects extend to the watershed/regional level

DURATION:

(ST) *Short-term*: effects are measurable for days to months

(MT) *Medium-term*: effects are measurable for months to 2 years

(LT) *Long-term*: effects are measurable for multiple years but not permanent

(P) *Permanent*: effects are permanent

FREQUENCY:

(O) Occurs *once*.

(S) Occurs *sporadically* at irregular intervals.

(R) Occurs on a *regular* basis and at regular intervals

(C) *Continuous*

REVERSIBILITY:

(R) *Reversible*

(I) *Irreversible*

ENVIRONMENTAL CONTEXT:

(U) *Undisturbed*: local assessment area is relatively unaffected or not adversely affected by human development

(D) *Developed*: local assessment area has been substantially previously disturbed by human development or human development is still present

SIGNIFICANCE:

(S) *Significant*

(N) *Not significant*

(N/A) *Not Applicable*

PREDICTION CONFIDENCE:

Based on scientific information, professional judgment and effectiveness of mitigation

(L) *Low* level of confidence

(M) *Moderate* level of confidence

(H) *High* level of confidence

LIKELIHOOD:

Based on professional judgment

(L) *Low* probability of occurrence

(M) *Medium* probability of occurrence

(H) *High* probability of occurrence

16.5 Cumulative Effects Assessment

The assessment indicates that the Project is likely to contribute low magnitude residual effects to the RAA. These effects could be quantified (e.g., by calculating potential increases in cumulative travel distance and associated time and costs); however, overlap between the Project and other facilities generating vessel traffic within the RAA are expected to be negligible based on current and planned levels, and the separation distances between the Project and other local projects. The cumulative effects, if any, would not affect the viability of navigation within the RAA and are therefore expected to be low magnitude and not significant.

16.6 Follow-up Program

Based on the mitigation measures and limited residual effects, no follow-up program will be required.

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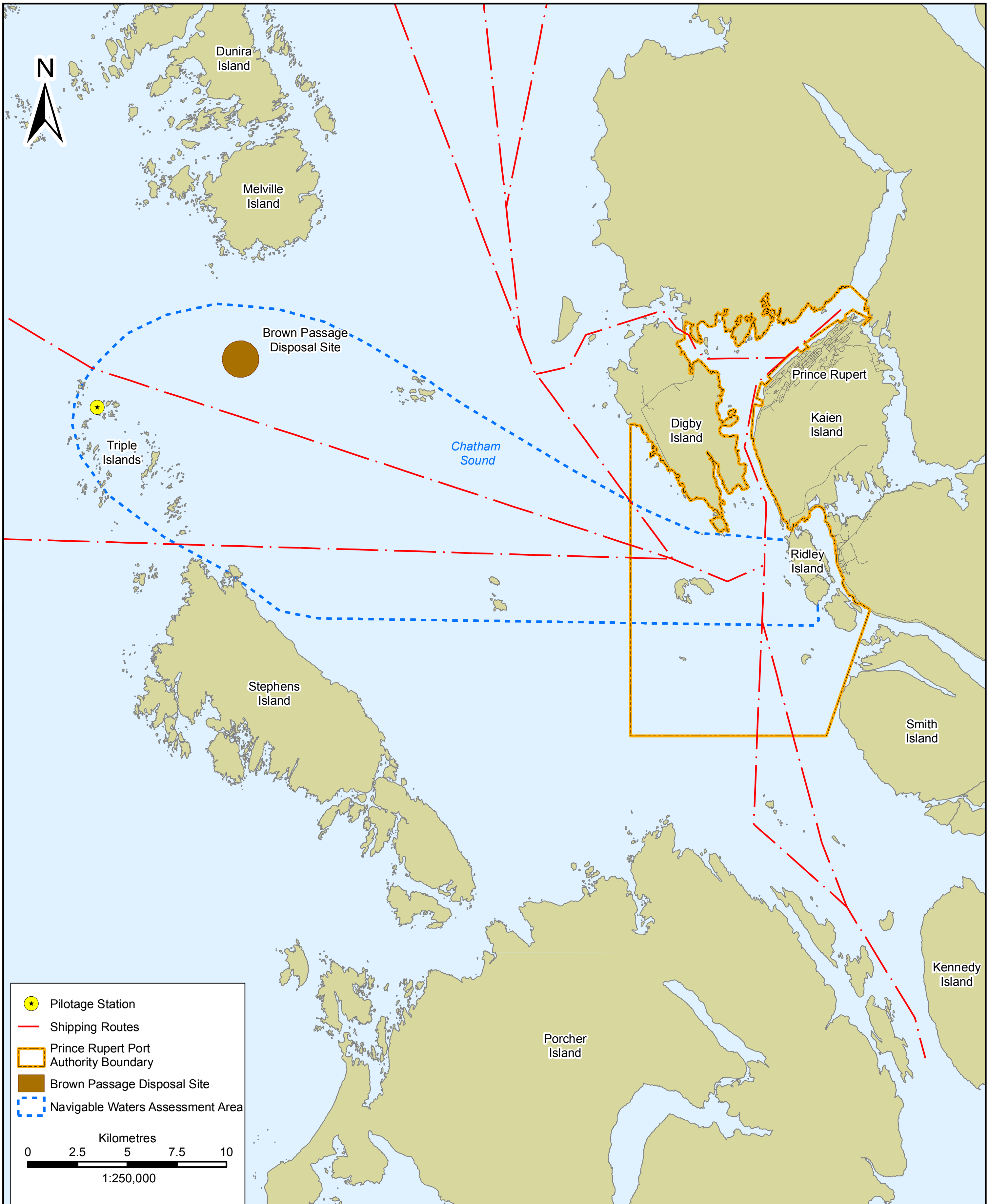
16.8 Figures

Please see the following page.



Client: Canpotex | Prince Rupert Port Authority

Job No.:	123110264
Scale:	1:250,000
Date:	17-Nov-11
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App'd By:	SW

Fig. No.: 16-1

Stantec

ASSESSMENT BOUNDARIES FOR NAVIGABLE WATERS

NAVIGATION

RIDLEY ISLAND, BRITISH COLUMBIA

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17 EFFECTS OF THE ENVIRONMENT ON THE PROJECT

According to the *Canadian Environmental Assessment Act*, an "environmental effect" includes any change to the Project that may be caused by the environment. The types of environmental factors that could potentially affect the Project include:

- Shoreline erosion and sedimentation
- Extreme weather
- Seismic activity and tsunamis
- Climate change and sea level rise.

Depending on the type and scale of the environmental event, one or more components of the Project could be affected, including:

- Trestle, berth and berth approach
- Road, rail and utility corridor
- Onshore terminal facility.

Planning, design, and construction method decisions have been made with the intent of reducing potential effects of the environment on the Project. Some of these mitigation measures include, but are not limited to:

- Reduction of the site footprint, which will limit environmental disruption and changes to natural environmental patterns
- Structure design that meets or exceeds the relevant codes and design criteria, which will promote natural environmental stability and protection against extreme environmental events
- Construction and operational/maintenance activities will be scheduled to minimize potential environmental disruptions.

During initial screening, it was determined that shoreline erosion and sedimentation do not pose any risks to the Project. Shoreline erosion has the potential to result in the destabilization of project components, specifically the rail causeway in Porpoise Harbour and the trestle causeway. Should destabilization become a problem it will be identified through the operational monitoring plan and measures, such as the addition of rip-rap, will be immediately taken. Any increases in sedimentation that may result as a consequence of shoreline erosion may affect water quality but would not have any adverse impacts on project infrastructure. As a result, effects to the Project resulting from shoreline erosion and sedimentation are considered unlikely and are not assessed further.

The following sections discuss the remaining environmental factors, their likelihood of occurrence and possible mitigation measures.

17.1 Extreme Weather

For the purposes of this assessment, extreme weather is considered to include wind, waves, and rainfall. Severe weather has the potential to damage Project infrastructure and berthed vessels. It can also make for hazardous working conditions, resulting in temporary Project closures.

17.1.1 Effects of Extreme Weather on the Project

Ridley Island is not sheltered from the oceanic influence of Chatham Sound. Ocean surface level winds are strongly influenced by the surrounding topography. At the Prince Rupert Airport station (located on Digby Island) winds blow predominantly from the SSE or East (Air Quality TDR). Wind speeds are moderate, with average speeds of 3.5 m/s (12.4 km/h) and maximums of 22.2 m/s (80.0 km/h). Calm winds (<0.5 m/s) occur about 6% of the time. At the Prince Rupert Galloway Rapids station, surface winds are predominantly south-westerly or north-easterly and wind speeds are weaker (Air Quality TDR). Average wind speeds are 1.8 m/s (6.5 km/h) and maximums are 12.2 m/s (43.9 km/h). Calm winds (<0.5 m/s) occur about 27% of the time.

Extreme winds can produce high waves, dense blowing sea foam, heavy tumbling of the sea and poor visibility, all of which can make on- and offshore working conditions hazardous, and can result in temporary Terminal closures. High winds and heavy seas at low temperatures can cause freezing snow and spray conditions. This is most likely to occur between November and April. Safe working conditions aboard a vessel or at the Terminal can be impeded by freezing spray.

Overall, Ridley Island is not protected from waves from Chatham Sound. Some limited protection is provided to the onshore Project infrastructure by Coast Island directly to the west of Ridley Island. The offshore Project infrastructure (i.e., berth and trestle) has no protection from incoming Chatham Sound waves.

Extreme precipitation events can result in stoppages of outdoor work if they create unsafe working conditions (as determined by the Project manager or site supervisor).

No adverse effects of extreme weather are anticipated on Project operations, unless the extreme weather results in severe waves (addressed in Section 17.2.3).

17.1.2 Mitigation Measures

Project onshore and offshore design will account for extreme weather conditions (i.e., wind, waves, rain) where possible, through the use of applicable codes and standards that will incorporate regional climate information. Extreme weather events are expected in frequencies as low as 1 in 50 years (Sandwell 2009).

The berth was designed for normal and extreme conditions. Significant design wave height has been set at a maximum of 3.1 m for a return period of 50 years. The likelihood of occurrence of this wave was 63% within this 50-year design life (Sandwell 2009). Given the anticipated low frequency of such events, it is expected that the Project, with the appropriate design standards, will be capable of withstanding these infrequent extreme weather events (e.g., winds of 68 knots). The Project will be constructed to meet extreme weather criteria identified in the National Building Code.

Project berth platform and trestle elevation of 12 m Chart Datum was determined for extreme conditions (Sandwell 2009). Chart Datum (CD) corresponds to 3.820 m below local published mean sea level. The factors incorporated into the design included the mean high water level (6.1 m CD), sea level rise due to climate change (1.0 m), 60% of maximum wave (5.8 m), and clearance from top of deck (1.5 m). The selected sea level rise was based on the most recent data presented by the Intergovernmental Panel on Climate Change (IPCC) at the time of the Sandwell report (Sandwell 2009).

Vessels will dock and undock only if weather conditions are within the design criteria, and will remain at berth so long as mooring hook capacity is not exceeded (35 m/s; 68 knots). Shiploading operations will consist of a custom designed all-weather shiploader with a hatch cover system. A conveyor system in an elevated and enclosed gallery will be used to load potash into the moored vessel. The fabric cover will span the whole length of the conveyor (including the tripper) ensuring the material remains dry and the environmental impact is minimized.

Rain is an expected work condition and the construction schedule will allow for reasonable rain delays. The Project is designed to withstand extreme rainfall of 150 mm in a single day, with an expected frequency of occurrence of 1 in 50 years (Sandwell 2009). The EMP will include provisions for site drainage; sedimentation and erosion control will be designed to ensure that structural loadings in the event of extreme rain do not put facility structures at risk. The drainage pipe system is designed for the 100 year design storm return (Sandwell 2009). In all cases, the roof runoff collection system is designed for the 20 year design storm return. During any infrequent larger storms, the overflow from the system is anticipated to be captured and conveyed by the storm sewer system.

To reduce discharge of storm sewer water from site, a filtration wetland will be designed and constructed as a detention basin with a storage capacity of approximately 2,600 m^3. The basin is sized for the 100 year design storm return event. An emergency overflow path will be constructed to the adjoining washdown water collection basin. Storm sewer water will be discharged from causeway.

17.2 Seismic Activity and Tsunamis

Western Canada experiences higher than average seismic activity due to its location near some major plate tectonic boundaries. The Juan de Fuca Plate (in the vicinity of Vancouver Island) is currently moving eastward beneath the North American Plate upon which most of Canada rests, while the Pacific Plate is moving north-westward along the edge of the North American Plate in the vicinity of Haida Gwaii (formerly the Queen Charlotte Islands). The Queen Charlotte-Fairweather Fault, which lies west of Haida Gwaii, takes up most of the movement, which is estimated at 6 – 7 mm/year (Mazzotti *et al.* 2003). It is quite possible that some of the movement is also convergent (with the Pacific Plate sliding beneath the North American) (Mazzotti *et al.* 2003). These movements cause ongoing small earthquakes, and rarely, earthquakes that are of significant enough magnitude to cause damage to buildings and infrastructure in nearby towns. As it is not possible to accurately predict when large earthquakes might occur, it is important that Project proponents along the west coast of Canada be prepared for such events.

The most recent significant subduction earthquake event was documented in 1700. An approximate return period of 500 to 600 years is anticipated for the region (Golder 2009). For Prince Rupert, the large subduction earthquake is expected to have a magnitude in the order of 8+, initiated 200 km or more west of the site (Golder 2009).

Between 1965 and 1991 there were approximately five earthquakes in proximity to Prince Rupert (east of Graham Island and west of Terrace). Of these, four were between 3.0 and 4.9 on the Richter scale (Energy, Mines and Resources Canada 1994); two of the epicentres were near Terrace, one was in Hecate Straight south of Dixon Entrance, and one was west of Porcher Island. The fifth earthquake was >6.5 on the Richter scale, with the epicentre in Hecate Straight, south of Dixon Entrance.

In 2001, a magnitude 6.3 earthquake occurred just east of the Queen Charlotte-Fairweather Fault (Rogers *et al.* 2002). It was felt in the Prince Rupert area. This earthquake generated a small tsunami that produced a run-up of 20 cm on Vancouver Island (Rogers *et al.* 2002).

17.2.1 Effects of Seismic Activity on the Project

All Project components could be affected by a seismic event, although the berth would likely sustain the greatest impact.

Marine terminal trestle and berths will consist of conventional piers constructed using 166 steel piles of three different sizes (50 piles @ 914 mm diameter, 76 piles @ 1,219 mm diameter, 40 piles @ 1,524 mm diameter) socketed 6 m into bedrock and filled with concrete for their entire length. The berth and access trestle decks will be constructed of concrete. An earthquake of significant magnitude could lead to permanent lateral ground movement and alter the berth and trestle foundation. This could lead to settlement and/or damage to the infrastructure.

Seismic motion may also cause subsidence or uplift in the area due to the relative movement of the tectonic plates. As most motion is taken up by the Queen Charlotte-Fairweather Fault, it is unlikely that significant subsidence/uplift will affect the Project Site.

17.2.2 Mitigation Measures

Seismic activity off the west coast of BC is presented in the 2005 National Building Code of Canada (NBCC 2005) seismic hazard model, where seismic hazard is computed for appropriately selected return periods and seismic performance criteria. The NBCC (2005) seismic model is the fourth generation model, which has revised the seismic zones by using a current earthquake database, refined recurrence statistics for the earthquake populations, new ground motion relationships derived from current empirical earthquake data and the introduction of spectral ground motion parameters.

Site specific ground motion parameters were obtained from the interactive website maintained by the Geological Survey of Canada (GSC). The Project's berth and trestle structure and other supported structural works will be designed by taking the following seismic event performance criteria into account (outlined in Table 17-1):

- A 1 in 100 year seismic event has a 40% probability of exceedence in 50 years, which is the Project's lifespan. If this type of event occurred, it is expected there would be minor, easily reparable damage and full operation would be restored almost immediately.
- A 1 in 475 year seismic event has a 10% probability of exceedance in 50 years, which is the Project's lifespan. If this type of event occurred, the Terminal and rail line would potentially require rail realignment and repairs to crane beam joints to become fully operational again.
- A 1 in 2,475 year seismic event has a 2% probability of exceedance in 50 years, which is the Project's life span. If this type of event occurred, it is expected that there would be no structure collapse; however, damage may not be economically feasible to repair.

Site seismicity was considered for onshore and offshore Project infrastructure. Site-specific seismic ground motion parameters correspond to firm-ground conditions (Site Class C, NBCC 2005), where the shear wave velocity of the upper 30 m of soil varies from 360 to 760 m/s. The peak firm-ground acceleration (PGA) values and spectral accelerations at 0.2, 0.5, 1.0, and 2.0 second structural periods established for the Prince Rupert Site (54.22° North, 130.33° West) are summarized in Table 17-1.

Table 17-1: Prince Rupert Firm Ground Motion Parameters (Class C)

Average Return Period in Years	Probability of Exceedance in 50 Years	Peak Firm-ground Acceleration (PGA)	Spectral Acceleration (Sa)			
			0.2 s	0.5 s	1.0 s	2.0 s
100	40%	0.05 g	0.09 g	0.06 g	0.04 g	0.02 g
475	10%	0.09 g	0.19 g	0.13 g	0.08 g	0.05 g
2,475	2%	0.18 g	0.38 g	0.25 g	0.15 g	0.09 g

SOURCE: Sandwell 2010

Golder carried out in-situ shear wave velocity measurements using borehole geophysics in the analyzed bedrock (Golder 2010, Golder 2009). Onshore and offshore foundations constructed directly on bedrock correspond to Site Class A. Determined accelerations and velocities corresponded to Site Class A with similar values applicable for an overburden soil thickness up to 3 m overlying rock. In areas where the overburden was found to be more than 3 m, accelerations and velocities for a Site Class E were recommended by Golder for design.

The geotechnical parameters used to develop the offshore design considered the following factors:

- Weak overburden soils
- Significant and often large variations in soil thickness and depth to rock over short horizontal distances
- Large and concentrated loads expected to be imposed on the foundation.

Based on the geotechnical analysis, it was determined that the offshore infrastructure (berth and trestle) should be supported on rock-socketed piles (Golder 2009).

The berth was modelled and analyzed using Staad, a structural design and analysis software, and is designed for normal and extreme weather conditions (Sandwell 2009). The berth foundations consist of 24 bents, with each bent containing four piles anchored by pin piles. A fifth pile is provided at fender locations to support the parallel motion fenders. Pile lengths vary from 42 m at the centre of the berth to 67 m (including pin pile lengths) at the extreme north and south ends of the berth. At bents 6 and 22 there are three additional piles located to the south and north of the main pile bent respectively. These piles provide lateral restraint during seismic events. In the event these piles buckle and fail, the whole berth structure will act as a vertical pile system.

Access to the berth from the onshore facilities is provided by a 554 m long trestle via a 185 m causeway structure. The access trestle consists of 16 spans, typically 36 m long and is designed to accommodate a phase 2 future conveyor and walkway running along the north side of the structure. The trestle is built up on steel piles with supporting pin pile anchors. A concrete pile cap will be poured across the top of each group of piles (also called a pier). As part of the fire protection, the rotating-ball-and-sliding-sleeve-style pipe expansion joints are proposed at each end of the structure span to accommodate the seismic movement in a 1 in 475 years seismic event. At the mid span, the bellows type flexible joint will be installed, to accommodate pipe and structure thermal expansion or contraction.

On the berth, pipe expansion joints are proposed at each end of the structure span to accommodate the seismic movement in a 1 in 475 years seismic event, and, at the mid span to accommodate pipe and structure thermal expansion or contraction.

The long storage building is constructed on shallow concrete spread foundations and covered by a glue laminated A-Frame timber building. The storage shed is constructed with cast-in-place continuous concrete strip foundations and elevated concrete piers which support glue laminated timber A-Frames. The continuous strip foundations are tied together using concrete “tie-beams” to maintain building alignment and minimize any lateral deferential movements or spreading due to a seismic event. The sloped asphalt floor surface of the structure is placed on compacted structural fill.

17.2.3 Effects of a Tsunami on the Project

The seismic activity of the region may also result in tsunami risk. Tsunamis can be generated by earthquakes, landslides or submarine landslides (Fritz *et al*. 2001, Rogers *et al*. 2002). The largest tsunamis tend to be caused by earthquakes with offshore epicentres (Bobrowsky 2001). Even distant earthquakes can generate tsunamis that may reach the coast of BC (Clague *et al*. 1994).

Ridley Island is exposed to waves from Chatham Sound. Onshore infrastructure is provided only limited protection by Coast Island, while offshore infrastructure (i.e., berth and trestle) has no protection from incoming easterly waves. Mathematical modelling using various approach angles and basin depth/geometry could determine the impact of approaching tsunami waves on Ridley Island, but modelling has not been conducted for this assessment.

Run-ups of up to 20 m asl have been predicted for some parts of coastal BC (Bobrowsky 2001), but run-ups of up to and over 10 m asl are considered most common (Dorner and Wong 2003).

Thus, a potential tsunami with a run-up of 10 m in height must be considered for mitigation purposes. Tsunamis are also commonly known to flow onto land like rivers, unlike typical ocean waves, and this should also be considered during mitigation decisions.

The potential effects of run-up caused by a tsunami on the Project Site would include erosion and flooding, and possible damage to Project infrastructure components.

17.2.4 Mitigation Measures

Design wave heights account for significant waves in 50 year return periods (as discussed in Section 17.1.2). In the event of an earthquake that is expected to generate a tsunami, or where a tsunami warning is issued, it is expected that the Project will be secured to the greatest extent possible, and evacuated.

17.3 Climate Change and Sea Level Rise

Increasing concentrations of greenhouse gases in the atmosphere are believed to be causing global climate change (IPCC 1990, 1995, 2001, 2007). Increased temperatures may contribute to a sea level rise. The 1995 IPCC report estimates an average sea level rise of between 0.8 and 2.0 m above the 1900 level by 2100. In 2007, the IPCC revised these estimates to between 0.18 and 0.59 m at 2090 – 2099 relative to 1980 – 1999. Thus, use of a predicted sea level rise of 1.0 m in the design of offshore infrastructure is conservative. Other atmospheric changes relating to climate change may include increased storm intensity and other changes relevant to coastal stability such as surface winds, ocean waves, storm surges, and ice conditions (Forbes *et al.* 1997).

17.3.1 Effects of Climate Change and Sea Level Rise on the Project

Rising sea levels have prevailed on the BC coast, with the exception of the western coast of Vancouver Island (NRC 2007). The rising levels have been offset by the effects of tectonic uplifting and the relative mountainous character of the BC coast (NRC 2007).

The Project will be constructed to meet extreme weather criteria identified in the National Building Code (2005). A conservative sea level rise of 1.0 m will be incorporated into the design of the offshore infrastructure based on a 50 year design life (Section 17.1.2).

17.3.2 Mitigation Measures

The design of the structures incorporates an adequate factor of safety to address changes in weather severity during the lifetime of the Project (as discussed in Section 17.1.1, above), including storms and sea level rise associated with climate change.

17.4 Significance of Effects of Environment on the Project

A significant effect of the environment on the Project would be one that resulted in a long term interruption in service or major damage to infrastructure. Additionally, a significant effect of the environment on the Project would be one that resulted in a significant adverse residual effect to any of the VECs, based on their individual significance criteria (i.e., if an effect of the environment resulted in a significant residual effect to old forest). Based on a consideration of the various mitigative strategies applied through design criteria and the EMP, it is concluded that significant adverse effects of the environment on the Project are not likely.

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18 EFFECTS OF POTENTIAL MALFUNCTIONS AND ACCIDENTS

This section evaluates potential environmental effects of Project-related accidents and malfunctions. Section 16(1)(a) of CEAA requires that the environmental effects of potential Project accidents and malfunctions be included in the EIS. In accordance with the Project EIS Guidelines, the EIS assesses effects of the following potential accident and malfunction scenarios:

- Train derailment along the Skeena River (upstream of the eulachon spawning reach)
- Fuel spill at the terminal refuelling station
- Potash spill to the marine environment
- Marine vessel collision with another vessel or grounding
- Marine vessel collision with a marine mammal.

Canpotex and PRPA have numerous management and response procedures currently in place throughout their respective organizations to prevent accidents and malfunctions with potentially adverse environmental effects. These management plans include spill prevention and response plans, which address prevention of large-scale or catastrophic releases of materials that could have serious environmental and commercial consequences.

The primary objective of this section is to determine environmental effects that may result from representative or key Project- related accidents or malfunctions. This section also identifies a series of operational procedures and measures to be implemented, including:

- Procedures that will minimize or eliminate potential for accidents and malfunctions to occur
- Initial response measures following an accident or malfunction
- Additional measures to further contain and clean-up accidental spills or releases
- Restoration, follow-up and monitoring programs.

The residual environmental effects of accidents and malfunctions and their significance are presented in the context of these well-established plans and procedures.

18.1 Approach

18.1.1 Identification of Potential Accidents and Malfunctions Scenarios

Credible Project-related accidents and malfunctions scenarios were identified through discussion with government and First Nations representatives, professional judgment, and previous experience with similar environmental assessments.

The five types of Project-related accidents and malfunctions considered in this assessment include:

1. Train derailment along the Skeena River
2. Fuel spill at the terminal’s refuelling station

3. Potash spill to the marine environment
4. Marine vessel collision with another vessel or grounding
5. Marine vessel collision with a marine mammal.

18.1.2 Assessment Methods

The assessment of potential accidents and malfunctions:

- Considers the potential accidents and malfunctions that may occur during Project construction and commissioning, operations, and decommissioning
- Considers the likelihood and circumstances under which these events could occur
- Determines the residual effects that may result and the significance of the residual effects.

Spatial boundaries used in this assessment are specific to each accidents and malfunctions scenario. For each scenario, the spatial boundary encompasses the total area over which all VECs may be affected. For a list of VECs included in this assessment, see Section 18.1.3 below.

Significance criteria used in this assessment are specific to each VEC that is assessed. These criteria are defined in the assessments of routine Project effects for each VEC (Sections 7 to 16). The residual environmental effect of an accidents and malfunctions scenario is considered to be significant if the effects on any of the individual VECs assessed under that scenario are determined to be significant.

18.1.3 Identification of Potential Interactions with Valued Environmental Components

A preliminary screening was conducted on each VEC to determine if any of the five potential accidents and malfunctions scenarios was likely to affect that VEC. Based on this initial screening, it was determined that neither Noise and Vibration (Section 8) or Ambient Light (Section 9) has the potential to be affected by potential Accidents and Malfunctions. Most foreseen accidental event scenarios will include a form of clean-up and site remediation activity. In each case there would likely be the involvement of some heavy diesel-powered equipment with consequent noise emissions, likely at a very local scale. If the nature of the spill required clean-up during the night, some working lights would likely be present, again impacting the immediate work area only. Although some noise and light will be generated during any clean-up events, these effects will be localized and short-term and therefore are considered not significant. As such, Noise and Vibration and Ambient Light are not assessed further with respect to potential Accidents and Malfunctions. All other VECs are assessed in Table 18-1. Brief rationale for the assignation of ‘1s’ is provided under each scenario, however, only VECs ranked as ‘2’ are assessed fully for their respective scenarios.

Table 18-1: Potential Interactions of Project-related Accidents and Malfunctions Scenarios with Valued Environmental Components

Accidents and Malfunctions Scenario	Air Quality	Vegetation Resources	Wildlife and Wildlife Habitat	Aquatic Environment	Human Health	Archaeological and Heritage Resources	First Nations Current Use	Navigable Waters
Train Derailment – Skeena River	1	1	1	2	1	1	2	0
Fuel Spill at Terminal Refuelling Station	0	1	1	1	1	1	1	0
Potash Spill to Marine Environment	0	0	0	1	0	0	1	0
Marine Vessel Collision or Grounding	0	0	2	2	2	1	2	2
Marine Vessel Collision with a Marine Mammal	0	0	0	2	0	0	0	0

NOTES:

Project-Environment Interactions

0 = No interaction

1 = Interaction occurs; however, based on past experience and professional judgment the interaction would not result in a significant environmental effect, even without mitigation; or interaction would not be significant due to application of codified environmental protection practices that are known to effectively mitigate the predicted environmental effects

2 = Interaction could result in an environmental effect of concern even with mitigation; the potential environmental effects are considered further

18.1.4 Assessment of Potential Environmental Effects

The potential environmental effects of accidents and malfunctions on each VEC were assessed using the following process:

1. A scenario for a credible worst case event was developed for the VECs with interactions presented as ‘2s’ in Table 18-1. This ‘worst case’ scenario was developed intentionally to be conservative. For example, the scenario may have included the selection of a specific time of year or location that would be most harmful if an event occurred.
2. The mechanisms through which the scenario could result in an effect on the VEC are described.
3. The Project design measures that would minimize the risk of the accident or malfunction, as well as emergency response measures and other mitigation measures that would help minimize the effect are described. The potential residual effect, taking into account the emergency response and/or Project design measures, is described or quantified using the measurable parameter(s) and other effect-characterization terms, as necessary.
4. The significance of predicted residual effects is evaluated for each VEC using the same significance criteria used for routine environmental effects (Sections 7 – 16).
5. Monitoring programs that might be required if an event occurred are described.

18.2 Baseline Conditions

Baseline conditions for each VEC considered in this assessment are outlined in the following EIS Sections: 7 (Air Quality), 10 (Vegetation Resources), 11 (Wildlife and Wildlife Habitat), 12 (Aquatic Environment), 13 (Human Health), 14 (Archaeological and Heritage Resources), 15 (First Nations Current Use), 16 (Navigable Waters).

18.3 Emergency Response Planning

Issues related to safety and the prevention of accidents and malfunctions are among the highest priorities considered during all phases of the Project. Following any accident or malfunction, senior officials representing PRPA, Canpotex and other selected agencies will meet to direct and coordinate all response activities leading to the eventual return to normal conditions.

PRPA have the following existing response plans in place to manage emergency events:

- PRPA Harbour Operations Practices and Procedures
- PRPA Emergency Plan (2003, Revised August 2008):
    - Including the PRPA Hazardous Materials Action Plan.

These plans will be updated as necessary to reflect the proposed Project. PRPA's Emergency Plan and Hazardous Materials Action Plan are reviewed annually and updated as required. All emergency response equipment inventories are maintained and updated annually. Spill response training is mandatory for the majority of PRPA Operations staff.

In accordance with the PRPA Emergency Plan (2003), PRPA will prepare a Project-specific plan to:

- Describe all of the emergency measures in place in the harbour and list all resources available to assist.
- Explain requirements and details for effective coordination of response during emergencies.
- Enable PRPA or designated responders to evaluate available resources and identify the need for improvements or amendments.
- Provide information for emergency response personnel familiarization, training and evaluation.

The objective of PRPA's Emergency Plan is to ensure a rapid, effective and well-coordinated emergency response to deal with marine related incidents within PRPA's jurisdiction. Particular emphasis is placed on planning and preparation to make effective use of all available resources in the event of a marine accident or other emergency and to minimize the potential for injury, loss of life, property damage, or environmental degradation.

Canpotex will develop an Emergency Preparedness and Response Plan (EPRP) for the Ridley Island Terminal. This plan will be similar to that developed for Neptune Bulk Terminals in North Vancouver, BC (Neptune Terminals 2011). The Canpotex EPRP will detail emergency response procedures for a variety of emergency scenarios, including those assessed here. The Canpotex EPRP will also detail training programs, such as staff emergency scenario training and practice drills, which will ensure rapid and effective response in the event of an emergency situation.

18.4 Train Derailment along the Skeena River

18.4.1 Description of the Possible Event

CN will operate the potash trains until they reach the Canpotex Terminal. At the terminal, Canpotex will be responsible for unloading the potash railcars. Canpotex will also be responsible for maintaining the tracks within their lease area.

In the event of a train derailment, there is the potential for hazardous and non-hazardous materials to be introduced into the aquatic environment (i.e., the Skeena River), potentially affecting Aquatic Environment, Human Health, and First Nations Current Use. The Skeena River originates at the southern end of Spatsizi Plateau and flows 570 km before entering Chatham Sound to the south of Prince Rupert, near Port Edward. The Skeena River supports important First Nations, commercial, and recreational fisheries. It provides spawning habitat for salmon (Chinook, chum, coho, pink, sockeye and steelhead) and eulachon, both of which are important components of the ecosystem and of high value to First Nations, culturally and historically (Stoffels 2001). In recent years, there has been an increased interest in eulachon, as they have suffered declines since the mid-1990s and their importance in the marine ecosystem has only just begun to be understood (DFO 2000).

The CN Skeena Subdivision extends from the Canpotex Terminal to Terrace, BC (approximately 147 km). The spatial boundary for this assessment is the section of the Skeena Subdivision that follows the Skeena River (i.e., for approximately 79 km).

Hazardous Material

Trains delivering potash to the Canpotex Terminal will use approximately three locomotives and will have approximately 170 cargo-laden railcars. Each locomotive engine typically carries the following hazardous materials:

- 4,500 gallons (17 m^3) of diesel
- 300 gallons (1 m^3) of lube oil
- 7 gallons of compressor oil
- Small amounts of various greases
- Lead acid batteries.

Non-Hazardous Material

Potash is a stable, non-toxic, non-flammable, non-hazardous mineral compound that consists primarily of potassium chloride (KCl) (Agrium 2010). Potash is readily soluble in water (342 g/L water at 20°C) and dissolves into potassium (K^+) and chloride (Cl^-) ions. Potassium chloride has a wide variety of applications, including use in fertilizers, dietary supplements for humans, and feed supplements for animals (Agrium 2010). It is generally fine to 4 mm in size (Intrepid 2004).

Both red and white potash will be delivered to the terminal. The colour difference originates from the method of process and recovery. Red potash contains minor amounts of iron impurities and is approximately 95% potassium chloride, while white potash is approximately 98% potassium chloride (Stewart 1999). Each train will carry a maximum of 17,000 tonnes of potash (i.e., 100 tonnes per railcar).

A credible worst-case scenario for this assessment is that 10 rail cars and a locomotive derail and fully release their contents onto the banks of and/or into the Skeena River upstream of the eulachon spawning reach, releasing all associated petroleum products and potash. This scenario is considered worst-case because it is unlikely that: 1) 10 rail cars and a locomotive would derail; 2) that all railcars and the locomotive would enter the Skeena River; and, 3) that petroleum products and potash would be released into the river.

18.4.1.1 Historical Events

Since 1998, there have been 11 derailments along the mainline of the CN Skeena Subdivision (i.e., between Prince Rupert and Terrace). Ten of these involved the derailment of one railcar and one involved the derailment of a single locomotive (Table 18-2). None of these incidents resulted in a spill of either hazardous or non-hazardous materials.

During the same time period, there were 34 derailments during track-switching activities in rail yards (i.e., at the Terrace Yard, Ridley Island Terminals, Prince Rupert Yard, or at private customer yards in the Skeena Subdivision). None of these incidents resulted in a spill of hazardous or non-hazardous materials.

Table 18-2: Train Derailments on the Skeena Subdivision (1998 – 2010)

Location of Incident	Number and Size of Incidents				
	1 Railcar	2 – 9 Railcars	>10 Railcars	1 Locomotive	2 Locomotives
Mainline Derailments	10	0	0	1	0
Yard Derailments	10	9	2	11	2
Total	**20**	**9**	**2**	**12**	**2**

NOTE:
None of these incidents resulted in a spill of either hazardous or non-hazardous materials.

18.4.2 Project Design Measures to Minimize Risk

To minimize the potential for a derailment and spill into the Skeena River, the following measures will be implemented by Canpotex and CN in cooperation with contractors, sub-contractors, and other users of the rail line:

- Equipment will be inspected and properly maintained to avoid potential malfunction
- Speed limits will be observed
- National and international engineering codes and standards will be followed including the AREMA (American Railway Engineering and Maintenance-of-Way Association) Manual for Railway Engineering.

In the event of a derailment, and if a spill does occur, an emergency response protocol will be initiated immediately, as described below.

18.4.3 Emergency Response Approach

Qualified personnel will follow best management practices during all phases of the Project and will be familiar with the appropriate Emergency Response Plans in the unlikely event of an emergency.

If the preventative measures in place do not prevent the described scenario, an emergency response protocol will be initiated immediately, which will involve following CN's Emergency Response Plan. This includes, but is not limited to:

- Notification of all agencies and responders as per CN's Emergency Response Plan (2008)
- Activation of spill handling procedures including assessing feasibility of containment and clean-up based on water body and flow rates
- Implementation of spill handling procedures including: diverting materials away from water and deployment of absorbent booming where necessary
- Completion of reporting and disposal procedures
- Personnel will have the appropriate emergency response and spill contingency training and knowledge, and adequate emergency response equipment to limit the consequence of spills by prompt containment and clean-up actions.

As this discussion pertains to a release into a fast-moving body of water (i.e., the Skeena River), water quality, habitat and fish monitoring procedures will be implemented to assess short- and long-term effects and the required mitigation as deemed necessary by CN and the responding regulatory agencies.

18.4.4 Clean-Up and Restoration Methods

Material spilled into rivers can be difficult to recover because the material tends to be immediately flushed down stream, especially during high flows. However, for a spill of diesel or lube oil of the size being considered here, high flows can be beneficial because they can lead to the immediate dissipation and faster degradation of petroleum products, thus avoiding the effects associated with pooled contaminants.

Diesel oil is much lighter than both freshwater and seawater (i.e., 0.83 to 0.88 g/cm^3 for diesel oil compared with 1.00 and 1.03 g/cm^3 for fresh and saltwater respectively) and will not sink, facilitating natural attenuation by photo oxidation and evaporation. Riverbank clean-up is not usually required with a diesel spill because it is not sticky or viscous like crude oils. Small diesel spills (i.e., 500 to 5,000 gallons) will usually evaporate and disperse within a day or less, leaving little or no product on the surface for responders to recover (NOAA 2006). Diesel oil is readily and completely degraded by naturally occurring microbes, under time frames of one to two months (NOAA 2006).

Potash spilled into the Skeena River will dissolve quickly and will likely not be recoverable, especially during periods of high flow. However, potash spilled along the river bank and/or in shallow, low flow portions of the Skeena River will be contained and recovered.

Onsite environmental monitoring will occur during and after a spill event to monitor the success of any clean-up and restoration work.

18.4.5 Potential Environmental Effects and their Significance

18.4.5.1 Interactions with No Potential for Significant Effect

In Table 18-1, the following VECs were assigned a rating of ‘1’ in terms of their potential for interaction with a train derailment along the Skeena River: Air Quality, Vegetation Resources, Wildlife and Wildlife Habitat, and Archaeological and Heritage Resources. This rating means that an interaction may occur; however, based on experience and professional judgment, the interaction would not likely result in a significant environmental effect. Brief discussions for those VECs with a rating of ‘1’ are provided below.

Air Quality

Dust is created when potash is moved quickly or abruptly, such as in the event of a spill. A potash spill has the potential to affect Air Quality with the airborne dispersion of dust; however, potash dust is dispersed relatively quickly. The event would be temporary (i.e., limited to a brief period following the event) and localized (i.e., limited to the location of the event and near ranges). Direct inhalation of dust may cause irritation, but a scenario of this type excludes direct community contact.

There will be dust collection at all transport points and soft drop systems to minimize product degradation.

Vegetation Resources

The derailment of the train may cause some physical disturbance to Vegetation Resources. This effect would be localized to the immediate area of the derailment and would be temporary, as vegetation is expected to recover after clean-up activities. As noted above, spilled diesel is expected to be readily and completely degraded within two months of the incident.

Wildlife and Wildlife Habitat

The physical derailment of the train has the potential to affect Wildlife and Wildlife Habitat. If any wildlife is in the direct pathway of the accident, there is a risk of mortality or injury. This effect would be localized to the immediate impact area.

Archaeological and Heritage Resources

The physical derailment of the train has the potential to affect Archaeological and Heritage Resources if any heritage or archaeological sites are in the direct path of the accident. The likelihood of a train derailment affecting such a site (if any such sites do occur along the Skeena Subdivision) is considered low.

18.4.5.2 Interactions with Potential for Significant Effect

The Aquatic Environment and First Nations Current Use were assigned an interaction rating of ‘2’ (Table 18-1) because even with mitigation, the interaction could result in an environmental effect of concern. Any effect to the Aquatic Environment (i.e., fish or fish habitat) also has the potential to have an effect on First Nations Current Use (in terms of fisheries) and human health (consumption of contaminated fish) if the spill happens during an important life history stage for the harvested fish (e.g., spawning, rearing). Therefore, the potential effects of a spill on the Aquatic Environment, First Nations Current Use and Human Health are considered together.

Considerations of effects on Human Health are limited to consumption of contaminated fish. Other aspects of Human Health may be affected by the input of materials into the water, but given the high volume and flow rate of the Skeena River, hazardous materials would be diluted rapidly. In addition, potash is considered non-toxic to humans and animals and first responders (e.g., restricting access to the spill site) and other relevant public health and safety authorities will be on site to ensure that exposure to humans is reduced. Mitigation would include informing the public of any hazards and providing the public with any relevant public health advisories with respect to the gathering and ingestion of potentially contaminated wild foods.

Aquatic Environment and First Nations Current Use

Although a hydrocarbon spill under this scenario would be considered fairly small, the release of any amount of hydrocarbons has the potential to cause a temporary degradation of water quality and associated lethal and/or sub-lethal environmental effects on freshwater fish, aquatic invertebrates, and fish habitat capacity in the affected area. Diesel is considered to be one of the most acutely toxic oil types. Aquatic life that comes into direct contact with a diesel spill for prolonged periods of time may be killed; however, small spills in open or fast-moving water are so rapidly diluted that fish kills have not been reported in such environments (NOAA 2006). Sub-lethal environmental effects could include avoidance behaviour and disruption of feeding, spawning and migration patterns. A derailment resulting in a locomotive entering the river or riparian area could cause temporary physical blockage or damage to some freshwater fish habitat.

Potash is considered non-toxic to humans and animals. Potassium chloride occurs in freshwater naturally as 2.3 mg/L potassium and 8.3 mg/L chloride (UNEP 2001). All studies compiled by the United Nations Environment Programme (UNEP) on acute and chronic aquatic toxicity from potassium chloride were found to be >100 mg/L and concluded that it is not hazardous to freshwater organisms (UNEP 2001).

The magnitude of the environmental effect of an accidental release of hazardous materials is dependent on a number of factors including the type of spilled material, location and volume of the spill, the amount of product reaching the river, and the volume and flow rate of the river. Dissolution of large quantities (e.g., 10 loaded cars) of potassium chloride may create an elevated level of salinity that may be harmful to freshwater aquatic species that are not salt-tolerant and are in the direct path of the spill. Given the amount of potassium chloride that would be released this would be a very localized and short term effect.

Though unlikely, there is a potential to harm organisms, especially spawning fish such as salmon and eulachon, if a large spill occurred directly on or upstream of the spawning grounds. Anadromous fish (e.g., salmon and eulachon) that have migrated from the ocean into freshwater have made the slow process of physiological changes that allow their bodies to adjust to the freshwater. Once they have adjusted to freshwater, increased salinity may have detrimental effects. For example, sudden increases in salinity have been shown to affect swimming performance in salmon (Brauner *et al.* 1992). Eulachon may be at less risk since they typically spawn close to the river mouth (DFO 2011). However, salinity tolerance in eulachon eggs was identified as a data gap by DFO's 2011 Eulachon Management Plan (DFO 2011).

The physical properties of the Skeena River may help to mitigate the effects of a spill on the Aquatic Environment. The Skeena River is the second largest river in BC after the Fraser River. It is approximately 580 km long and drains an area just under 5,500 km^2 (BC 2011). The Skeena River ranges in flow rate from 171 m^3 per second in March, to 2,898 m^3 per second in June[9] (Environment Canada 2011). In terms of frequency, an accidental spill via this mechanism into the Skeena River is considered sporadic and irregular (i.e., highly unlikely). In the unlikely circumstance that this scenario were to occur, the effects would be detrimental but highly localized (the rail line runs 79 km along the Skeena River) and temporary given the high flow volume of the Skeena River.

With the proposed mitigation and monitoring, effects from an accidental contaminant spill would likely be localized and may result in temporary disturbance to some freshwater species and habitat during clean-up within the local zone of influence. This disturbance is not expected to be measureable beyond two years and so would be considered short-term in duration. Effects are considered reversible because of the dynamic nature of fluvial systems and the rapid dissolution of potash into potassium and chloride ions. If a spill were to occur, affected habitats would be restored to pre-spill conditions, leaving no long-term effects. Therefore, the potential residual effects on the Aquatic Environment, First Nation Current Use and Human Health of an accidental spill into the Skeena River resulting from a potash train derailment are predicted to be not significant.

18.5 Fuel Spill at Terminal Refuelling Station

18.5.1 Description of the Possible Event

Fuels, lubricants, concrete and general process chemicals, including paints and solvents, will be used, or stored in small quantities during all Project phases. These types of hazardous materials may be released into the environment during all Project phases and at numerous sites within the Project footprint. However, a credible worst-case scenario would involve a fuel spill at the Terminal refuelling station. The fuelling station will consist of two 5,000 L capacity double wall horizontal tanks with fuel dispensers. One will contain diesel and the other gasoline. The tanks and re-fuelling area will be situated on a concrete containment slab, near the administration and maintenance facilities in the southwest portion of the Canpotex lease area. In a worst case scenario, 5,000 L of diesel and 5,000 L of gasoline would be released. This scenario is considered worst case because it is unlikely that the entire capacity of the two fuel tanks would be released. The fuel tanks will have oil stop and discharge shut-off valves to prevent large spills in the event of an accident or malfunction and a remote emergency stop station will be provided with interlocks into the fire alarm system. In addition,

[9] Flow data for the Skeena River is taken 23 km upriver from Terrace; therefore the flow rate above is a conservative value as flow rate increases closer to the mouth of the river.

the National Fire Protection Association (NFPA) requires that containment systems have a capacity of 110% of the aggregate tank volume.

The spatial boundary for this assessment is a 500 m buffer around the Terminal refuelling station.

Ship collisions or ship grounding could be a potential source of spilled hazardous materials to the environment; these are discussed in Section 18.7.

18.5.2 Project Design Measures to Minimize Risk

To minimize the potential for a hazardous material spill, Canpotex and PRPA, in cooperation with all contractors, sub-contractors and other terminal users, will ensure the following:

- Terminal operators will ensure that their own Spill and Emergency Response Plans are up to date.
- All construction and operations equipment will be properly maintained.
- Spill containment will be in place, as appropriate.
- Construction management plans will include hazardous materials storage and handling procedures.
- Storage of hazardous materials near waterbodies will be prohibited, and restricted near sensitive habitats.
- Construction and operations management programs will be developed. These will encompass handling and storage requirements for hazardous materials and will incorporate spill contingency procedures.
- Designated refuelling areas will be a safe distance from ignition sources.
- All employees will be trained to respond to hazardous materials spills, and to operate basic fire protection equipment.

18.5.3 Emergency Response Approach

Should a hazardous material spill occur, the primary goal is to ensure safety, and when safe to do so, to contain the material and keep it out of the drainage system, ocean and other sensitive habitats. At any time, if a hazardous material is observed leaking, the PRPA and Canpotex Emergency Response programs will be initiated and the site will be secured.

The existing PRPA Hazardous Materials Action Plan will be updated to ensure that it is applicable to the Project. The Canpotex Emergency Preparedness and Response Plan will detail emergency response actions to be undertaken in the event of an onsite fuel spill. These emergency plans will include the following measures:

- Notifying of all agencies and responders (PRPA, Canpotex, CN, Burrard Clean, RCMP, adjacent land owners, Prince Rupert fire department and the Ministry of Forests, Forest Services Branch, etc.)
- Shutting off any vehicles involved in the accident or malfunction

- Contacting the site foreman/supervisor for assistance
- Containing the spill and prohibiting spilled material from entering storm drains
- Contacting the superintendent and/or the Terminal Compliance Manager (carried out by the Foreman/supervisor)
- Closing outfall valves if spill is large enough
- Contacting the appropriate responder and/or agency (Quantum, local Fire Department, PRPA Manager of Operations and Security, and Prince Rupert Port Authority Security; carried out by the supervisor in charge)
- Initiating spill handling procedures, including assessing the feasibility of containment and clean-up
- Implementing spill handling procedures, including diverting fuel away from water, deployment of absorbent booming, and soil/environmental clean-up as identified in spill contingency plans
- Implementing disposal procedures and completing incident reporting to appropriate regulatory agencies.

Spill response kits will be available on-site. Kits will include booms and fences to contain spills and to prevent wildlife from entering spill areas. Emergency response actions will be directed towards identified areas of sensitive habitats.

Implementation of the Project design measures will reduce the likelihood of a spill occurring. Contingency Plans will help to reduce the spill volume and extent, should a spill occur. It is not expected that a spill would result in subsequent ignition; however, employees are trained in initial fire control techniques until the local fire department arrives. Monitoring will take place to document full environmental recovery.

General spill management procedures involve the responsible parties implementing their spill response plan, which usually involves engaging a contractor specializing in spills (i.e., Burrard Clean) on-site as soon as possible. PRPA and terminal staff will provide support as required, as well as follow steps in the response plan to properly contain and limit the effects of the spill until professionals can respond.

Employee training will include protocols on how to:

- Stop the leak
- Eliminate potential for ignition
- Evacuate all individuals
- Contain the spill
- Prevent seepage of the product
- Advise supervisor (who will contact appropriate Agencies, if applicable)
- Conduct site remediation.

18.5.4 Clean-Up and Restoration Methods

Following initial response and containment of a hazardous materials spill, the following clean-up and reclamation tasks will be undertaken as necessary to restore damaged habitats:

- Riparian areas will be re-vegetated to pre-spill conditions where required.
- Habitat compensation works will be implemented for all harmful loss or alteration to fish habitat (riparian and in-water) where required.
- The Proponents will ensure that an on-site environmental monitor is present during all clean-up and reclamation works.

18.5.5 Potential Environmental Effects and their Significance

18.5.5.1 Interactions with No Potential for Significant Effect

In Table 18-1, the following VECs were assigned a rating of '1' in terms of their potential for interaction with a fuel spill at the terminal refuelling station: Vegetation Resources, Wildlife and Wildlife Habitat, Aquatic Environment, Human Health, Archaeological and Heritage Resources, and First Nations Current Use. This rating means that an interaction may occur, however, based on experience and professional judgment, the interaction would not likely result in a significant environmental effect. Brief discussions for those VECs with a rating of '1' are provided below.

Vegetation Resources

It is expected that should a spill occur at the terminal refuelling station, it would likely occur on disturbed areas with no sensitive vegetation. Most spills are expected to be rapidly contained and cleaned up. With appropriate mitigation measures in place (as outlined above), the geographic extent of a potential spill is expected to be site-specific with effects of relatively short duration. Staff will be trained to respond to fuel spills and will use spill containment kits to prevent the spread of materials to areas with valued vegetation resources.

Wildlife and Wildlife Habitat

As for Vegetation Resources, it is expected that a spill at the terminal refuelling station would occur on disturbed areas and would not likely result in direct spillage onto wildlife or wildlife habitat. In addition, initial spill containment methods and subsequent clean-up measures (as outlined above) will help to minimize the spread of hazardous materials into adjacent habitat. As such, contaminants are unlikely to enter the food chain via wildlife ingestion of exposed vegetation. Spill containment kits will be present on site in locations where risk of spill is deemed the greatest, such as the refuelling station.

Aquatic Environment

In the event of a spill at the terminal refuelling station, spill handling procedures would be implemented immediately, including diverting fuel away from water and preventing fuel from entering storm drains. Based on the volume of fuel that could be released and the emergency containment procedures that would be implemented, it is expected that fuel will not enter any freshwater or marine habitats.

Human Health

As discussed for Wildlife and Vegetation, it is expected that should a spill occur at the terminal refuelling station, it would likely occur in a disturbed area and would not result in spillage onto sensitive vegetation, wildlife or wildlife habitat. Implementation of the mitigation measures outlined above, along with the BMPs related to hazardous materials management, will reduce the likelihood of a spill at the terminal refuelling station. Additional mitigative measures to reduce human exposure to potentially harmful materials will be undertaken by first responders (e.g., restricting access to a spill site) and other relevant public health and safety authorities to inform the public of any hazards. These would also include any relevant public health advisories with respect to the gathering and ingestion of any potentially contaminated wild foods.

Archaeological and Heritage Resources

A fuel spill on a terrestrial Archaeological or Heritage Resource site might result in adverse effects to that site, particularly if fuel spill response involves excavating and removing fuel-saturated sediments. Furthermore, spills of fuels and other hazardous substances might render an archaeological or heritage resource site too toxic to be investigated by archaeologists through traditional field methods. However, no terrestrial archaeological or heritage resource sites have been identified in proximity to the terminal refuelling station. In the event of a spill, spill handling procedures would be implemented immediately, including diverting fuel away from any identified sensitive sites and bodies of water and preventing fuel from entering storm drains. Based on the volume of fuel that could be released and the emergency containment procedures that would be implemented, it is expected that fuel will not enter any freshwater or marine habitats. As such, a fuel spill at the terminal refuelling station is considered unlikely to affect intertidal or terrestrial Archaeological and Heritage Resources, even if any such sites do occur in the vicinity.

First Nations Current Use

It is expected that should a spill occur at the terminal it would occur on disturbed areas that are not being used by First Nations. There is however, the possibility that a spill of hazardous materials would temporarily limit access to areas of traditional use (e.g., during clean-up). Implementation of mitigation measures outlined above, along with the BMPs related to hazardous materials management will reduce the likelihood of a spill at the terminal refuelling station. If a spill should occur it is highly probable that it would be contained on the terminal site with little or no affect to traditional use resources and little or no effect on the total availability and abundance of these resources locally and regionally.

18.5.5.2 Interaction with Potential for Significant Effect

No VECs in Table 18-1 were assigned a rating of ‘2’. Therefore, a fuel spill at the terminal refuelling station is not considered likely to cause a significant effect to any VEC.

18.6 Potash Spill to the Marine Environment

18.6.1 Description of the Possible Event

Potash from the storage sheds will be reclaimed by an automated portal scraper reclaimer system. The portal reclaimer system scrapes the potash down the stockpile and onto a conveyor belt using multiple blades attached to a rotating chain on the bottom of the reclaimer. The reclaim rate is controlled from the shiploader control cab by adjusting the angle of the boom and therefore the depth that the blades cut into the stockpile. The reclaimed material will be conveyed from the storage shed to the vessel via a series of belt conveyors and loaded onto the vessel via shiploading equipment. Computerized sensor controls will be in place to monitor potential malfunctions, minimizing the risk of spills and their size should one occur.

In a credible, worst case scenario, an equipment malfunction or an operator error could result in a spill of potash from the conveyor system or the shiploading equipment into the marine environment. The potash shiploading system will have a design loading capacity of 6,000 tonnes per hour. Assuming this system is operating at full capacity, and that it would take five minutes for the system to be shut off following an incident, a maximum of 500 tonnes of potash could enter the marine environment. This scenario is considered unlikely because: 1) experience with similar marine terminal projects in other locations (e.g., Neptune Bulk Terminals, North Vancouver) suggests that the probability of a potash spill is low if the mitigation measures discussed below are implemented; and, 2) if a malfunction or operator error were to occur, the transfer equipment would be shut down immediately.

The spatial boundary for this assessment is a 100 m buffer around the marine trestle and shiploading equipment.

18.6.2 Project Design Measures to Minimize Risk

The Project has been designed to allow for the efficient transfer of potash between the shore and vessels, and to prevent spills of potash into the marine environment. A fabric trestle conveyor cover will be installed over the full length of the conveyor to keep material dry and provide environmental protection. The shiploading equipment will be equipped with an automated wash-down system including collection and transfer to shore to prevent potentially contaminated water spilling into the marine environment.

To minimize the potential for spills of potash during loading, the following measures will be implemented by Canpotex in cooperation with contractors, sub-contractors, and other terminal users:

- All transfer equipment will be regularly maintained to avoid potential equipment malfunction.
- Personnel will have the appropriate emergency response and spill contingency training and knowledge, and adequate emergency response equipment to limit the consequence of potash spills by prompt containment and clean-up actions.
- Computerized sensor controls will be in place to monitor potential malfunctions and minimize any spills to less than 10 tonnes, which should be contained within the spill trays.

Over the past 40 years that Canpotex has been in business no potash has entered the marine environment from the terminal.

18.6.3 Emergency Response Approach

In the event of a potash spill to the marine environment, an emergency response protocol will be initiated immediately, as detailed in the Canpotex Emergency Preparedness and Response Plan. As potash dissolves quickly in water and will not likely be recoverable, the response plan will focus on containment to limit the amount of potash that enters the marine environment. The response will include:

- Shutting down belt conveyors and shiploading equipment to limit amount of potash spilled
- Initiating containment and clean-up procedures to prevent potash from entering the marine environment (e.g., potash remaining on belt conveyors or potash spilled on the trestle deck)
- Notifying all agencies and responders as required in the PRPA Emergency Plan
- Completing applicable reporting and disposal procedures.

The Emergency Preparedness and Response Plan will also include methods and equipment to prevent potash spills from spreading and for recovering spilled potash.

18.6.4 Clean-Up and Restoration Methods

Following the initial response and containment procedures, all spilled potash that did not immediately dissolve in the marine environment will be recovered. Despite the non-toxic nature of potash, a spill could result in the loss of some marine organisms; particularly if potash spills onto intertidal habitats (see Section 18.6.5.1 below). If a measureable adverse effect is observed, habitat compensation works may be required. In the event of a spill, the Proponents will ensure that an on-site environmental monitor is present during all clean-up and restoration works.

18.6.5 Potential Environmental Effects and their Significance

18.6.5.1 Interactions with No Potential for Significant Effect

In Table 18-1, the following VECs were assigned a rating of ‘1’ in terms of their potential for interaction with a potash spill in the marine environment: the Aquatic Environment and First Nations Current Use. This rating means that an interaction may occur; however, based on experience and professional judgment, the interaction would not likely result in a significant environmental effect. No VECs were ranked with an effects rating of ‘2’ for this scenario. Brief discussions for those VECs with a rating of ‘1’ are provided below.

Aquatic Environment

Incidental inputs of potash to the marine environment could cause localized increase in salinity in the marine environment, which has the potential to affect marine species intolerant to salinity changes. Marine waters surrounding the Terminal exhibit dynamic fluctuations in salinity (as a result of seasonal inputs of freshwater from the Skeena River) and any localized increases in salinity would dissipate rapidly. Potash readily dissolves into potassium and chloride ions in water, which are naturally present in seawater at concentrations of 380 mg/L K^+ (potassium) and 19,000 mg/L Cl^- (chloride) (UNEP 2001). Species living in environments with dynamic salinity fluctuations have adapted to those conditions and are generally tolerant of changes.

If potash were to spill onto intertidal habitats during low tide, marine biota (e.g., algae, invertebrates) directly exposed to the potash could be killed due to osmotic effects. Organisms could also be physically harmed or killed during clean-up activities. Because potash is non-toxic, only those organisms directly exposed to potash would be affected. Following clean-up activities, the affected habitat would be quickly recolonized through recruitment from adjacent unaffected habitats.

The accidental input of potash to the marine environment may have temporary, localized effects on marine biota. However, as potash dissolves rapidly in water and is non-toxic, these effects are expected to be minimal.

First Nations Current Use

Any effect to the Aquatic Environment (i.e., fish or fish habitat) also has the potential to have an effect on First Nations Current Use (in terms of fisheries). Since effects to the aquatic environment are expected to be minimal (above), it is unlikely that any harvested species used by First Nations are affected.

18.6.5.2 Interactions with Potential for Significant Effect

No VECs in Table 18-1 were assigned a rating of ‘2’. Therefore, a potential potash spill to the marine environment is not considered likely to cause a significant effect to any VEC.

18.7 Marine Vessel Collision or Grounding

18.7.1 Description of the Possible Event

Bulk cargo vessels bound for the Canpotex Terminal will transit east from Triple Island to Ridley Island. Triple Island is located approximately 37 km west of Ridley Island, between Stephens and Dundas Islands. The shipping route between Triple Island and the Canpotex Terminal represents the spatial boundary for the assessment of potential accidents and malfunctions involving marine vessel collisions or groundings. The open waters west of Triple Island are not considered in this assessment, as it is expected that vessel collisions and groundings, though extremely unlikely, are more credible in inshore coastal waters.

No bulk fuel (oil, chemical or liquid natural gas) transport occurs between Triple Island and Prince Rupert Harbour. The development of oil and liquid natural gas terminals in the Kitimat area will likely increase the number of bulk fuel vessels traveling along the north coast of BC; however, these vessels will pass to the west and south of Triple Island and will not overlap with the assessment area. In addition, these vessels should not be using the anchorages at Stephen’s Island. These anchorages are managed by the Prince Rupert Port Authority and though they are used at the BC Coast Pilots discretion they are generally reserved for vessels travelling to Prince Rupert Harbour.

Vessels destined for Kitimat that require anchorages would use those located west of Triple Island. Therefore, marine accidents involving bulk fuel vessels (e.g., oil and liquid natural gas tankers) are not considered in this assessment.

Bulk cargo vessels transporting grain, coal, logs, wood pellets, wax and containers regularly transit between Triple Island and Prince Rupert Harbour. Accidents involving these vessels could result in the release of hazardous materials to the marine environment. Two credible worst-case scenarios are presented below.

18.7.1.1 Scenario 1—Vessel Collision

The vessel collision scenario is discussed as an ‘allision’, whereby a moving object (i.e., a vessel) collides with a stationary object (i.e., dock, berthed vessel). This scenario is represented by a vessel transiting past the Canpotex Terminal (not a Canpotex-bound vessel) that loses steerage and collides with a bulk carrier vessel berthed at the Canpotex Terminal, puncturing the docked bulk carriers’ fuel tanks.

18.7.1.2 Scenario 2—Vessel Grounding

The vessel grounding scenario involves a Canpotex vessel losing steerage and going aground within Prince Rupert Harbour limits, resulting in release of the ship’s fuel tanks.

Bulk carrier vessels that will call on Canpotex Terminal have a maximum capacity of 180,000 DWT (deadweight tonnage). Table 18-3 shows the typical bunker capacities for bulk carrier vessels of various sizes, indicating the volumes of fuel that will be carried on the ships calling on the Canpotex Terminal (Michel and Winslow 1999).

Table 18-3: Typical Bunker Capacities—Bulk Carrier Vessels

Description	Handysize	Panamax	Cape Size (5,000 TEU)
Deadweight Tonnes (MT)	30,000	70,000	160,000
Heavy Fuel Oil (m^3)	1,300	2,200	4,000
Diesel Oil (m^3)	130	270	300

Data from: Michel and Winslow (1999)

In a worst case scenario, a Cape Size vessel (160,000 DWT) would be involved in an accident such that all of its 4,000 m^3 heavy fuel oil and 300 m^3 diesel oil would be released into the marine environment. This scenario is considered worst case and unlikely because bulk carrier vessels typically have several segregated, protectively located fuel tanks. For the entire capacity of fuel to be lost, an accident would have to occur in such a manner as to puncture all of the ships fuel tanks.

18.7.2 Project Design Measures to Minimize Risk

In March 2006, under MARPOL 73/78 Annex 1 (The International Convention for the Prevention of Pollution from Ships/Regulations for the Prevention of Pollution by Oil), resolution MEPC.141(54) was adopted which requires all new vessels with an aggregate oil fuel capacity of 600 m^3 and above to adhere to new fuel tank protection measures (ABS 2006). Each bunker tank (which excludes tanks that do not normally carry fuel oil such as overflow tanks) fitted in such ships and having capacity (98% of the tank's gross volume) greater than 30 m^3 is to be protectively located. New ships are defined as:

- Building contracted on/after August 1, 2007
- Keel laying date on/after February 1, 2008 (where there is no contract)
- Delivery on/after August 1, 2010.

This MARPOL regulation, referred to as Regulation 12A:

- Limits the size of fuel oil tanks to not more than 2,500 m^3
- Requires fuel oil piping contained within the tanks to be located above specific distances unless fitted with remotely operated (fail safe) isolation valves at the tank's penetration
- Contains two options for determining the extent of protection for fuel oil tanks (prescriptive—double hull protection; and deterministic—oil outflow assessment) (ABS 2006).

Vessel traffic within Prince Rupert Harbour is coordinated and well managed through designated shipping routes, tug escorts, mandatory pilotage of large vessels, and other Port procedures and navigation aids. Procedures and mitigation in place to reduce the likelihood of accidents such as allisions and groundings include:

- PRPA Harbour Operations Practices and Procedures
- Mandatory pilotage (BC Coast Pilots) for large vessels
- Oil Pollution Emergency Plans for all vessels using the Prince Rupert Harbour
- PRPA Emergency Plan
- PRPA Hazardous Materials Action Plan
- Emergency Response Management System (to be developed, adopted and implemented for Project-specific purposes)
- Implementing and enforcing vessel speed limits
- Staff training on spill response and clean-up.

Additionally, all commercial vessels, including those that will be calling on Canpotex Terminal, have two steering gears (i.e., backup systems), as well as multiple separate fuel tanks, and ship safety features as discussed above.

PRPA's Emergency Plan and Hazardous Materials Action Plan are reviewed annually and updated as required. All emergency response equipment inventories are maintained and updated annually. Spill response training is mandatory for all PRPA staff whose job description requires that they have this training.

Canpotex's Emergency Preparedness and Response Plan will detail actions to be undertaken by Canpotex staff in the event of a vessel emergency, including notification of the appropriate agencies, assistance of direct responders, and incident reporting.

Alterations or disturbances to marine habitat that are the result of an accident or malfunction would be assessed in conjunction with the appropriate government agencies, and habitat compensation would be provided where required.

18.7.3 Emergency Response Approach

Burrard Clean (a government certified company specializing in fuel containment and clean-up) maintains a fuel spill response boat and equipment resources adjacent to Fairview Terminal on Kaien Island (north of Ridley Island). In the event of an incident within PRPA boundaries, Burrard Clean would respond to and be on scene within 30 minutes of being alerted. Outside PRPA boundaries (i.e., out to Triple Island) Burrard Clean would be on scene within approximately one hour depending on the location of the spill.

18.7.4 Clean-Up and Restoration Methods

Following initial response and containment of fuel released to the marine environment, the following clean-up and reclamation tasks will be undertaken as necessary to restore damaged habitats:

- Riparian areas will be re-vegetated to pre-spill conditions where required.
- Habitat compensation works will be implemented for all harmful loss or alteration to fish habitat (riparian and in-water) where required.
- The Proponents will ensure that an on-site environmental monitor is present during all clean-up and reclamation works.

18.7.5 Likelihood of Event Occurring

While the two scenarios described above are theoretically possible, the following information has been provided to demonstrate the relative likelihood of such accidents occurring, based on historical data and operational procedures.

Between 2006 and 2010, the following vessel call statistics applied for Prince Rupert Harbour (all Ports of Call) (Table 18-4).

Table 18-4: Vessel Call Statistics for Prince Rupert Harbour

Vessel Calls	2006	2007	2008	2009	2010
Prince Rupert Harbour	215	261	281	311	380

NOTES:
Numbers include cruise, grain, coal, log, wood pellet, wax, and container vessels (container shipments began in 2007)

In addition to the above, there are approximately 50 cruise ships that transit through Prince Rupert Harbour each year (25 northbound, 25 southbound). These vessels do not berth in Prince Rupert but travel through the harbour.

Historical data has been collected by Marine Communications & Traffic Services (Canadian Coast Guard) for the area extending from the northern tip of Vancouver Island to north of Haida Gwaii. The data provided is only available at the geographic scale described, and is provided as an indication of regional vessel traffic. It is important to note that this data is provided to highlight the relatively limited number of vessel movements (as shown above in Table 18-3) through Prince Rupert Harbour, when compared to vessel movements for the region as a whole.

Data reviewed included that collected for 2003 – 2004, 2004 – 2005, 2005 – 2006, 2007 – 2008, and 2008 – 2009. For these periods there were:

- 27,880 recorded vessel movements (inbound, outbound, transiting, and in-zone movements)
- 335 ship defects identified (i.e., 1.2% of all vessel movements; ship is considered defective if there are any defects in the ship's hull, main propulsion, steering gear, anchors, cables, radar or compass).

If similar percentages are assumed to be accurate for those vessels calling on Prince Rupert Harbour, we can expect that of the 1,448 vessels calling on the Port between 2006 and 2010, 17 of them (1.2%) may have had ship defects of one form or another.

For the period of 1998 to 2008, there were six reported incidents involving marine vessels in the Prince Rupert area. Details of these incidents are presented in Table 18-5.

Table 18-5: Marine Vessel Incidents in the Prince Rupert Area

Date	Location	Incident Type	Ship Type	Gross Tonnage	Damage Severity
9-Apr-1999	SE of Kinahan Islands	Grounding, Taking Water	Bulk Carrier	87,803	Extensive
20-Mar-2000	Prince Rupert	Grounding	Bulk Carrier	20,433	Considerable
18-Jun-2001	Duncan Bay	Striking	General Cargo and Container	30,745	Minor
6-Jan-2004	Lucy Island, Chatham Sound	Capsize	Barge	1,617	Extensive
10-Sep-2005	Prince Rupert Harbour	Striking	Passenger	50,764	Minor
11-Mar-2008	Prince Rupert	Taking Water	Barge	4,411	Considerable

NOTES
Source: Transportation Safety Board of Canada Marine Statistics (2009): http://www.tsb.gc.ca/eng/stats/marine/index.asp

Of the six reported incidents, three involved bulk cargo vessels. In two cases, the vessel sustained considerable to extensive damage as a result of grounding, but in neither case were fuel tanks punctured. In the third case, a cargo vessel struck a stationary object, resulting in only minor damage, again with no fuel loss.

As indicated in Table 18-5, the last recorded incident involving a bulk carrier in the Prince Rupert area occurred in 2001. Considering the number of vessels that call on the Port of Prince Rupert every year (see Table 18-4), the incidence of vessel collisions and groundings is extremely low.

For a vessel allision to occur both of a ship's steering modes would need to fail and the assisting tugs would have to be unable to effectively guide the vessel. If this were to occur, BC Coast Pilots would be contacted and additional tugs would be dispatched to attempt to slow the ship's speed or to bring the ship to a stationary position. In all likelihood, any allision between a transiting vessel and a docked bulk carrier would be at minimal speed. It is reasonable to expect only isolated damage to one of the berthed vessel's fuel tanks, given the distribution of the tanks, and their protection. In the event that the pilot is unable to slow or stop the vessel, then the potential exists for one of the berthed vessel's fuel tanks to be punctured, triggering the various response plans.

The likelihood of a Canpotex bulk carrier becoming grounded is negligible. Over the past 20 years, there have been three recorded vessel groundings within Prince Rupert Harbour (G. Paulson, pers. comm., 2010). In all three cases, the vessels were empty break-bulk cargo vessels at anchor waiting to berth at Port facilities. Vessels calling on Canpotex Terminal will arrive and depart at scheduled times for purposes of safety and operational efficiency, and will not go to anchor within the harbour limits for any reason. Therefore, it is highly unlikely that a vessel would go aground within the PRPA boundaries, as there is no opportunity for anchor dragging.

Under rare circumstances, a Canpotex bulk carrier may go to anchor at an approved anchorage on the west side of Stephens Island. Situations requiring this may include extreme weather events when berthing at the terminal is considered unsafe. In these cases, there is a potential for anchor dragging and grounding. However, this is considered highly unlikely.

18.7.6 Potential Environmental Effects and their Significance

18.7.6.1 Interactions with No Potential for Significant Effect

In Table 18-1, Archaeological and Heritage Resources was assigned a rating of '1' in terms of its potential for interaction with a marine vessel collision or grounding. This rating means that an interaction may occur; however, based on experience and professional judgment, the interaction would not likely result in a significant environmental effect. A brief discussion for this VEC is provided below.

Archaeological and Heritage Resources

In the event of a marine vessel collision or grounding leading to a fuel spill to the marine environment, there is a potential for Archaeological and Heritage Resources to be adversely affected if they occur near the shoreline or sub-tidally. With identification of these sensitive areas and mitigation measures to prioritize their protection (e.g., booming), effects to Archaeological and Heritage Resources are expected to be minimal.

18.7.6.2 Interaction with Potential for Significant Effect

In Table 18-1, Wildlife and Wildlife Habitat, Aquatic Environment, Human Health, First Nations Current Use and Navigable Waters were ranked with an effects rating of '2' because even with mitigation, interactions could result in environmental effects of concern. An assessment of the potential environmental effects of a fuel spill in the marine environment (i.e., resulting from vessel collision or grounding) on these VECs is provided below.

Wildlife and Wildlife Habitat

The release of heavy fuel oil to the marine environment has the potential to harm or kill wildlife such as marine avifauna. Birds present within the spill area may suffer lethal effects from hypothermia as a result of direct exposure to the oil or from the toxic effects of ingesting oil during preening or foraging (Stephenson 1997). Sub-lethal effects may include reduced growth rates, reduced fecundity, and increased susceptibility to disease.

Heavy fuel oil has a high viscosity and will not spread as rapidly as other less viscous fuel types (CONCAWE 1998). Heavy fuel oil is also very dense, meaning that it may sink when released in water, rather than float on the surface like other fuel types (CONCAWE 1998). Rapid volatilization of the low molecular weight components of heavy fuel oil will increase the density of the floating oil, causing it to sink more rapidly (CONCAWE 1998). These properties will help to reduce the area over which wildlife (e.g., birds) may come in contact with the oil; however, marine organisms may be affected as the oil settles on the seafloor. Potential effects on marine biota are discussed below, under the Aquatic Environment.

While it is possible that some marine avifauna could be harmed or killed as a result of fuel oil spilled, during an accidental vessel allision or grounding, rapid containment and clean-up will ensure that adverse effects are minimized. Given the limited volume of fuel that could be released to the marine environment and the emergency response plans that are currently in place, even the worst case scenarios described here are not expected to compromise the sustainability of any wildlife species' population. Therefore, the potential environmental effects of an accidental vessel allision or grounding on Wildlife and Wildlife Habitat are predicted to be not significant.

Aquatic Environment

The release of heavy fuel oil to the marine environment has the potential to affect marine organisms within the spill area. Mobile species such as fish and marine mammals may come in contact with surface oil during the spill, or may ingest oil while foraging. Depending on the level of exposure, marine organisms may suffer lethal or sub-lethal effects. Fish are considered most vulnerable to fuel spills during life stages that require them to be at or near the surface, such as rearing and spawning (Birtwell and McAllister 2002). Spring is generally considered the most sensitive time for fish as all life stages are represented in nearshore areas.

Some of the oil that is not recovered during clean-up activities will disperse into the water column and the rest will settle to the bottom and stick to exposed substrates. Weather conditions and temperature during the period immediately after the spill significantly influence the rate at which the oil disperses (CONCAWE 1998). Wind and wave action will help disperse the oil into the water column, while higher temperatures will increase the rate of volatilization (CONCAWE 1998). Oil that adheres to subtidal and intertidal substrates poses a threat to marine organisms, including benthic fish (e.g., flatfish) and a variety of invertebrates. Intertidal habitats are particularly susceptible if the spill occurs near the shoreline. Rapid emergency response and the booming of intertidal habitats will help to reduce the extent of shoreline oiling.

Even with the proposed emergency response and mitigation measures, some marine organisms are likely to be harmed if heavy fuel oil is released to the marine environment following an accidental vessel allision or grounding. However, given the limited volume of fuel that could be released and the emergency response plans that are currently in place, even the worst case scenarios described here are not expected to affect the viability of any marine species' population. Therefore, the potential environmental effects of an accidental vessel allision or grounding on the Aquatic Environment are predicted to be not significant.

Human Health

In the event of an accidental vessel allision or grounding, all appropriate government agencies and commercial operators in the Prince Rupert area will be immediately notified. The spill area will be quickly contained and unauthorized persons will be prohibited from entering the area. This exclusion zone will ensure that members of the general public are not exposed to the spilled fuel, and that Human Health is not affected.

Human Health has the potential to be affected if contaminated wildlife or aquatic species are harvested for consumption. Depending on the severity of the spill, specific area closures may be put in place until contaminant levels return to levels safe for human consumption. Given the limited volume of fuel that could be released to the marine environment and the emergency response plans that are currently in place, it is expected that any closures (if required) would be short-term and localized.

With the proposed emergency response and mitigation measures, there will be little or no pathways for human exposure (general public) to the spilled fuel. Therefore, the potential environmental effects of an accidental vessel allision or grounding on Human Health are predicted to be not significant.

First Nations Current Use

An exclusion zone will be implemented around the site of an accidental vessel allision or grounding. For reasons of public safety and to ensure rapid clean-up and containment, this exclusion zone will include the fuel spill area. If the exclusion zone includes areas that are important for Aboriginal food, social or ceremonial (FSC) fisheries, First Nations Current Use may be affected. In addition to the temporal loss of access to the exclusion area, First Nations Current Use may be affected by subsequent fisheries closures. While the timeframe of lost access and use is difficult to predict, the area affected is likely to be small compared to the total area available for First Nations Current Use. If important areas are identified near the accident site, all efforts will be made to protect those areas from oiling so as to limit the potential effects. Given the small quantity of oil that would be released and the location of the nearest First Nation community to the shipping lane, any effects on FN communities are expected to be minimal to none. With the proposed emergency response and mitigation measures, the potential environmental effects of an accidental vessel allision or grounding on First Nations Current Use are predicted to be not significant.

Navigable Waters

In the event of an allision or grounding, all vessels other than emergency responders would be excluded from the accident site. Depending on the location of the accident, this could cause delays for vessels operating near the exclusion area. Following a potential accident, damaged vessels would be repaired and removed; therefore, disruption to navigation would be temporary. Disruption of access to the Port of Prince Rupert is considered unlikely, as Canpotex vessels will not transit in the confined channel between Digby Island and Kaien Island.

As disruption of navigational use of waters around the accident site would be short-term and localized, the potential environmental effects of an accidental vessel allision or grounding on Navigable Waters are predicted to be not significant.

18.8 Marine Vessel Collision with a Marine Mammal

18.8.1 Description of the Possible Event

Large oceangoing vessels have the potential to strike marine mammals, leading to physical injury or death. This scenario is represented by an accidental collision between a bulk carrier calling on the Canpotex Terminal and a large baleen whale (e.g., humpback whale) causing the death of that animal. This scenario is credible because there are numerous confirmed cases in which large baleen whales have been struck and killed by marine vessels. However, this scenario is considered worst case because: 1) the probability of a vessel colliding with a whale is very low; and, 2) a strike may result in sub-lethal injuries, not necessarily death.

The spatial boundary for this assessment is the shipping route between Triple Island and the Canpotex Terminal.

18.8.2 Project Design Measures to Minimize Risk

Bulk carriers calling on the Canpotex Terminal will transit only within the designated shipping routes between Triple Island and Ridley Island. This will ensure that vessels do not inadvertently travel through important marine mammal feeding areas or other areas of high marine mammal abundance, presuming that these areas do not overlap with the shipping lanes. Bulk carriers will also observe a maximum speed limit of 14 knots while transiting between Triple Island and Ridley Island. Research suggests that vessel speed is positively correlated with both the probability of a strike and the severity of injuries resulting from a strike (Kite-Powell *et al.* 2007, Vanderlaan and Taggart 2007). If a marine mammal is observed in the path of a bulk carrier, the vessel operator may take the following actions to reduce the likelihood of a collision:

- Reduce the vessel’s speed, when and where it is safe to do so.
- Alter the vessel’s course, when and where it is safe to do so.

18.8.3 Potential Environmental Effects and their Significance

18.8.3.1 Interaction with No Potential for Significant Effect

No interaction rankings of '1' were predicted for any of the VECs (Table 18-1).

18.8.3.2 Interaction with Potential for Significant Effect

The Aquatic Environment VEC was ranked with an effects rating of '2' (Table 18-1) because even with mitigation, an interaction could result in an environmental effect of concern. The potential effects of a vessel collision with a marine mammal on the Aquatic Environment are discussed below.

Aquatic Environment

Recorded incidents of vessel strikes to marine mammals typically involve large baleen whales (Laist *et al.* 2001). Toothed whales (e.g., porpoises, dolphins) and pinnipeds (e.g., seals, sea lions) are generally small (relatively), fast, and agile, and are presumed to be more effective at avoiding vessels. Not all baleen whales are equally likely to be struck by vessels (Laist *et al.* 2001). Differences in physiology and behaviour may increase the risk of ship strikes for particular species. For example, the slow-moving North Atlantic Right whale (not found in BC) experiences a particularly high incidence of vessel strikes (Jensen and Silber 2004, Kite-Powell *et al.* 2007).

Within the assessment area for this scenario (Triple Island to Ridley Island), bulk carrier vessels may encounter several species of large baleen whales, including humpback whales, grey whales, minke whales, and fin whales. The humpback whale was selected for this scenario, as it is one of the most abundant species of marine mammals in nearshore waters on the North Coast of BC.

The probability that a bulk carrier vessel will strike a humpback whale is extremely low. In an extensive review of vessel collisions with whales, Jensen and Silber (2003) compiled all records of ship strikes from around the world. They identified only 44 cases of humpback whales being struck by vessels. While this value likely underestimates the true number of incidents because many strikes are not reported, it suggests that strikes to humpback whales are generally rare.

The maximum speed limit (14 knots) that will be observed by bulk carriers calling on the Canpotex Terminal will reduce the likelihood of a collision with a humpback whale. Current research suggests that the probability of a vessel strike is positively correlated with a vessel's speed (Kite-Powell *et al.* 2007). Based on Kite-Powell *et al.*'s model, a large vessel travelling at 25 knots has a 50% probability of striking a whale travelling in its path, while at a speed of 10 knots, that likelihood is reduced to 30%. Depending on the severity of the injuries sustained, a marine mammal may or may not recover from a vessel strike. However, research also suggests that the severity of the strike is positively correlated with vessel speed (Vanderlaan and Taggart 2007). Vanderlaan and Taggart (2007) modeled the probability of lethal injury to a whale based on vessel speed and found that the probability of lethal injury decreases from 79% at 15 knots, to 31% at 10 knots and 21% at 8.6 knots. Laist *et al.* (2001) similarly concluded that serious injuries to whales are infrequent at vessel speeds of less than 14 knots, and are rare at vessel speeds of less than 10 knots.

In addition to observing the 14 knot maximum speed restriction, vessel operators will take measures to avoid a collision with a marine mammal whenever it is safe to do so. These measures include reducing the vessels' speed and/or making slight alterations to the vessels' course. These actions will only be undertaken when and where they do not compromise the safety of the vessel, the crew, other vessels, and the environment.

With the proposed mitigation measures, it is considered highly unlikely that a bulk carrier calling on the Canpotex Terminal will strike a marine mammal. In the worst case scenario, if a strike was to occur and a single affected animal was to die, this is not likely to compromise the viability of the species' population. Therefore, the potential environmental effects of an accidental vessel collision with a marine mammal on the Aquatic Environment are predicted to be not significant.

18.9 Train Collision with an Ungulate

18.9.1 Description of the Possible Event

Trains have potential to strike ungulates (such as moose and deer) on the rail line, leading to physical injury or death. This scenario is represented by an accidental collision between a train and an ungulate causing the death of that animal. This scenario is credible because there are known instances of train collisions with moose and deer along the Bulkley and Skeena subdivisions; the spatial boundary for this assessment is the CN rail line between the Canpotex Terminal at Prince Rupert and Lorne Creek (Mile 97.0 Bulkley Subdivision).

18.9.2 Project Design Measures to Minimize Risk

CN is currently evaluating the following mitigation options to reduce wildlife mortality in high collision risk areas between Smithers and Endako on CN's Telkwa Subdivision:

- Combination of brush management and snow wing-ploughing along Subdivision sections identified with high moose-train interactions
- Sounding the whistle upon sighting of animal on rail right-of-way
- Trials are underway to fence sections of high mortality areas. Monitoring is being done to determine effectiveness in moose behaviour and mortality rates.

18.9.3 Potential Environmental Effects and their Significance

18.9.3.1 Interaction with No Potential for Significant Effect

No interaction rankings of '1' were predicted for any of the VECs (Table 18-1).

18.9.3.2 Interaction with Potential for Significant Effect

The Wildlife and Wildlife Habitat VEC was ranked with an effects rating of '2' (Table 18-1) because even with mitigation, an interaction could result in an environmental effect of concern. The potential effects of a train collision with an ungulate on Wildlife and Wildlife Habitat are discussed below.

Wildlife and Wildlife Habitat

The analysis of potential effects of train collisions with ungulates is based on data provided by CN and the Ministry of Forests, Lands, and Natural Resource Operations on the number of wildlife collisions that they have been recorded over 16 years from 1995 to 2010. When there is a wildlife collision, CN train crews record the species, date and location of the collision. These data are provided by CN to the Ministry of Forests, Lands, and Natural Resource Operations.

Based on the data available, 98 moose and 24 deer were reported as killed from 1995 to 2010 along the 225 km CN Bulkley and Skeena Subdivisions between Prince Rupert and Lorne Creek. This is equivalent to 0.027 and 0.007 collisions/km/year for moose and deer, respectively. Over the 16 years that these data were collected 33 of the 98 moose collisions (34%) and seven of the 24 deer collisions (29%) occurred in 1999 alone. In February of 1999, 225 cm of snow was recorded at the Terrace airport (Environment Canada 2009, Internet site). This was the most snow recorded within a month over that time period. Snow depths of 90 cm are known to restrict moose movements (Coady 1974). As such, the deep snow in the winter of 1999 may have led to increased use of the rail right-of-way as a movement corridor by ungulates. Heavy snowfall conditions compound moose-train interactions (Andersen *et al*. 1991) and so likely account for the high collision rate during 1999.

In addition to snowfall, collision rates are also influenced by habitat quality along the rail line, line of sight and train speed. As such, ungulate mortality may be particularly high during years of heavy snowfall and in areas where food availability attracts ungulates to the rail line.

Ungulate mortality has the potential to increase given the expected increase in rail traffic along the CN Skeena and Bulkley Subdivisions. The rail traffic associated with Canpotex is expected to increase by four trains per day (two inbound and two outbound). The average number of trains per day from 1995 to 2010 is 9.84 trains per day (9.3 trains per day from 1995 to 2008 and 13.6 from 2009 to 2010). With the Project increase in rail traffic, the increase in the frequency of moose collisions will increase to 0.038 and 0.009 collisions/km/year for moose and deer respectively; increasing mortality from 6.12 to 8.62 moose per year and from 1.5 to 2.1 deer per year over the 225 km length of the rail line. Compared to highways, this predicted rail mortality rate, would fall within the mid-range of provincial highway mortalities for moose and the low-range for deer (Sielecki 2004).

The last provincial moose census of the area occurred in the Terrace Area in 1989 which estimated the population size of moose between 500 and 700 individuals in the Skeena Islands Area (BC Ministry of Environment 1989). If the number of moose mortalities from rail collisions increased by 2.5 moose per year as a result of the Project, then an additional 0.35 to 0.5% of the local population may be affected. This is a conservative estimate of effects (i.e., worst case) for a number of reasons. First, the calculation of the average number of collisions/km/year is an overestimate since it includes data from 1999, when collision rates were uncharacteristically high due to snow. Second, the increase in rail traffic is based on the assumption that the Canpotex terminal will be operating at full capacity, which is a conservative assumption.

Direct mortality for ungulates during operations is expected to be low in magnitude, with a regional scale, long term in duration, and at a regular interval. These effects will likely not be measurable at the population level. Because the confidence limits around the population estimate are wide (i.e., 500 to 700) an increase in moose mortality by 0.35 to 0.5% would not be detectable given the uncertainty in the population estimate. Therefore project effects from mortality are predicted to be *not significant*.

In addition to the Canpotex project; terminal development in the Prince Rupert Region will be accompanied by additional increases in the frequency of trains using the CN rail line from Lorne Creek to Prince Rupert. Including Canpotex, rail traffic is expected to increase by up to 20.7 trains per day as a result of the Fairview Phase II development (eight trains per day; increasing mortality by five moose per year), and RTI (8.7 trains per day; increasing mortality by 5.5 moose per year). This results in a predicted increase in mortality from 6.12 to 19.1 moose per year. For moose, this total mortality represents approximately 2.7 to 3.7% of the population.

Management of ungulate populations in British Columbia is coordinated by the BC Ministry of Forests, Lands and Natural Resource Operations through their administration of the *Wildlife Act*. For ungulates, part of this population management includes setting annual harvest rates. The annual harvest rate depends on a variety of parameters including: population size, trends, and population objectives; recruitment rates of calves into the breeding population; natural mortality (e.g., mortality associated with predation, weather conditions, etc.), and human-induced mortality (road collisions, rail collisions, and First Nations harvest). Each year biologists assess these parameters and determine the annual allowable harvest (BC Ministry of Forests, Lands, and Natural Resource Operations, 2011). In BC, sustainable harvest rates for moose reportedly range from 3% to 9% (BC Ministry of Forests, Lands, and Natural Resource Operations, 2011).

The predicted increase in rail mortality is within the range of the reported moose harvest in the last several years. Between 2005 and 2008 the moose harvest ranged from zero to 44 individuals in the Skeena 6-10 management unit, and between 22 to 66 individuals in management unit 6-15 (which overlap the Skeena and Bulkley subdivisions). The last provincial moose census of the area occurred in the Terrace Area in 1989 which estimated the population size of moose between 500 and 700 individuals in the Skeena Islands Area (BC Ministry of Environment 1989). The 2011 estimate of the moose population in the Skeena Region is between 25,000 and 45,000 individuals; and that the population trend from 2008 to 2011 ranges from decreasing (>20% decline) to stable (<20% change).

The predicted increase in rail mortality for moose is of concern for the local population. However, given the typical sustainable harvest rates for moose populations in the province, this level of mortality is not likely to affect the sustainability of moose populations in the region or province. The proportion of increase in rail mortality as a result of the Canpotex Project is low relative to the total cumulative mortality. However, CN is continuing to work with the Ministry of Forests, Lands, and Natural Resource Operations, local Rod and Gun Club representatives, and moose expert at the Moose Mortality Working Group to look at mortality rates on CN's Telkwa Subdivision. This group also examines mitigation measures, the success in reducing mortality and the impact of increased train traffic on mortality rates. This group will continue to operate and examine wildlife train impacts.

The cumulative effect of train collisions with ungulates is predicted to be *not significant*. However, given the uncertainty on demographic parameters (such as the moose population estimate in the region which is based on 1989 data) and uncertainty on the effectiveness of mitigation that CN is currently examining, the confidence in this prediction is low.

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19 CAPACITY OF RENEWABLE RESOURCES

The *Canadian Environmental Assessment Act* requires under section 16(2) (d) that comprehensive study reports "*address the capacity of renewable resources that are likely to be significantly affected by the project to meet the needs of the present and the future*". Renewable resources on Ridley Island and in Prince Rupert Harbour include vegetation (potential forestry resources), wildlife, and aquatic resources. An adverse effect on these resources could result in a reduced capacity to support sustainable forestry, fishing, hunting and trapping.

The effects of the Project on renewable resources were assessed in detail in this EIS. Renewable resources assessed include vegetation (Section 10), wildlife (Section 11), and aquatic (Section 12) resources. The effects assessments for each of these renewable resource VECs were conducted in accordance with the approved Scope of Assessment for the Project as well as environmental assessment methods that have been developed to satisfy the regulatory requirements of both CEAA and CPAEAR. The measures for significance were determined for each VEC and were generally determined by a regulatory standard or a threshold (where available) and based on community and First Nations values or management objectives.

After consideration of the Project's design and Project-specific mitigation and compensation measures, none of these thresholds or standards was exceeded. Therefore the determination for each of the renewable resource VECs described above was that the Project would not result in significant adverse residual effects.

As there are no predicted significant adverse effects on any renewable resources that may be affected by the Project, the effects of the Project on the capacity of these renewable resources are *not significant*.

As required by the Scope of Assessment, the Project's potential effects on vegetation, wildlife, and aquatic resources that support First Nations culture, health and traditional economy are assessed and discussed in the section on First Nations Current Use (Section 15). Based on our understanding of First Nations Current Use, any potential Project-related effects on Capacity of Renewable Resources will not affect Current Use.

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20 SUMMARY OF ENVIRONMENTAL EFFECTS AND MITIGATION MEASURES

20.1 Summary of Mitigation Measures

The following table provides a summary of all mitigation measures proposed as part of the EIS.

Table 20.1: Summary of Mitigation Measures

Section	Phase	Proposed Mitigation
Air Quality	Construction/ Decommissioning	▪ Equipment maintenance. ▪ Equipment will be powered with low sulphur fuel when available. ▪ If required, dust from roads will be reduced using dust suppressants, and surface paving. ▪ Scheduling (e.g., minimize activities that generate large quantities of dust during high dry winds).
	Operation	▪ Use of Best Available Technology Economically Achievable (BATEA) to reduce CAC and GHG emissions. ▪ To minimize dust, conveyers will be fully covered and will have spill trays to facilitate clean-up. ▪ Dust collection system will allow dust to be captured at all transfer points and bagged or returned to the potash handling system. Dust collection will be provided in the potash storage building to capture fugitive dust generated by stacking and reclaim operations.
Noise and Vibration	Construction/ Decommissioning	▪ Avoid construction along the east side of Ridley Island during night-time hours and on weekends where practicable. ▪ Nearby residents will be advised of significant noise-causing construction activities and these will be scheduled to create the least disruption to receptors. If noise complaints related to traffic occur, they will be logged and investigated to assess whether they are linked to Project activities. ▪ Standard best management practices (e.g. internal combustion engines, quality mufflers and vehicle maintenance). ▪ If possible, the new tracks should be continuously welded rail to avoid additional noise from jointed rail. ▪ Near sensitive receptors the number of pieces of construction equipment operating simultaneously and engine speed will be reduced where practical. ▪ A communication and complaint documentation and resolution plan will be developed. ▪ Construction equipment will be strategically placed to distance high noise producing equipment from nearby residents where possible.
	Operation	▪ Rail lubricators may be advisable if wheel squeal is problematic where sharp track curves occur. ▪ Standard best management practices (e.g., internal combustion engines, quality mufflers and vehicle maintenance). ▪ Proper maintenance of conveyor components.

Section	Phase	Proposed Mitigation
Ambient Light	Construction/ Decommissioning	▪ Where applicable, adhere to design goals stated within the Canada Green Building Council Leadership in Energy and Environmental Design (LEED) guidelines (LEED 2004) and the International Commission on Illumination (CIE 2003). ▪ Use of shielded, cut-off design construction lighting. ▪ Only direct light to where it is needed while still ensuring that safety requirements are met. ▪ Retain a tree line on the east side of the island and on the high ground where possible. ▪ Control light levels, including reducing use of lights where activities are not occurring.
	Operation	▪ All outdoor operational lighting will be equipped with “dark sky” shielded fixtures. ▪ Streetlights will be shielded and of cut-off design. ▪ Control light levels, including reducing use of lights where activities are not occurring. ▪ Centralized lighting control system to be able to selectively turn off lights where they are not required.
Vegetation Resources	Construction/ Decommissioning	▪ Development of a drainage and erosion control plan (as outlined in the EMP). These techniques may include the construction of berms to direct runoff and maintain hydrological regimes of sensitive plants and plant communities, as well as the installation of silt fences to remove suspended solids before runoff water leaves the Project site. ▪ Development of a weed control plan to manage indirect effects from introduction of invasive species. ▪ Development of a wetland compensation plan as determined through consultation with CWS. This compensation plan may include some of the following activities: • Provision of funding to organizations whose mandates are consistent with enhancement, preservation, restoration and creation of wetland habitat (e.g., Ducks Unlimited Canada). • Funding to organizations whose mandate is to specifically provide one or more of the identified functions provided by wetlands affected by the project (e.g., Pacific Carbon Trust). • Enhancement, restoration of construction of wetland areas to replace or better provide the lost functions. • Preservation of wetland areas that provide functions similar to those on the Project footprint. Preservation can be made through securement of property and/or land use covenants. • Restoration of degraded wetland areas with the potential to provide these functions. • Creation of wetland areas with design goals to provide these functions. ▪ The wetland compensation plan will include planting of traditional use plant species where possible and practicable.
	Operation	▪ Compliance with weed control plan.

Section	Phase	Proposed Mitigation
Wildlife and Wildlife Habitat	Construction/ Decommissioning	▪ To the greatest extent possible, clearing, grading, construction, and temporary storage of materials will be limited to the Project site. Boundaries of the footprint will be clearly marked to ensure clearing does not extend beyond this. ▪ Development of a wetland compensation plan as determined through consultation with CWS. ▪ Vegetation will be cleared outside of the nesting season for birds (April 1 to July 31) where possible, to avoid mortality of birds, nests or eggs. Should clearing be required during the nesting season, nest surveys will be conducted by qualified biologists to ensure no nests are present. ▪ The two trees containing the bald eagle nests will be retained and a 50 m no-development setback will be established around the trees. While the nest is active there will be no construction activity within 1.5 times the height of the tree (approximately 35 m buffer [BC MOE, 2005]). ▪ Feeding and harassment of wildlife is prohibited. ▪ Prior to vegetation clearing and grubbing there will be a search and salvage to remove western toads from the project footprint to avoid mortality of individuals. Western toads will be salvaged when they are active (January to October) and will be relocated to an appropriate site as determined through consultation with EC. ▪ To minimize the risk of toads being killed as a result of on-land disposal activities disposal into potential breeding ponds will occur in the fall following completion of western toad's breeding period. If disposal is required during the breeding season, exclusion fencing will be placed around potential breeding ponds, prior to the breeding period to deter use of the ponds. ▪ To avoid road and rail mortality during construction, western toads will be salvaged and relocated during their migration between terrestrial and breeding habitats. The need to salvage and relocate will be reassessed prior to commissioning. ▪ Equipment used for construction and operation activities will be maintained in good working order and properly muffled to unnecessary noise.
	Operation	▪ Feeding and harassment of wildlife is prohibited. ▪ Best management practices (e.g., maintenance of equipment and properly muffled equipment). ▪ Enforcing low vehicle speeds on Ridley Island roads and avoiding toads on roadway (e.g., 40km/h). ▪ To avoid road and rail mortality during construction, western toads will be salvaged and relocated during their migration between terrestrial and breeding habitats. The need to salvage and relocate will be reassessed prior to commissioning.

Section	Phase	Proposed Mitigation
Aquatic Environment	Construction/ Decommissioning	▪ Seasonal Avoidance: Blasting will be avoided where possible during the peak of the juvenile salmon migration as defined through conversations with DFO. ▪ Marine Mammal Monitoring Program: A marine mammal monitoring program will be implemented to enforce the 500-m exclusion zone during blasting operations. Blasting will only occur during daylight hours to ensure that marine mammals can be seen if they approach or enter the exclusion zone. ▪ Bubble Curtains: During pile driving, bubble curtains may be used to reduce sound levels emitted to the marine environment. ▪ Fish Salvage Program: A fish salvage will take place prior to infilling the tidal pond. Salvage methods will include the use of traps and seine nets. Fish will be released to suitable habitat undisturbed by the Project. ▪ Blasting Guidelines: Guidelines for underwater blasting (Wright and Hopky 1998) recommended by DFO will be followed: • Ammonium nitrate-fuel oil mixtures will not be used. • After loading a charge in a hole, the hole will be back-filled (stemmed) with angular gravel to the level of the substrate/water interface or the hole collapsed to confine the force of the explosion to the formation being fractured. The angular gravel is to have a particle size of approximately 1/12th the diameter of the borehole. • All "shock-tubes" and detonation wires will be recovered and removed after each blast. • Explosives will not be knowingly detonated within 500 m of any marine mammal (or within visual contact from an observer using 7x35-power binocular). • The blasting contractor will use appropriate equations to ensure that no explosive is detonated in or near fish habitat that produces, or is likely to produce, an instantaneous pressure change (i.e., overpressure) greater than 100 kPa (14.5 psi) in the swimbladder of a fish. ▪ A vibratory pile driver will be used wherever feasible. ▪ Erosion Control: Erosion and runoff controls will be in place on land to minimize increases in TSS and turbidity in nearshore waters around the terminal. ▪ Water Treatment: Stormwater, wastewater, and sewage associated with the terminal will be collected and treated before discharge from the site, and a Waste Management Plan will be prepared. ▪ TSS Monitoring: TSS levels will be monitored during in-water construction activities (e.g. shoreline infilling, causeway construction, pile installation, blasting, dredging and disposal at sea) to ensure that levels do not exceed the established guidelines. ▪ Habitat Compensation: where habitat loss cannot be avoided it will be compensated for with the rehabilitation of existing marine fish habitats and/or the creation of new habitats. Details will be provided in a habitat compensation plan developed in conjunction with DFO.
	Operation	▪ Water Treatment: Stormwater, wastewater, and sewage will be collected and treated before discharge from the site, and a Waste Management Plan will be prepared for the construction and operation phases of the Project. Storm

Section	Phase	Proposed Mitigation
		water will be diverted through drainage ditches to avoid contamination with potash and other materials and, where required, will undergo water/oil separation before being discharged to the marine environment. Sewage will undergo secondary treatment at an on-site treatment plant before being discharged. Follow-up monitoring of sewage discharge will be performed as per provincial and regional requirements. Potash washdown water will be routed through a two-stage, 1,500 m^3 settling pond prior to being discharged through the marine outfall. This settling pond allows the water to be tested to ensure pH and contaminant levels are suitable for disposal prior to discharge via the marine outfall. ▪ Erosion Control: Erosion and runoff controls will be in place on land to minimize increases in TSS and turbidity in nearshore waters around the terminal.
Archaeological and Heritage Resources	Construction	▪ Avoidance of CMTs where possible (preferred mitigation). ▪ Where removal of CMT is required, activity will be monitored by a crew comprised of a professional archaeologist and a local First Nation representative to ensure that the stem-round samples are properly collected for CMT dating purposes. ▪ Where necessary level II recording as outlined in the CMT Handbook (Archaeology Branch 2001) including the direct dating of CMTs by increment corer or stem-round sampling. ▪ Systematic Data Recovery (SDR) where avoidance of terrestrial archaeological and heritage sites is not feasible, may involve: • Scientific excavation and recovery of some or all portions of the sites to be impacted. • Collection and analysis of artifacts, faunal remains, botanical remains, and other archaeological remains. • Collection and processing of carbon samples for dating. • Completion of other appropriate specialized analytical processes (e.g. geochemical analyses of stone tools, blood residue analysis, etc.). • Cataloguing of all collected artifacts and their subsequent curation in an approved facility. • Detailed final report to ensure that the collected data and the results of all analytical processes are available to other archaeologists and First Nations. ▪ SDR where intertidal avoidance is not feasible, may involve: • The adoption of wet site procedures using high-pressure hoses and a wet-screening process. • Mapping of the distributions of artifacts and features. • Surface collection of artifacts. • Detailed recording of intertidal features. • SDR protocol as described for terrestrial archaeological and heritage sites.
Human Health	Construction/ Operation/ Decommissioning	▪ Mitigations are consistent with those already identified for noise, light and air quality.

Section	Phase	Proposed Mitigation
Navigable Waters	Construction/ Decommissioning	▪ A marine communication plan will be in place to ensure that vessels are aware of construction activities in the area and of protection zones if required. ▪ Protection zones affecting navigation will be identified. ▪ Use of dark sky shielded fixtures.
	Operation	▪ All shipping within the Port of Prince Rupert will be conducted following the rules of shipping established by the Port under the *Canada Marine Act* and in compliance with the requirements of the Canadian Coast Guard (CCG), and with the Port Authority Operations Regulations. ▪ Measures to reduce lighting interference with navigation and navigational aids will be implemented based on recommendations provided during the environmental assessment and NWPA Marine Referral process. ▪ Use of dark sky shielded fixtures where possible without affecting human safety. ▪ Installation of navigational aids on the new structure where required. ▪ Updated navigational charts showing the jetty location.
First Nations Current Uses	Construction/ Decommissioning	▪ As per mitigation outlined for Archaeology and Heritage Resources, Aquatic Resources and Navigation. ▪ Where possible traditional use plants will be used for replanting. ▪ Canpotex and the PRPA have offered accommodation to compensate for loss of potential access to the project site.

20.2 Summary of Residual Effects

The following table summarizes the residual effects from the Project, after implementing mitigation measures, on each VEC.

Table 20.2: Summary of Residual Effects

Section	Potential Effect	Residual Effects
Air Quality	**Change in criteria air contaminants:** Exhaust from equipment use and the creation of dust during construction and commissioning, as well as equipment and vessel use during operations, have the potential to introduce air contaminants into the atmosphere.	▪ **Adverse** in direction (condition of the atmospheric environment is worsening in comparison to baseline conditions and trends). ▪ **Low** in magnitude (effect occurs that is detectable but is within normal variability of baseline conditions). ▪ **Local** in geographic extent (effect restricted to the LAA). ▪ **Medium-term** in duration (effect occurs for between 3 and 20 years). ▪ Is **sporadic** in frequency. ▪ **Reversible**. ▪ **Disturbed** in ecological context (effect takes place within an area with human activity. Area has been substantially previously disturbed by human development or human development is still present).
	Change in greenhouse gas emissions: Exhaust from equipment and vessel use during operation has the potential to alter the amount of greenhouse gases introduced into the atmosphere.	A full analysis of Project-related GHG emissions was conducted in Section 7.0 of the Air Quality Technical Data Report (Stantec 2011). It was determined that the Project: 1) is a low emitter; 2) does not exceed jurisdictional policies; 3) does not exceed the industry profile; and 4) will implement best practices. As such, Project emissions of GHGs were not considered in the environmental effects characterization.

Section	Potential Effect	Residual Effects
Noise and Vibration	**Change in noise levels:** Higher noise levels due to Project construction and decommissioning, and from the export terminal and increased rail traffic may cause disturbance and/or annoyance at nearby receptor sites.	▪ **Adverse** in direction (negative change). ▪ **Low** in magnitude (effect is detectable but only on a few individuals). ▪ **Local** in geographic extent (limited to Ridley Island or within 1 km of the rail corridor up to Lorne Creek). ▪ Is **rare** in frequency. ▪ **Long-term** in duration (measurable for more than two years or for the life of the Project). ▪ **Reversible**. ▪ **Undisturbed** ecological context (effect takes place within an area with human activity. Area has been substantially previously disturbed by human development or human development is still present).
	Change in vibration: Vibration at nearby receptors from construction/decommissioning activities and increased rail traffic may cause annoyance and/or structural damage.	▪ **Adverse** in direction (negative change). ▪ **Low** in magnitude (effect is detectable by only on a few individuals). ▪ **Site-specific** in geographic extent (limited to the Project footprint or rail corridor). ▪ Is **sporadic** in frequency. ▪ **Long-term** in duration (measurable for more than two years or for the life of the Project). ▪ **Reversible**. ▪ **Undisturbed** ecological context (effect takes place within an area with human activity. Area has been substantially previously disturbed by human development or human development is still present).
Ambient Light	**Change in ambient light quality:** Change in light spill or trespass, change in glare and change in sky glow may result from exterior light use during all phases of the project.	▪ **Adverse** in direction (negative change). ▪ **Low** in magnitude (effect is detectable but is minimized through design mitigation). ▪ **Local** in geographic extent (limited to Ridley Island and the Village of Port Edwards [i.e., the LAA]). ▪ Is **continuous** in frequency. ▪ **Long-term** in duration (measureable for the life of the Project). ▪ **Reversible**. ▪ **Undisturbed** ecological context (there are no existing disturbances of comparable magnitude or the environment is unable to withstand adverse effects).

Section	Potential Effect	Residual Effects
Vegetation Resources	**Loss of rare vascular plants:** Site preparation activities involve complete vegetation removal within the Project footprint and therefore may result in the loss of rare vascular plants.	▪ **Neutral** in direction (no change compared to baseline status). ▪ **Undisturbed** ecological context (effect takes place within an area that is relatively unaffected or not adversely affected by human development).
	Loss of ecological communities of conservation concern: Site preparation activities involve complete vegetation removal within the Project footprint and therefore may result in the loss of ecological communities of conservation concern.	▪ **Adverse** in direction (negative change). ▪ **Moderate** in magnitude (effect will result in elimination of some native species or communities, or alteration (but not elimination) of rare plant populations or ecological communities; wetland function will not be lost. ▪ **Site-specific** in geographic extent (environmental effects are restricted to the site infrastructure (i.e., Project footprint). ▪ Occurs **once** in frequency. ▪ **Long-term** in duration (measureable for the life of the Project). ▪ **Irreversible.** ▪ **Undisturbed** ecological context (effect takes place within an area that is relatively unaffected or not adversely affected by human development).
	Loss of old forest: Site preparation activities involve complete vegetation removal within the Project footprint and therefore may result in the loss of old forest.	▪ **Adverse** in direction (negative change). ▪ **Low** in magnitude (alteration, but not elimination, of the abundance of native species or communities. However, no rare species or wetland function will be lost). ▪ **Site-specific** in geographic extent (environmental effects are restricted to the site infrastructure (i.e., Project footprint). ▪ Occurs **once** in frequency. ▪ **Long-term** in duration (measureable for the life of the Project). ▪ **Reversible**. ▪ **Undisturbed** ecological context (effect takes place within an area that is relatively unaffected or not adversely affected by human development).
	Loss of wetland function: Site preparation activities involve complete vegetation removal within the Project footprint and therefore may result in the loss of wetland function.	▪ **Neutral** in direction (no change compared to baseline status). ▪ **Undisturbed** ecological context (effect takes place within an area that is relatively unaffected or not adversely affected by human development).

Section	Potential Effect	Residual Effects
	Loss of riparian areas: Site preparation activities involve complete vegetation removal within the Project footprint and therefore may result in the loss of riparian areas	▪ **Adverse** in direction (negative change). ▪ **Low** in magnitude (alteration, but not elimination, of the abundance of native species or communities. However, no rare species, communities or wetland function will be lost). ▪ **Site-specific** in geographic extent (environmental effects are restricted to the site infrastructure (i.e., Project footprint). ▪ Occurs **once** in frequency. ▪ **Long-term** in duration (measureable for the life of the Project). ▪ **Reversible**. ▪ **Undisturbed** ecological context (effect takes place within an area that is relatively unaffected or not adversely affected by human development).
	Loss of traditional use plants: Site preparation activities involve complete vegetation removal within the Project footprint and therefore may result in the loss of traditional use plants	▪ **Adverse** in direction (negative change). ▪ **Low** in magnitude (alteration, but not elimination, of the abundance of native species or communities. However, no rare species, communities or wetland function will be lost). ▪ **Site-specific** in geographic extent (environmental effects are restricted to the site infrastructure (i.e., Project footprint). ▪ Occurs **once** in frequency. ▪ **Long-term** in duration (measureable for the life of the Project). ▪ **Reversible**. ▪ **Disturbed** in ecological context (effect takes place within an area with human activity. Area has been substantially previously disturbed by human development or human development is still present).

Section	Potential Effect	Residual Effects
Wildlife and Wildlife Habitat	**Change in habitat availability:** Site preparation activities will remove breeding, feeding and wintering habitat for wildlife; and deposition of sediment in man-made ponds designated for waste disposal may reduce habitat quality; noise and disturbance associated with project activities can reduce quality of adjacent habitats.	▪ **Adverse** in direction (negative change). ▪ **Low** in magnitude (effect is detectable but only on a few individuals [<0.5% of the population]). ▪ **Local** in geographic extent (environmental effects extend beyond the Project footprint but remain localized within LAA). ▪ Occurs **once** in frequency. ▪ **Permanent** in duration. ▪ **Reversible**. ▪ **Disturbed** ecological context (area has been substantially previously disturbed by human development or human development is still present).
	Risk of mortality: There is mortality risk for some wildlife species, such as small mammals, amphibians, and bird nests and nestlings during vegetation clearing and grubbing. Sediment waste disposal in man-made ponds, and increased road and rail traffic may result amphibian in mortality.	▪ **Adverse** in direction (negative change). ▪ **Low** in magnitude (effect is detectable but only on a few individuals [<0.5% of the population]). ▪ **Site-specific** in geographic extent (environmental effects are restricted to the site infrastructure (i.e., Project footprint). ▪ Occurs **rarely** in frequency. ▪ **Long-term** in duration (effects are measurable for the life of Project). ▪ **Reversible**. ▪ **Disturbed** ecological context (area has been substantially previously disturbed by human development or human development is still present).
	Alteration of movement: Project activities in the marine environment may induce avoidance behaviour by marine birds, potentially interrupting their foraging activities. There is potential for the road and rail corridor to alter the movement of western toads migrating between terrestrial and aquatic breeding habitat.	▪ **Adverse** in direction (negative change). ▪ **Low** in magnitude (effect is detectable but only on a few individuals [<0.5% of the population]). ▪ **Local** in geographic extent (environmental effects extend beyond the Project footprint but remain localized within the LAA). ▪ Is **continuous** in frequency. ▪ **Long-term** in duration (effects are measurable for the life of Project). ▪ **Reversible**. ▪ **Disturbed** ecological context (area has been substantially previously disturbed by human development or human development is still present).

Section	Potential Effect	Residual Effects
Aquatic Environment	**Loss or alteration of fish habitat:** Project activities associated with construction of the marine terminal and the road, rail and utility corridor have the potential to result in harmful alteration, disruption or destruction of fish habitat (HADD).	▪ **Adverse** in direction (negative change). ▪ **Moderate** in magnitude (measurable effects to habitat function anticipated in moderately sensitive habitats or anticipated mortality risk to non-listed species). ▪ **Site-specific** in geographic extent (effects restricted to habitat within the Project footprint). ▪ Occurs **once** in frequency. ▪ **Medium-term** in duration (effects are measurable for many months to two years). ▪ **Reversible**. ▪ **Undisturbed** ecological context (effect takes place within an area that is relatively unaffected or not adversely affected by human development).
	Direct mortality or physical injury: Non-motile marine organisms (e.g., some invertebrates) may be buried or crushed during shoreline infilling associated with construction of the marine causeway and the road, rail and utility corridor. Motile organisms (e.g., fish and marine mammals) may be harmed or killed by intense underwater sound levels produced by in-water construction activities such as blasting, pile-driving and dredging.	▪ **Adverse** in direction (negative change). ▪ **Moderate** in magnitude (measurable effects to habitat function anticipated in moderately sensitive habitats or anticipated mortality risk to non-listed species). ▪ **Local** in geographic extent (effects extend beyond Project footprint but remain within the local assessment area). ▪ Is **sporadic** in frequency. ▪ **Medium-term** in duration (effects are measurable for many months to two years). ▪ **Reversible**. ▪ **Undisturbed** ecological context (effect takes place within an area that is relatively unaffected or not adversely affected by human development).
	Sensory disturbance: In-water Project activities will produce underwater sounds that could elicit behavioural responses in marine organisms.	▪ **Adverse** in direction (negative change). ▪ **Low** in magnitude (measurable effects to habitat function anticipated in low-sensitivity habitats and no measurable reduction in number of any fish species anticipated). ▪ **Regional** in geographic extent (effects extend into the regional assessment area). ▪ Is **regular** in frequency. ▪ **Long-term** in duration (affects are measurable for multiple years but are not permanent). ▪ **Reversible**. ▪ **Undisturbed** ecological context (effect takes place within an area that is relatively unaffected or not adversely affected by human development).

Section	Potential Effect	Residual Effects
	Degradation of sediment and water quality: The construction and operation of the Project could result in changes to sediment and water quality, i.e. the physical and chemical parameters of marine sediment and seawater, including inorganic and organic contaminants.	▪ **Adverse** in direction (negative change). ▪ **Low** in magnitude (measurable effects to habitat function anticipated in low-sensitivity habitats and no measurable reduction in number of any fish species anticipated). ▪ **Local** in geographic extent (effects extend beyond Project footprint but remain within the local assessment area). ▪ Is **sporadic** in frequency. ▪ **Short-term** in duration (effects are measurable for days to a few months). ▪ **Reversible**. ▪ **Undisturbed** ecological context (effect takes place within an area that is relatively unaffected or not adversely affected by human development).
Human Health	**Changes to country foods causing human health effects:** Dredging and marine facilities construction activities may elevate TSS and expose fish to increased metal and PAH concentrations in water and sediment. Consumption of contaminated fish tissues may pose a health risk to humans.	▪ **Neutral** (no change to baseline conditions.
	Changes to air quality causing human health effects: Emissions of CACs to the surrounding airshed have the potential to result in adverse health effects to people that inhale them.	▪ **Adverse** in direction (negative change). ▪ **Low** in magnitude (Incomplete exposure pathway or no change predicted in uptake of Project-related contaminants of concern). ▪ **Local** in geographic extent (effects extend beyond Project footprint but remain within the local assessment area). ▪ Is **continuous** in frequency. ▪ **Long-term** in duration (measurable for more than 20 years). ▪ **Reversible**. ▪ **Disturbed** ecological context (area has been substantially previously disturbed by human development or human development is still present).

Section	Potential Effect	Residual Effects
	Changes to ambient light causing human health effects: Potential effects of increased ambient light levels from construction and operation to local people relate to light trespass (direct brightening of naturally darker zones), glare/visual issues, and sky glow (indirect brightening of naturally darker zones). Exceedance of Commission Internationale de L'Éclairage (CIE) standards for these three light attributes can lead to annoyance and reduction in quality of life to local residents.	▪ **Adverse** in direction (negative change). ▪ **Low** in magnitude (Incomplete exposure pathway or no change predicted in uptake of Project-related contaminants of concern). ▪ **Local** in geographic extent (effects extend beyond Project footprint but remain within the local assessment area). ▪ Is **continuous** in frequency. ▪ **Long-term** in duration (measurable for more than 20 years). ▪ **Reversible**. ▪ **Disturbed** ecological context (area has been substantially previously disturbed by human development or human development is still present).
	Changes to noise causing human health effects: Potential effects of increased noise levels from construction and operation include reduced ability to communicate, reduced sleep quality and quantity, and reduced quality of life.	▪ **Adverse** in direction (negative change). ▪ **Low** in magnitude (Incomplete exposure pathway or no change predicted in uptake of Project-related contaminants of concern). ▪ **Local** in geographic extent (effects extend beyond Project footprint but remain within the local assessment area). ▪ Occurs **regularly** in frequency. ▪ **Long-term** in duration (measurable for more than 20 years). ▪ **Reversible**. ▪ **Disturbed** ecological context (area has been substantially previously disturbed by human development or human development is still present).

Section	Potential Effect	Residual Effects
Archaeological and Heritage Resources	**Destruction of CMTs:** The clearing of vegetation from the Project area prior to grading and construction activities would result in the destruction of CMTs, if present in the footprint.	▪ **Adverse** in direction (negative change). ▪ **Low/Moderate** in magnitude (Effect is detectable but is limited to small portions of archaeological or heritage sites of low significance[1] or to portions of archaeological or heritage sites already substantially disturbed by previous developments or affects small but intact portions of archaeological or heritage sites of moderate or high significance[1], or substantial, intact portions of archaeological or heritage sites of low significance[1].) ▪ **Site-specific** in geographic extent (effects restricted to habitat within the Project footprint). ▪ Occurs **once** in frequency. ▪ **Long-term** in duration (Measurable for the life of the Project). ▪ **Irreversible**. ▪ **Disturbed** ecological context (area has been substantially previously disturbed by human development or human development is still present). [1] 'Significance' in this context is defined as per the BC Archaeological Impact Assessment Guidelines
	Disturbance or destruction of terrestrial archaeological or heritage sites: Terrestrial archaeological or heritage sites may be damaged or destroyed, if present in the footprint, by site preparation activities and the installation of services.	▪ **Adverse** in direction (negative change). ▪ **Low/High** in magnitude (Effect is detectable but is limited to small portions of archaeological or heritage sites of low significance or to portions of archaeological or heritage sites already substantially disturbed by previous developments or effects substantial, intact portions of one or more sites of moderate or high significance. ▪ **Site-specific** in geographic extent (effects restricted to the Project footprint). ▪ Occurs **once** in frequency. ▪ **Long-term** in duration (Measurable for the life of the Project). ▪ **Irreversible**. ▪ **Disturbed or Undisturbed** in ecological context.
	Disturbance or destruction of intertidal archaeological or heritage sites: Intertidal archaeological or heritage sites may be damaged or destroyed, if present in the footprint, by development activities during construction of the Project and may arise in relation to construction of marine facilities such as the causeway, trestle, and berth.	▪ **Adverse** in direction (negative change). ▪ **Low/High** in magnitude (Effect is detectable but is limited to small portions of archaeological or heritage sites of low significance or to portions of archaeological or heritage sites already substantially disturbed by previous developments or effects substantial, intact portions of one or more sites of moderate or high significance. ▪ **Site-specific** in geographic extent (effects restricted to the Project footprint). ▪ Occurs **once** in frequency. ▪ **Long-term** in duration (Measurable for the life of the Project). ▪ **Irreversible**. ▪ **Disturbed or Undisturbed** in ecological context.

Section	Potential Effect	Residual Effects
First Nations Current Uses	**Changes to current traditional use patterns:** Project construction and operation activities have the potential to alter or destroy vegetation, wildlife, freshwater, and marine First Nation traditional resources and heritage sites will restrict access to terrestrial and near shore marine habitats and will have an adverse environmental effect on First Nation traditional land use on Ridley Island.	▪ **Adverse** in direction. ▪ **Low** in magnitude. ▪ **Site-specific** in geographic extent. ▪ Is **regular** in frequency. ▪ **Long-term** in duration. ▪ **Reversible**.
Navigable Waters	**Physical interference:** Nearshore recreational navigation along the west coast of Ridley Island near the Project site may be affected by the presence of the new berth and access trestle, construction equipment and vessels. During operations, small crafts capable of using the shallow waters between Ridley and Coast Islands will be required to detour around the jetty, travel on the seaward side of Coast Island. Lighting at the terminal may also interfere with navigation. At decommissioning, the berth and access trestle will remain in place; therefore, potential physical interference from the structure will remain after decommissioning.	▪ **Adverse** in direction (negative change). ▪ **Low** in magnitude (: measurable effects to use of Navigable Waters anticipated in low-use areas). ▪ **Site-specific** in geographic extent (effects restricted to area within the marine Project footprint). ▪ Is **sporadic** in frequency. ▪ **Permanent** in duration (effects are permanent). ▪ **Reversible**. ▪ **Disturbed** ecological context (area has been substantially previously disturbed by human development or human development is still present).
	Change in vessel traffic: Vessel traffic is anticipated to increase in the LAA during construction of the jetty structure and associated dredging and disposal at sea, as well as during operations.	▪ **Adverse** in direction (negative change). ▪ **Low** in magnitude (measurable effects to use of Navigable Waters anticipated in low-use areas). ▪ **Regional** in geographic extent (effects extend into the RAA). ▪ Is **regular** in frequency. ▪ **Long-term** in duration (effects are measurable for >2 years but are not permanent). ▪ **Reversible**. ▪ **Disturbed** ecological context (area has been substantially previously disturbed by human development or human development is still present).

20.3 Summary of Cumulative Environmental Effects

A screening of the cumulative environmental effects of the Projects, in combination with the residual environmental effects from past, current, and likely future projects, was complete to determine if there is a risk of meaningful cumulative environmental effects. The cumulative effects assessment was conducted in two stages. The initial stage consisted of answering the following three questions for each of the VECs:

1. Is the Project predicted to have demonstrable residual environmental effects?
2. Are these effects likely to act in a cumulative fashion with the residual environmental effects of past, current, and likely future projects?
3. Is there a reasonable expectation that the combined cumulative effects (from question 1 and 2) will result in significant adverse environmental effects?

A total of 20 past, current, and future projects in the vicinity of the Port of Prince Rupert were included in the cumulative effects assessment. The projects and their residual effects are summarized in Table 20.3, their location is shown in Figure 20-1.

Table 20.3: Residual Cumulative Effects from Past, Present and Likely Future Projects

Project	Residual Environmental Effects
Marine Terminals/Facilities including: Atlin Terminal, Northland Terminal, Lightering Dock, Ocean Dock, Westview Dock, and Fairview Terminal (Phase I and II)	▪ Air emissions due to shipping traffic and equipment use for loading/unloading vessels ▪ Approximately 13 km of shoreline development including jetties and bank armouring (along Kaien Is. and in Porpoise Harbour) ▪ Infill of an estimated 24 ha of marine habitat ▪ 380 vessels per year in 2010 and upwards of 967 by 2017
Prince Rupert Airport	▪ Air emissions from aircraft and vehicle traffic ▪ Loss of approximately 13 ha of terrestrial habitat on Digby Is.
City of Prince Rupert	▪ Non point-source air emissions from motor vehicle traffic and heating homes/businesses ▪ Loss of approximately 900 ha of terrestrial habitat on Kaien Is. from municipal developments (including land portions of marine terminals) ▪ Sewage and storm water discharges to Prince Rupert harbour
District of Port Edward	▪ Non point-source air emissions from motor vehicle traffic and heating homes/businesses ▪ Loss of approximately 46 ha of terrestrial habitat from municipal developments on mainland
CN Rail Line	▪ Approximately 40 ha of terrestrial habitat loss and an estimated 2 ha of marine infill associated with 25 km of rail in the Prince Rupert and Port Edward area ▪ Up to 14 trains (inbound and outbound) per day currently and 34 train per day in the future ▪ Air emissions due to locomotive operation

Project	Residual Environmental Effects
Watson Island Pulp and Paper Mill	▪ Loss of approximately 48 ha of terrestrial habitat on Watson Is. ▪ Infill of an estimated 6 ha of marine and estuarine habitat for “land-bridge” to mainland and pipeline causeways
Ridley Island Developments including: Prince Rupert Grain, Ridley Terminals (existing and proposed expansion), Houston Pellet, ICEC, the former Ridley Island log sort, and future developments	▪ Air emissions due to shipping traffic and equipment use for loading/unloading vessels ▪ Loss of approximately 48 ha of terrestrial habitat on Ridley Is. ▪ Infill of an estimated 35 ha of marine intertidal habitat for “land-bridge” to Kaien Island and overburden disposal ▪ Anticipated loss of approximately 175 ha of terrestrial habitat for future developments
Combined Residual Environmental Effects in the Prince Rupert Area	▪ Air emissions ▪ 13 km of shoreline development ▪ Sewerage and storm water discharges ▪ 1,270 ha of terrestrial habitat loss ▪ 67 ha of marine infill

A summary of the cumulative environmental effects that are predicted to occur are provided below. A more detailed discussion of the cumulative environmental effects is provided in the VEC-specific chapters. In all cases, the cumulative environmental effects are predicted to be not significant.

Air Quality

Cumulative effects include emissions of CACs and GHGs from all existing and industrial sources and publicly disclosed projects in combination with the Project emissions. The emissions from vessels, locomotives, and permitted sources were included in the dispersion modelling completed for the Project. Non-point sources identified above were integrated into the model via the ambient air quality conditions. With respect to CACs considered in the assessment, the dispersion modelling indicates that nearly all of the maximum predicted ground-level concentrations of SO_2, NO_2, CO, and $PM_{2.5}$ were below the national regulatory objectives. Only a small amount of the predicted concentrations are attributable to the Project. Exceptions occurred in the case of one-hour SO_2, where the predicted concentrations were virtually equal to the most stringent national objective of 450 $\mu g\ m^{-3}$. Therefore, the cumulative environmental effects on the Air Quality VEC are predicted to be not significant. Potential effects of GHG emissions cannot be attributed to any specific project, and as such, the significance of their cumulative effects was not assessed.

Noise and Vibration

Project activities will result in demonstrable and measurable residual effects on noise and vibration, and these effects will act cumulatively with the effects of other projects and activities in the area. As there was a reasonable expectation that the Project’s contribution to cumulative effects could have a significant effect on noise and vibration levels, a detailed cumulative effects assessment was completed. Results of this assessment indicate that for all receptors, the change due to increases caused by the Project will be within the criterion set by Health Canada. Therefore, cumulative effects on the Noise and Vibration VEC are predicted to be not significant.

Ambient Light

There is potential for the Project to contribute to increased spillover light in the RAA cumulatively with light emitted from other facilities on Ridley Island. However, as a result of the Project's design specifications and mitigation measures, such as the timing of activity and the use of appropriate shielding, cumulative effects of additional light from the Project are not expected to be substantial. Therefore, cumulative effects on the Ambient Light VEC are predicted to be not significant.

Vegetation Resources

Project effects on vegetation resources will result in residual effects due to the loss of Blue-listed upland communities, old forest, riparian area and traditional use plants. These residual effects have the potential to act cumulatively with other projects and activities in the region including past, current, and future proposed projects in Prince Rupert and on Ridley Island. The vegetation RAA is the Kaien Landscape Unit, within which Ridley Island falls (as identified by Schedule 1 of the Central and North Coast Order). It has a terrestrial area of 50,111 ha, of which approximately 38,562 ha (77%) are forested (Government of BC 2011). Approximately 31,306 ha (80%) of this is old forest, according to the provincial Vegetation Resource Inventory; cumulative effects on old forest are not significant. Given that less than 5% of the RAA is developed, and given the abundance of forest in the RAA with the potential to support blue-listed communities, riparian area and traditional use plants, there is no reasonable expectation that the Project's contribution to cumulative effects will compromise the sustainability of the affected resources regionally. Therefore, combined cumulative effects on Vegetation Resources are considered to be not significant.

Wildlife and Wildlife Habitat

The Project does result in demonstrable and measurable residual effects on wildlife resources. Specifically, the Project will result in the loss and alteration of habitat for wildlife, result in a low level of wildlife mortality risk for nesting birds and western toad, and alter the local movement of marine birds feeding near the entrance to Prince Rupert Harbour adjacent to Ridley Island. Past, current and future developments in the area have similar effects on wildlife and will act cumulatively with these residual Project effects.

The current population status of species (Special Concern, Threatened, or Endangered) is a measure of the past cumulative effects of development on wildlife. The approach to the assessment of Project effects on wildlife is inherently cumulative in nature because of its focus on the sustainability of populations of species at risk. There has been a loss of 1,095 ha of terrestrial habitat from past and current projects in the Prince Rupert region, which has potentially contributed to the current population status of SARA listed species. The Project will affect 121 ha of terrestrial habitat and additional future projects will contribute to loss of an additional 175 ha. The Project contribution to habitat loss is predicted to affect less than 0.3% of the species populations of SARA-listed species potentially affected by the Project (i.e., marbled murrelet, northern goshawk, and western toad). However, given the mitigation measures in place and the limited regional development, there is no reasonable expectation that the cumulative environmental effects will affect the sustainability of wildlife resources in the Prince Rupert region.

The rationale for this conclusion is that most wildlife populations in the region are secure, the alteration of movement to wildlife will be low in magnitude, Project-related effects to the risk of mortality will be minor as there are proven mitigation measures (such as adherence to timing windows, and toad salvage and relocation), the total area of habitat affected is low and will primarily affect wildlife species with secure populations, and the Project-specific habitat loss for western toads will be mitigated through wetland compensation.

Aquatic Environment

Project activities will result in demonstrable and measurable residual effects on the aquatic environment. In-water construction activities will result in the loss or alteration of marine fish habitats and the injury or mortality of sedentary marine organisms within the Project footprint. Underwater sounds produced during construction and operations may result in local avoidance of some areas by fish and marine mammals. These project-specific effects will act cumulatively with similar effects of other projects and activities in the Prince Rupert Harbour.

Within the Prince Rupert Harbour, approximately 13 km of shoreline have been affected by coastal development, including jetty construction and shoreline armouring. This development has led to the loss of approximately 67 ha of marine habitat. These areas of habitat loss represent only a small fraction of the total available marine fish habitat within the Prince Rupert Harbour, and an even smaller fraction of available habitat in the RAA. Given the limited amount of regional development and the abundance of undisturbed marine fish habitats, cumulative effects of past, current and future projects on the marine environment are not expected to impact any population of fish, invertebrate or marine mammal at the regional level.

Under the *Fisheries Act*, marine fish habitats affected by current and future developments will be compensated for with the creation new habitats, ensuring that the productive capacity of the marine environment is not diminished. Localized losses of sedentary marine organisms will be temporary, as most affected species are abundant in adjacent unaffected areas, and are expected to quickly recolonize the disturbed habitats. Sensory disturbance resulting from anthropogenic underwater sounds will also be site-specific and temporary, as marine animals are expected to return to ensonified areas following the cessation of acoustic disturbance. Given that the viability of no marine species will be compromised, cumulative effects on the Aquatic Environment VEC are predicted to be not significant.

Human Health

Cumulative effects assessment for human health includes evaluation of the potential residual effects from changes to air quality, light, noise and country foods. The air quality assessment indicated no significant adverse residual cumulative effects for CACs in the local study area and all sensitive receptor locations. Predicted ambient air quality met all applicable air quality objectives, based on both Project emissions and also combined cumulative assessment for all relevant projects. Therefore the cumulative effects of air quality on human health are considered to be not significant.

The assessment of light effects concluded that while there could be some increased light emissions from Project activity and other projects on Ridley Island, changes would not be substantial, would be mitigated through timing of activity, use of appropriate shielding, and would be of relatively short duration. The cumulative effects of altered ambient light conditions on human health were considered to be not significant.

The noise assessment for the Project indicated no significant effects to human health based on Health Canada's % Highly Annoyed metric and in comparison to background noise levels for all Project phases. Cumulative noise effects between the Project and other large scale noise generating activities within the assessment area are not expected to occur or would be negligible due to the separation distances involved between the Project and other local Projects. Therefore, cumulative residual effects from noise on human health were considered to be not significant.

The Project was not considered to have any appreciable effect on local marine or terrestrial country foods based on implementation of appropriate mitigation measures during marine dredging, best practices and planning in regards to spill control and response, and controls for air emissions. No residual effects to country foods were identified for other past, current or future projects. Therefore, the combined cumulative effects of country foods are not considered significant for this Project.

In summary, there are no significant adverse residual cumulative effects on Human Health based on evaluation of the proposed Project and other past, current, or future projects.

Archaeological and Heritage Resources

Other projects in the LAA are known to have resulted in the loss or disruption of terrestrial and intertidal archaeological sites. Based on our assessment no such loss or disturbance is expected to occur as a result of the Project. However, eighteen CMTs have been identified as being in conflict with the road and rail corridor and will likely be lost. Prior to the removal of any CMT, it will be systematically recorded including collection of a stem round. As a result of this mitigation measure, there will be no significant loss of archaeological or heritage resources and therefore no residual effects. Though other projects may have affected this resource in the past, the lack of residual effects associated with the current Project means there is no potential for cumulative effects.

Navigable Waters

The assessment indicates that the Project is likely to contribute low magnitude residual effects to the RAA. These effects could be quantified (e.g., by calculating potential increases in cumulative travel distance and associated time and costs); however, overlap between the Project and other facilities generating vessel traffic within the RAA are expected to be negligible based on current and planned levels, and the separation distances between the Project and other local projects. The cumulative effects, if any, would not affect the viability of navigation within the RAA and are therefore expected to be low magnitude and not significant.

20.4 Summary of Significance Determinations

Table 20.4 provides a summary of the potential effects, proposed mitigation and significance of each VEC in the EIS.

Table 20.4: Summary of Significance Determinations

Section	Potential Effects	Proposed Mitigation	Significance
Air Quality	Change in CAC emissions	▪ Equipment maintenance ▪ Low sulphur fuel ▪ Dust suppressants ▪ Scheduling ▪ Minimize disturbance ▪ Preserve vegetation ▪ Erosion control structures ▪ Cover trucks ▪ Site paving	**Not significant** (with a high level of certainty and a moderate probability of occurrence)
Noise and Vibration	Change in noise level	▪ Avoid night-time and weekend construction activities along the east side of Ridley Island where possible. ▪ Use welded track if practical. ▪ Maintain mufflers on internal combustion engines. ▪ Near sensitive receptors, reduce number of construction equipment in operation simultaneously. ▪ Proper maintenance of conveyors.	**Not significant** (with a high level of certainty and high probability of occurrence)
	Change in vibration	▪ Vibration effects at nearby receptors have not been predicted, however the mitigation measures identified for noise will also reduce vibration effects.	**Not significant** (with a high level of certainty and high probability of occurrence)
Ambient Light	Change in ambient light quality	▪ Use of "dark sky" shielded luminaires for outdoor lighting. ▪ Retain tree line directed to Port Edward where possible. ▪ Control outdoor light levels. ▪ Centralized lighting control systems.	**Not significant** (with a high level of certainty and high probability of occurrence)

Section	Potential Effects	Proposed Mitigation	Significance
Vegetation Resources	Loss of rare vascular plants	▪ None	**Not significant**
	Loss of ecological communities of conservation concern	▪ Development of a drainage and erosion control plan (as outlined in the EMP).	**Not significant**
	Loss of old forest	▪ None	**Not significant**
	Loss of wetland function	▪ Development of a drainage and erosion control plan (as outlined in the EMP). These techniques may include the construction of berms to direct runoff and maintain hydrological regimes of sensitive plants and plant communities, as well as the installation of silt fences to remove suspended solids before runoff water leaves the Project site. ▪ Development of a weed control plan to manage indirect effects from introduction of invasive species. ▪ Development of a wetland compensation plan as determined through consultation with CWS. This compensation plan may include some of the following activities: • Provision of funding to organizations whose mandates are consistent with enhancement, preservation, restoration and creation of wetland habitat (e.g., Ducks Unlimited Canada). • Funding to organizations whose mandate is to specifically provide one or more of the identified functions provided by wetlands affected by the project (e.g., Pacific Carbon Trust). • Enhancement, restoration of construction of wetland areas to replace or better provide the lost functions. • Preservation of wetland areas that provide functions similar to those on the Project footprint. Preservation can be made through securement of property and/or land use covenants. • Restoration of degraded wetland areas with the potential to provide these functions. • Creation of wetland areas with design goals to provide these functions.	**Not significant** (with a high level of certainty)
	Loss of riparian areas	▪ Development of a drainage and erosion control plan (as outlined in the EMP).	**Not significant**
	Loss of traditional use plants	▪ The wetland compensation plan will include planting of traditional use plant species where possible and practicable.	**Not significant** (with a high level of certainty)

Section	Potential Effects	Proposed Mitigation	Significance
Wildlife and Wildlife Habitat	Change in habitat availability	▪ Limit and mark Project footprint clearing limits. ▪ Establish wetland compensation program to replace and protect habitat for use by western toads.	**Not significant** (with a moderate level of certainty and high probability of occurrence)
	Risk of mortality	▪ Clear vegetation outside of the nesting season for birds (April 1 to July 31). ▪ Establish a 50 m no-development and no-disturbance setback around the two trees with Bald Eagle nests. ▪ Prohibit feeding and harassment of wildlife. ▪ Establish a wildlife encounter management plan to report Project related wildlife deaths and nuisance animals to Canpotex, and the appropriate provincial wildlife authority. ▪ Salvage and relocate western toads prior to vegetation clearing and grubbing. ▪ Salvage and relocate western toads to prevent road and rail mortality. ▪ Place exclusion fencing around western toad breeding ponds.	**Not significant** (with a moderate level of certainty and medium probability of occurrence)
	Alteration of movement	▪ Properly maintain equipment	**Not significant** (with a high level of certainty and low probability of occurrence)
Aquatic Environment	Habitat loss or alteration	▪ Habitat compensation for lost/disturbed fish habitats. ▪ Best management practices.	**Not significant** (with a high level of certainty and high probability of occurrence)
	Direct mortality or physical injury	▪ Seasonal Avoidance ▪ Marine Mammal Monitoring Program ▪ Bubble curtains ▪ Fish Salvage Program ▪ Blasting Guidelines ▪ Best management practices	**Not significant** (with a moderate level of certainty and moderate probability of occurrence)
	Sensory disturbance	▪ Seasonal Avoidance ▪ Use of vibratory pile driver wherever feasible ▪ Bubble curtains ▪ Best management practices	**Not significant** (with a moderate level of certainty and moderate probability of occurrence)
	Degradation of water and sediment quality	▪ Erosion Control Waste water treatment ▪ Best management practices	**Not significant** (with a high level of certainty and low probability of occurrence)

Section	Potential Effects	Proposed Mitigation	Significance
Human Health	Changes in country foods to affect human health	▪ Waste water treatment ▪ Best management practices	**Not significant** (with a moderate level of certainty and high probability of occurrence)
	Changes in air emissions to affect human health	▪ Equipment maintenance ▪ Low sulphur fuel ▪ Dust suppressants ▪ Scheduling ▪ Minimize disturbance ▪ Erosion control structures ▪ Cover trucks ▪ Site paving if necessary	**Not significant** (with a moderate level of certainty and high probability of occurrence)
	Changes in ambient light to affect human health	▪ Use of “dark sky” shielded luminaires for outdoor lighting ▪ Retain tree line directed to Port Edward ▪ Control outdoor light levels ▪ Centralized lighting control systems	**Not significant** (with a moderate level of certainty and high probability of occurrence)
	Changes in noise levels to affect human health	▪ Avoid night-time construction activities on the east side of the island ▪ Internal combustion engines ▪ Near sensitive receptors the number of construction equipment in operation simultaneously will be reduced ▪ Proper maintenance of conveyors	**Not significant** (with a high level of certainty and high probability of occurrence)

Section	Potential Effects	Proposed Mitigation	Significance
Archaeological and Heritage Resources	Destruction of CMTs	▪ Avoidance of CMTs within or adjacent to the Project footprint where possible. ▪ Equipping construction foremen with Chance Find Protocol. ▪ Systematic recording, including stem-round collection, of all CMTs identified within the Project footprint.	**Not significant** (with a high level of certainty and low probability of occurrence)
	Disturbance or destruction of terrestrial archaeological or heritage sites	▪ Equipping construction foremen with Chance Find Protocol. ▪ Systematic recording of identified archaeological and heritage sites. ▪ Additional mitigation by systematic data recovery and/or archaeological monitoring of development where warranted.	**Not significant** (with a high level of certainty and low probability of occurrence)
	Disturbance or destruction of intertidal archaeological or heritage sites	▪ Equipping construction foremen with Chance Find Protocol. ▪ Systematic recording of identified archaeological and heritage sites. ▪ Additional mitigation by systematic data recovery and/or archaeological monitoring of development where warranted.	**Not significant** (with a high level of certainty and low probability of occurrence)
First Nations Current Uses	Changes to current traditional use patterns	▪ As per mitigation outlined for Archaeology and Heritage Resources, Aquatic Resources and Navigation. ▪ Where possible traditional use plants will be used for replanting. ▪ Canpotex and the PRPA have offered accommodation to compensate for loss of access to the project site.	**Not significant** (subject to government confirmation with potentially affected First Nations)
Navigable Waters	Physical interference	▪ Marine communication plan. ▪ Protection zones. ▪ Use of dark sky shielded fixtures where possible without affecting human safety. ▪ Installation of navigational aids on the new structure where required. ▪ Updated navigational charts showing the jetty location.	**Not significant** (with a high level of certainty and low probability of occurrence)
	Change in vessel traffic	▪ Marine communication plan. ▪ Protection zones. ▪ Standard procedures will be followed by vessels entering the port.	**Not significant** (with a high level of certainty and low probability of occurrence)

20.5 Summary of Aboriginal Engagement and Consultation

Canpotex and the PRPA have undertaken a number of consultation activities to inform First Nations, about the Project, and to seek input during Project planning. Prior to posting of the Notice of Commencement to initiate the CEAA assessment process, Canpotex carried out a number of early engagement activities with potentially interested First Nations (Metlakatla, Lax Kw'alaams, Gitxaala, Kitselas and Kitsumkalum) in the region. On April 8, 2009 a preliminary Project Description was sent to interested First Nations along with an offering to come to the communities to discuss the Project. Meetings with the interested First Nations have been ongoing since this time and Canpotex and the PRPA have offered capacity-funding to support their participation in consultation activities and the Project review process.

Since February 2008 and November 2011 there have been over 20 letters, 50 emails, 50 meetings, and 35 telephone calls between the proponents and each interested First Nations. There have also been three working group meetings to which all First Nations were invited to participate. What was formerly the scoping document and was revised to be the EIS Guidelines were also provided to First Nations for their comment. A summary of issues raised during working group meetings and from their review of the EIS Guidelines is provided in Table 20.5.

Table 20.5: Summary of Issues from Initial First Nations Engagement

Primary Issue	How the Issue is Addressed in the EIS
The scope of the Project should include marine vessel operation and navigation out to the pilotage station at Triple Islands	Scope of assessment has been increased out to Triple Islands for the assessment of vessel activity and accidents and malfunctions.
Projects currently or proposing to ship to Kitimat (e.g. Enbridge) and to use Triple Island Pilotage station should be included in the cumulative effects assessment in the Navigable Waters and Accidents and Malfunctions sections.	Scope of the assessment was increased to include Triple Islands, however, vessels travelling to Kitimat transit west and south of Triple Islands with pilots accessing the vessel either by helicopter or small vessel and therefore, do not transit in this project's assessment area. In addition, Kitimat vessels should not be using the anchorages at Stephen's Island. While these anchorages are used at the BC Coast Pilots discretion, they are managed by the PRPA and reserved for vessels travelling to PRPA waters.
The transportation of dredged materials as well as the effects of disposing those materials should be addressed in the assessment.	A separate report assessing the effects of disposal of dredge material at proposed disposal sites has been completed and summarized in the EIS.
Metlakatla and other potential vessel users in Prince Rupert (i.e., tourism operators) should be consulted with regarding their use of waters in the Prince Rupert Area.	Interviews were conducted as part of the Navigation assessment. Traditional Use Studies that include discussions on water use have been requested from First Nations.
Vibration should be included as a VEC.	EIS expanded to include vibration under the heading "Noise and Vibration".
The scope of the project should include traffic along the rail corridor to Lorne Creek.	The scope of assessment has been increased to include the assessment of air, noise and vibration, and ungulate strikes along the rail line to Lorne Creek.

Primary Issue	How the Issue is Addressed in the EIS
The list of projects to be included in the Cumulative Effects Assessment should include the Port Land Use Plan and this should include assessment of marine based activities.	The cumulative effects Project Inclusion List has been expanded to include land use developments as outlined in the Port Land Use Plan. Marine components associated with future projects cannot be assessed at this time because there is insufficient information on what, if any, marine infrastructure/vessel use will be required. Effects associated with future projects will be assessed under the CPAEAR and possibly CEAA when they are proposed.
Disposal at sea sites other than Brown Passage should be considered	Two new disposal at sea sites are being proposed. A full effects assessment has been completed for these sites.
The potential for increases in marine traffic accidents as a result of new projects should be assessed.	This issue is included in the accidents and malfunctions section.

Construction of the Project will affect First Nations access to the Project site, an area that had been used previously for traditional purposes including hunting, fishing and other traditional uses of the land (i.e., berry and bark collection). It will also result in the loss of some CMT's known to occur within the Project footprint. Apart from CMTs there are no other known intertidal or terrestrial archaeological or heritage sites that will be affected by the Project. The project will also result in a number of benefits to First Nations including economic benefits associated with job production, and increased tourism as well as biological benefits as a result of the identification of two potential new disposal at sea sites thus eliminating the need to use Brown Passage.

20.6 Conclusions

The environmental effects of the Project have been determined using assessment methods and analytical tools that reflect current best practices of environmental and socio-economic practitioners. Based on this assessment no adverse biological, health or heritage effects are predicted. Residual effects are predicted to be of low magnitude, range in duration from short-term to long-term, localized in geographic extent and generally reversible at the terminal site following decommissioning.

It is the conclusion of the EIS that the Project can be constructed, operated and decommissioned without significant adverse effects, including consideration of cumulative effects and accidents and malfunctions. The Project, as proposed, will benefit the local and regional economy with the addition of new industrial and transportation infrastructure and activities on lands designated for that purpose.

20.7 Summary Table

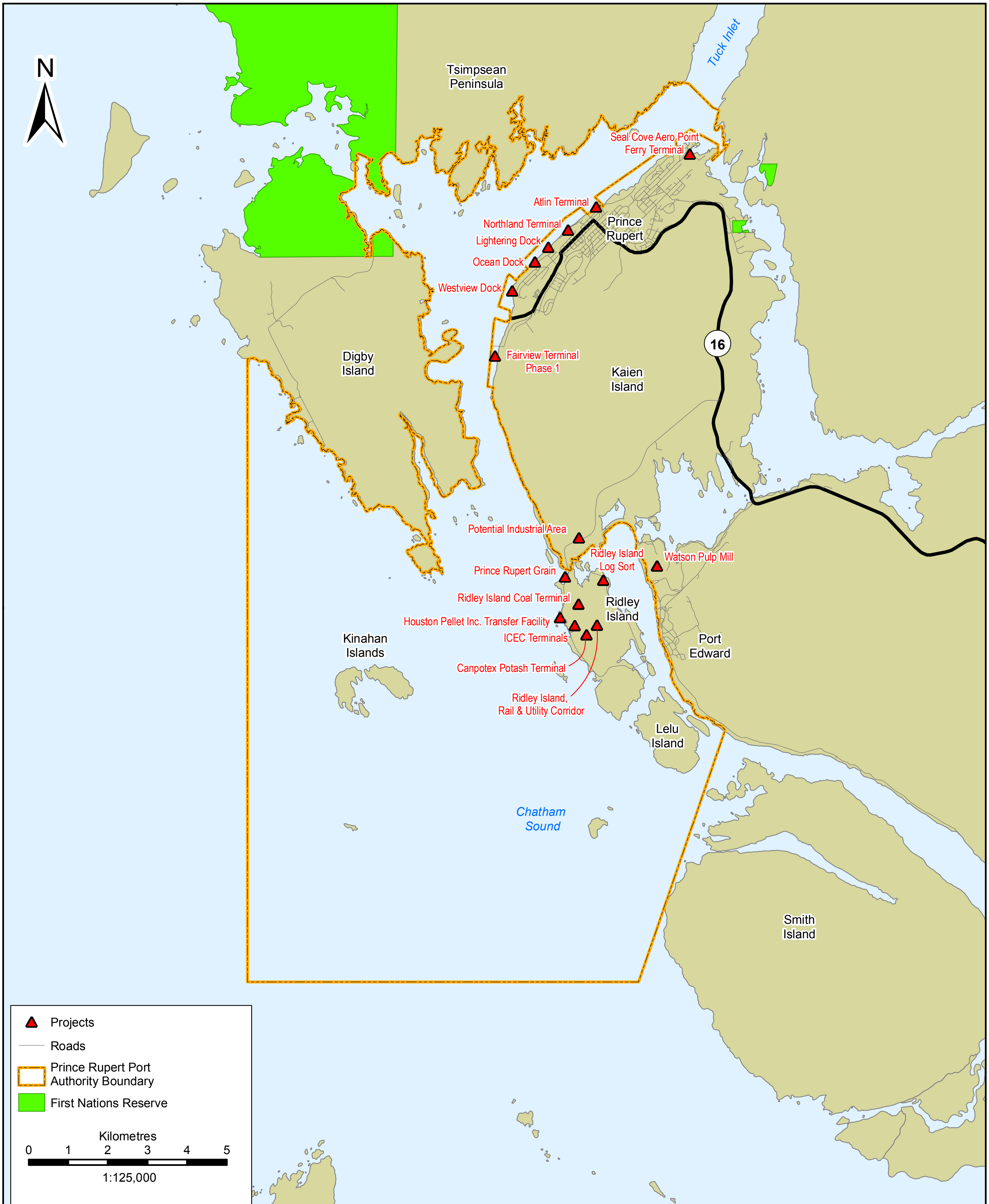
Table 20.6: Summary Table

Section	Potential Effects	Proposed Mitigation	Potential Residual Effects	Potential Cumulative Effects	Standards and Guidelines	Public Comments and Responses	Aboriginal Comments and Responses	Proposed Commitments
Air Quality	Change in CAC emissions	▪ Equipment maintenance ▪ Low sulphur fuel ▪ Dust suppressants ▪ Scheduling ▪ Minimize disturbance ▪ Preserve vegetation ▪ Erosion control structures ▪ Cover trucks ▪ Site paving	▪ Construction: none ▪ Operations: none except for PM10 over the water, northwest of the berth.	▪ Modelling results indicate that the addition of publicly disclosed projects in the assessment area do not have a substantial effects on maximum predicted concentration of CACs.	▪ National Ambient Air Quality Objectives ▪ BC Ambient Air Quality Objectives ▪ Guidance for Air Quality Dispersion Modelling in British Columbia	▪ None	▪ **Comment 1:** Scope should be increased out to Lorne Creek ▪ **Response 1:** Scope increased to Lorne Creek	▪ Use grid (rather than generator set) electrical power for equipment wherever feasible ▪ Use clean fuels in heavy duty diesel vehicles and/or equipment where practical ▪ Sweep paved routes adjoining unpaved traffic areas ▪ Visual inspections to address potential dust emissions ▪ Use suppressants to reduce dust ▪ Implement Air Quality and Dust Control Plan ▪ Maintain construction equipment
	Change in GHG	▪ None	▪ None	▪ Effects of GHGs cannot be attributed to any specific project, and as such, the significance of their cumulative effect was not assessed.	▪ Incorporating Climate Change Considerations in Environmental Assessments: General Guidance for Practitioners (CEA Agency 2003) ▪ Third Assessment Report of Intergovernmental Panel on Climate Change (IPCC, 2001)		▪ None	
Noise and Vibration	Change in noise level	▪ Avoid night-time and weekend construction activities along the east side of Ridley Island where possible. ▪ Use welded track if practical. ▪ Maintain mufflers on internal combustion engines. ▪ Near sensitive receptors, reduce number of construction equipment in operation simultaneously. ▪ Proper maintenance of conveyors.	▪ Construction: in Port Edward sound pressure levels are unlikely to cause more than a brief annoyance during moments of particularly intensive activities. ▪ Operations: Closest residents will occasionally perceive the operational sounds, and will hear the train passages.	▪ Modelling results indicate that the addition of future projects in the assessment does not result in exceedances in Health Canada criteria for noise. Therefore cumulative effects of the Project on noise are expected to be not significant.	▪ Draft Guidance on Noise Assessment for CEAA Projects (Health Canada 2005) ▪ Useful Information for Environmental Assessment (Health Canada 2010) ▪ Prince Rupert Noise control Bylaw No. 2430	▪ None	▪ **Comment 2:** Vibration should be included as a VEC ▪ **Response 2:** Vibration included as part of the Noise and Vibration section ▪ **Comment 3:** Scope should extend out to Lorne Creek. ▪ **Response 3:** Scope extended	▪ Blasting will be completed in accordance with Blast Management Plan ▪ Position stationary noise emission sources as far as is practical from sensitive receptors ▪ Maintain log of noise complaints and address if related to the Project ▪ Develop communication plan to advise residents of noise-causing construction ▪ Avoid construction during the night and weekend where practicable.
	Change in vibration	▪ Vibration effects at nearby receptors have not been predicted, however the mitigation measures identified for noise will also reduce vibration effects.	▪ None	▪ None	▪ ISO 2613: evaluation of Human Exposure to Whole-body Vibration, Part 2			
Ambient Light	Change in ambient light quality	▪ Use of "dark sky" shielded luminaires for outdoor lighting. ▪ Retain tree line directed to Port Edward where possible. ▪ Control outdoor light levels. ▪ Centralized lighting control systems.	▪ Some light from the Project will be observable from Port Edward	▪ The addition of light effects from publicly disclosed sites in the assessment area will not result in significant cumulative effects	▪ Guide on the Limitation of the Effects of Obtrusive Light from Outdoor Lighting Installations ▪ LEED, Green Building Rating System	▪ None	▪ None	▪ Vegetation buffers will be left were practical

Section	Potential Effects	Proposed Mitigation	Potential Residual Effects	Potential Cumulative Effects	Standards and Guidelines	Public Comments and Responses	Aboriginal Comments and Responses	Proposed Commitments
Vegetation Resources	Loss of rare vascular plants	▪ None	▪ None	▪ Given the less than 5% of the RAA is developed or is slated for development by publicly disclosed projects there is no reasonable expectation that the Project's contribution to cumulative effects will compromise the sustainability of the affected resources regionally.	▪ *Species at Risk Act* ▪ Policy on Wetland Conservation ▪ British Columbia Conservation Framework ▪ *British Columbia Weed Control Act* ▪ *British Columbia Forest and Range Practices Act*	▪ None	▪ **Comment 4:** Cumulative Effects should include Land Use Plan ▪ **Response 4:** Land Use Plan included for vegetation and wildlife cumulative effects assessment	▪ Implement Weed Management Plan ▪ Reduce risk of invasive species by inspecting all construction equipment arriving on the Project site ▪ Wetland Compensation Plan
	Loss of ecological communities of conservation concern	▪ Development of a drainage and erosion control plan (as outlined in the EMP).	▪ None for wetland communities of conservation concern ▪ 1.8 ha of blue-listed upland communities					
	Loss of old forest	▪ None	▪ Old forest within the Project footprint will be lost					
	Loss of wetland function	▪ Development of a drainage and erosion control plan (as outlined in the EMP). These techniques may include the construction of berms to direct runoff and maintain hydrological regimes of sensitive plants and plant communities, as well as the installation of silt fences to remove suspended solids before runoff water leaves the Project site. ▪ Development of a weed control plan to manage indirect effects from introduction of invasive species. ▪ Development of a wetland compensation plan as determined through consultation with CWS.	▪ None					
	Loss of riparian areas	▪ Development of a drainage and erosion control plan (as outlined in the EMP).	▪ 47 ha of riparian habitat will be lost					
	Loss of traditional use plants	▪ The wetland compensation plan will include planting of traditional use plant species where possible and practicable.	▪ Some traditional use plants will be lost					
Wildlife and Wildlife Habitat	Change in habitat availability	▪ Limit and mark Project footprint clearing limits. ▪ Establish wetland compensation program to replace and protect habitat for use by western toads.	▪ 36.3 ha of moderately suitable habitat for marbled murrelets and northern goshawks will be lost ▪ 119.9 ha of highly suitable terrestrial habitat and 4.15 ha of highly suitable breeding habitat for western toads will be lost though some will be compensated through the wetland compensation plan	▪ There is no reasonable expectation that the Project's contribution to cumulative impacts will affect the sustainability of wildlife resources in the Prince Rupert Region because (1) most wildlife population in the region are secure; (2) alteration of movement to wildlife will be low in magnitude; (3) Project related effects to the risk of mortality will be minor as they will be mitigate using proven measures; (4) the total are of habitat affected by the Project will primarily affect wildlife species with secure populations; (5)habitat loss of western toads will be mitigated through wetland compensation	▪ Migratory Birds Environmental Assessment Guideline (EC 1998) ▪ Environmental Assessment Best Practices Guide for Wildlife at Risk in Canada. ▪ Addressing Species at Risk Considerations under the *Canadian Environmental Assessment Act* for Species under the Responsibility of the Minister responsible for Environment Canada and Parks Canada.	▪ None	▪ **Comment 5:** Cumulative Effects should include Land Use Plan ▪ **Response 5:** Land Use Plan included for vegetation and wildlife cumulative effects assessment	▪ Clearing activities will be completed outside of nesting season where possible ▪ If clearing during nesting season a nest survey will be completed in advance to ensure there are no nests present. ▪ Avoid construction within 50 m of eagles nests where practical ▪ Salvage and relocate toads during migration ▪ Prohibit feeding and harassment of wildlife ▪ Drivers must follow posted speed limits
	Risk of mortality	▪ Clear vegetation outside of the nesting season for birds (April 1 to July 31). ▪ Establish a 50 m no-development and no-disturbance setback around the two trees with Bald Eagle nests. ▪ Prohibit feeding and harassment of wildlife. ▪ Establish a wildlife encounter management plan to report Project related wildlife deaths and nuisance animals to Canpotex, and the appropriate provincial wildlife authority. ▪ Salvage and relocate western toads prior to vegetation clearing and grubbing. ▪ Salvage and relocate western toads to prevent road and rail mortality. ▪ Place exclusion fencing around western toad breeding ponds.	▪ None					
	Alteration of movement	▪ Properly maintain equipment	▪ Some minor disturbance to marine birds as a result of vessel activity					

Section	Potential Effects	Proposed Mitigation	Potential Residual Effects	Potential Cumulative Effects	Standards and Guidelines	Public Comments and Responses	Aboriginal Comments and Responses	Proposed Commitments
Aquatic Environment	Habitat loss or alteration	▪ Habitat compensation for lost/disturbed fish habitats ▪ Best management practices	▪ None	▪ Given the limited amount of regional development (67 ha) and the abundance of undisturbed marine fish habitat, cumulative effects of past, present and future projects on the marine environment are not expected to impact any population of fish, invertebrate or marine mammal at the regional level.	▪ Policy for the Management of Fish Habitat (DFO 2001)\ ▪ Habitat Conservation and Protection Guidelines, Second Edition (DFO 1998) ▪ Decision Framework for the Determination and Authorization of Harmful Alteration, Disruption or Destruction of Fish Habitat (DFO 2008) ▪ Practitioners Guide to the Risk Management Framework for DFO Habitat Management Staff, Version 1 (DFO 2010) ▪ DFO Operational Policy Statements for the Pacific Region	▪ None	▪ **Comment 6:** transportation of dredged materials and the effect of disposing them should be assessed ▪ **Response 6:** Disposal at sea, including transportation activities, is assessed as part of the Project ▪ **Comment 7:** The Aquatic cumulative effects section should include Land Use Plan ▪ **Response 7:** Land Use Plan not included as part of aquatic assessment because it is unknown if or how future development will use the aquatic environment ▪ **Comment 8:** Disposal at sea site other than Brown Passage should be considered ▪ **Response 8:** two new proposed disposal at sea sites are being assessed as part of the EIS	▪ Development of a Habitat Compensation Plan and post construction monitoring plan ▪ Water quality monitoring program
	Direct mortality or physical injury	▪ Seasonal Avoidance ▪ Marine Mammal Monitoring Program ▪ Bubble curtains ▪ Fish Salvage Program ▪ Blasting Guidelines ▪ Best management practices	▪ Construction: sedentary invertebrate with high reproductive rates are expected to be affected by the Project.					
	Sensory disturbance	▪ Seasonal Avoidance ▪ Use of vibratory pile driver wherever feasible ▪ Bubble curtains ▪ Best management practices	▪ Construction: Some short term sensory disturbance and localised displacement for fish and marine mammals					
	Degradation of water and sediment quality	▪ Erosion Control Waste water treatment ▪ Best management practices	▪ Construction: localized increases in TSS					
Human Health	Changes in country foods to affect human health	▪ Waste water treatment ▪ Best management practices	▪ None	▪ Consistent with tcumulative effects assessment results for the air quality, noise and vibration, ambient light and aquatics sections, no significant effects as a result of past present and future projects are expected.	▪ CCME marine Aquatic Life Sediment Quality Guidelines (ISQG) ▪ BC Ministry of Environment (MoE) and Health Canada Ambien Air Quality Objectives ▪ Canada-wide Standard for Respirable Particulate Matter ▪ FCSAP Ecological Risk Assessment Guidance (EC, 2010)	▪ **Comment**: Loss of access to small beach located on the south west corner of Ridley Island. ▪ **Response**: Land access to the beach is lost irrespective of the project due to Port security requirements. Water access will not be affected.	▪ None	▪ As identified under Air Quality, Noise and Vibration, Ambient Light and Aquatic Environment
	Changes in air emissions to affect human health	▪ Equipment maintenance ▪ Low sulphur fuel ▪ Dust suppressants ▪ Scheduling ▪ Minimize disturbance ▪ Erosion control structures ▪ Cover trucks ▪ Site paving if necessary	▪ Negligible increase in PM					
	Changes in ambient light to affect human health	▪ Use of "dark sky" shielded luminaires for outdoor lighting ▪ Retain tree line directed to Port Edward ▪ Control outdoor light levels ▪ Centralized lighting control systems	▪ Low level increases in light levels in Port Edward					
	Changes in noise levels to affect human health	▪ Avoid night-time construction activities on the east side of the island ▪ Internal combustion engines ▪ Near sensitive receptors the number of construction equipment in operation simultaneously will be reduced ▪ Proper maintenance of conveyors	▪ Brief annoyance during moments of particularly intensive activity					

Section	Potential Effects	Proposed Mitigation	Potential Residual Effects	Potential Cumulative Effects	Standards and Guidelines	Public Comments and Responses	Aboriginal Comments and Responses	Proposed Commitments
Archaeological and Heritage Resources	Destruction of CMTs	▪ Avoidance of CMTs within or adjacent to the Project footprint where possible. ▪ Equipping construction foremen with Chance Find Protocol. ▪ Systematic recording, including stem-round collection, of all CMTs identified within the Project footprint.	▪ None	▪ Though other projects have affected this resource in the past, the lack of residual effects associated with the current Project means there is no potential for cumulative effects.	▪ Reference Guide on Physical and Cultural Heritage Resources (CEAA 1996)	▪ None	▪ None	▪ Develop Archaeological Resource Monitoring Plan ▪ Protect CMTs where feasible. If not feasible systematic recording will be conducted
Archaeological and Heritage Resources	Disturbance or destruction of terrestrial archaeological or heritage sites	▪ Equipping construction foremen with Chance Find Protocol. ▪ Systematic recording of identified archaeological and heritage sites. ▪ Additional mitigation by systematic data recovery and/or archaeological monitoring of development where warranted.	▪ None	▪ Though other projects have affected this resource in the past, the lack of residual effects associated with the current Project means there is no potential for cumulative effects.	▪ Reference Guide on Physical and Cultural Heritage Resources (CEAA 1996)	▪ None	▪ None	▪ Develop Archaeological Resource Monitoring Plan ▪ Protect CMTs where feasible. If not feasible systematic recording will be conducted
Archaeological and Heritage Resources	Disturbance or destruction of intertidal archaeological or heritage sites	▪ Equipping construction foremen with Chance Find Protocol. ▪ Systematic recording of identified archaeological and heritage sites. ▪ Additional mitigation by systematic data recovery and/or archaeological monitoring of development where warranted.	▪ None	▪ Though other projects have affected this resource in the past, the lack of residual effects associated with the current Project means there is no potential for cumulative effects.	▪ Reference Guide on Physical and Cultural Heritage Resources (CEAA 1996)	▪ None	▪ None	▪ Develop Archaeological Resource Monitoring Plan ▪ Protect CMTs where feasible. If not feasible systematic recording will be conducted
First Nations Current Uses	Changes to current traditional use patterns	▪ As per mitigation outlined for Archaeology and Heritage Resources, Aquatic Resources and Navigation. ▪ Where possible traditional use plants will be used for replanting. ▪ Canpotex and the PRPA have offered accommodation to compensate for loss of access to the project site.	▪ None	▪ Based on available information no significant effect on First Nation current use is expected.	▪ None	▪ None	▪ None	▪ None
Navigable Waters	Physical interference	▪ Marine communication plan. ▪ Protection zones. ▪ Use of dark sky shielded fixtures. ▪ Installation of navigational aids on the new structure where required. ▪ Updated navigational charts showing the jetty location.	▪ Loss of access to shallow waters between Coast and Ridley Islands ▪ Increased lighting from trestle	▪ Given the negligible overlap between the Project and other facilities generating vessel traffic within the RAA and the separation distance between the Project and other local projects the cumulative effects, if any, would not affect the viability of navigation within the RAA.	▪ None	▪ None	▪ **Comment 9:** Assessment should include marine vessel operation and navigation out to the pilotage station at Triple Islands ▪ **Response 9:** scope increased as requested ▪ **Comment 10:** Projects proposing to ship to Kitimat and to use Triple Island pilotage station should be included in the Navigable Waters and Accident and Malfunctions cumulative effects sections ▪ **Response 10:** Vessel travelling to Kitimat travel west of Triple Islands and therefore were not included in the assessment ▪ **Comment 11:** First Nations and other potential vessel users should be consulted ▪ **Response 11:** Assessment included consultation with vessel users. Requests for TUSs were submitted to First Nations.	▪ Marine communication plan to ensure vessel operators are aware of construction activities in the area. ▪ All shipping in PRPA waters will be conducted following the rules of shipping established by the Port under the Canada Marine Act
Navigable Waters	Change in vessel traffic	▪ Marine communication plan. ▪ Protection zones. ▪ Standard procedures will be followed by vessels entering the port.	▪ Increase in vessel traffic between Triple Islands and Ridley Island	▪ Given the negligible overlap between the Project and other facilities generating vessel traffic within the RAA and the separation distance between the Project and other local projects the cumulative effects, if any, would not affect the viability of navigation within the RAA.	▪ None	▪ None	(see above)	(see above)



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21 ENVIRONMENTAL MANAGEMENT

21.1 Planning

Project related commitments regarding environmental mitigation measures and monitoring activities to be conducted during the Project's implementation are outlined in Sections 20.2 and 22. Adherence to these commitments will ensure sound environmental practices are incorporated into all aspects of project planning, design, construction and operation.

Based on current best management practices (BMPs) and professional judgment and expertise, an environmental management program (EMP) including a series of management plans will be developed for the construction, operation, and decommissioning phases of the Project. The component plans will describe measures and controls to avoid or minimize adverse environmental effects during Project-related activities, as well as action plans and emergency response procedures to protect environmental values and minimize risks to public and worker safety.

A list of the EMP plans is provided below and followed by summary descriptions. This information is intended to provide an outline of the key elements of the environmental management plans and to be read in conjunction with the information contained in the EIS.

- Human and Safety Management Plan
- Air Quality and Dust Control Plan
- Noise, Vibration and Ambient Light Management
- Spill Prevention and Emergency Response Plan
- Water Management Plan
- Habitat Compensation Plan
- Archaeological Resource Monitoring Plan
- Blast Monitoring Plan
- Sediment and Erosion Control Plan
- Weed Control Plan.

21.2 Environmental Management Program

The environmental management program will describe the administrative roles and responsibilities of individual members of the environmental management team. This team will be responsible for reporting on compliance with regulatory permits, approvals and licences, and Canpotex and the PRPA's Commitments and Assurances.

The environmental management team will consist of experienced, independent monitors or inspectors, including specialists who are qualified to conduct water quality, archaeological, erosion and sediment control, site restoration, and other on-site monitoring programs as required. Since work on different Project components will proceed concurrently, the plan will provide for a sufficient number of monitors and back up monitors to ensure adequate coverage throughout the Project area.

Members of the environmental management team will have the authority to issue a stop work order when continued activity poses an immediate detrimental risk to the environment and/or contravenes the intent of the EMP regulatory requirements, or Canpotex and/or PRPA's Commitments and Assurances. The team will also have the authority to direct site-specific corrections, as warranted, and in consultation with the construction manager.

21.2.1 Health and Safety Management Plan

The objective of the health and safety management plan will be to promote safety awareness to all Project personnel, public, and area stakeholders. The plan will describe specific procedures and protocols to be followed by Project personnel to mitigate health and safety hazards, with reference to applicable regulations.

Health and safety procedures, including specific instructions regarding the use of personal safety devices, will be identified and communicated to Project personnel during mandatory site orientation sessions. The plan will incorporate guidance provided by the National Institute for Occupational Health and Safety on matters such as personal protective equipment, designation of evacuation and isolation areas, and decontamination procedures. Health and safety will be a key element of all Project operations.

21.2.2 Air Quality and Dust Control Plan

The air quality and dust control plan will describe procedures to minimize emissions from combustion sources and fugitive dust emissions. These procedures will relate to the operation and maintenance of vehicles and equipment, and other general construction and operations activities.

Examples of best management practices to minimize combustion sources and effects include:

- Maintain equipment and use equipment powered with low sulphur fuel when available.
- Use Best Available Technology Economically Achievable (BATEA) to reduce CAC and GHG emissions.

Examples of best management and mitigation measures to minimize fugitive dust emissions and effects include:

- Use covered conveyors with spill trays.
- Use a dust collection system that allows dust to be captured at all transfer points and bagged.
- Schedule activities that generate large quantities of dust to avoid high wind events where possible.
- Sweep paved routes adjoining unpaved traffic areas as required during construction.
- Conduct visual inspections, as required, to identify and address potential dust emissions.

In addition to the above all management personnel will be trained in the operation and maintenance of the dust control equipment and records of training will be kept on file.

21.2.3 Noise, Vibration, and Ambient Light Management

A number of standard mitigation measures have been incorporated into the Project design to minimize Project noise and vibration effects and may include the following:

- Avoid construction along the east side of Ridley Island during night-time hours and on weekends where practicable.
- Advise nearby residents of significant noise-causing construction activities and schedule these activities to create the least disruption.
- Implement best management practices (e.g., mufflers, vehicle maintenance).
- Minimize use of construction equipment near sensitive receptors where possible.
- Avoid additional noise from rail by installing continuously welded rail.
- Maintain conveyor components.
- Log and investigate any noise complaints to assess whether they are linked to Project activities.
- Develop a communication and complaint documentation and resolution plan.

Examples of best management practices to minimize ambient light sources and effects associated with the Project include the following:

- Adhere to Leadership in Energy and Environmental Design (LEED) and International Commission on Illumination design goals where applicable.
- Use shielded, cut-off design construction lighting.
- Direct light only to where it is needed while still ensuring safety requirements are met.
- Retain tree line on the east side of the island and on the high ground where possible.
- Control light levels, including reducing use of lights where no activities are occurring.
- Install a centralized lighting control system to enable selective use of lights.

21.2.4 Spill Prevention and Emergency Response Plan

The spill prevention and emergency response plan will be developed to protect the environment, Project personnel, and public safety, as well as Project infrastructure and equipment in the event of an emergency. The plan will identify mitigation measures to prevent an accident or malfunction, the response to be taken to minimize adverse effects should such an event occur, as well as monitoring, evaluation, and reporting procedures. The plan will also identify emergency contact information and list the types and location of emergency response equipment and materials available to Project personnel.

Procedures and steps for response and remediation of any spills of fuel or other hazardous materials will be identified. A detailed plan will be developed in accordance with regulatory and permitting requirements and will contain:

- Listing of products and potential dangers
- Emergency action plans
- Staff Individuals responsible for spill response
- Reporting requirements and contact information (e.g., applicable provincial and federal government agencies)
- List of available (on-site and off-site) materials and equipment (and response time)
- Initial response procedures
- Spill containment procedures
- Specific measures for dealing with spills into or adjacent to a body of water
- Spill reclamation procedures
- Other site specific information relevant to responding to or addressing a spill.

21.2.5 Water Management Plan

The water management plan will incorporate erosion control, water treatment, and effluent monitoring to minimize effects of the terminal project on the marine environment. Examples of best management practices to minimize water-related effects associated with the Project include:

- Implementation of erosion and runoff controls on land to minimize increases in TSS and turbidity in nearshore waters around the terminal.
- Monitoring of TSS levels during in-water construction activities
- Collection and treatment of stormwater, wastewater, and sewage before discharging from the terminal site.
- Diverting of stormwater through drainage ditches to avoid contamination with potash and other materials, and use an oil/water separator before discharging to the marine environment, as required.
- Conducting follow-up monitoring of sewage discharge as per provincial and regional requirements.
- Routing of potash washdown water to a settling pond prior to discharge through the marine outfall.
- Collection of water discharged to the marine environment for bi-annual testing of TSS, turbidity, fecal coliforms, and contaminants (i.e., metals, PCBs, BTEX, and PAHs) for comparison to provincial and federal guidelines.
- Preparation of a waste management plan for the construction and operation phases of the Project.

21.2.6 Habitat Mitigation and Compensation Plan

Project construction and operation activities will affect both terrestrial and aquatic habitat in the area. The Habitat Mitigation and Compensation Plan will describe measures to be taken to address site-specific effects requiring special consideration, as well as compensation measures. Terrestrial vegetation, wetlands, and the marine environment will be addressed.

The terrestrial component of the plan may include, but not be limited to the following:

- Construct berms to direct runoff and maintain hydrological regimes of sensitive plants and plant communities.
- Develop a weed control plan to manage indirect effects from introduction of invasive species.
- Limit clearing, grading, construction, and temporary storage of materials to Project footprint.
- Clear vegetation outside of the nesting season to avoid mortality of birds or eggs.
- Retain trees containing bald eagle nests with a 50 m no-development setback around each tree and no construction activity within 1.5 times the height of the tree during nesting.
- Develop a wetland compensation plan as per discussions with EC.
- Salvage any western toads from the project footprint prior to vegetation clearing and grubbing; install exclusion fencing around potential western toad breeding ponds if disposal is to occur in these ponds during the breeding season; and capture and relocate toads crossing the road during breeding migration.

The aquatic component of the plan may include, but not be limited to the following:

- Schedule project activities where possible to avoid potential effects on sensitive life stages of marine life, such as out-migrating and spawning salmon and seasonally-abundant marine mammals.
- Monitor marine mammal presence and enforce a 500 m exclusion zone during blasting operations.
- Conduct blasting only during daylight hours to ensure visibility of marine mammals in area.
- Use bubble curtains during pile driving to reduce sound levels emitted to marine environment.
- Salvage fish prior to infilling the tidal pond.
- Follow blasting guidelines recommended by Fisheries and Oceans Canada.
- Use a vibratory pile driver whenever feasible.

21.2.7 Archaeological Resources Monitoring Plan

An Archaeological Resources Monitoring Plan will be prepared based on input to be provided by a professional consulting archaeologist who is knowledgeable regarding the potential archaeological resources in the Project area.

The Plan will include mitigation measures as described in Section 15 to protect, monitor and, where necessary, assess and recover artifacts from traditional use sites, culturally modified trees

(CMTs), and other types of archaeological sites that occur or may be encountered in the Project area during construction.

The Plan will also describe procedures to be followed in the unlikely event that a previously unidentified archaeological site or feature is encountered during construction activities.

21.2.8 Blast Management Plan

The Contractor will prepare a Blast Management Plan to ensure all appropriate safety precautions and environmental protection measures are followed during the course of construction. This Plan will address all blasting associated with on-land site preparation and dredging. All blasting in and adjacent to fish habitat will comply with Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters (Wright and Hopky 1998). The plan will include descriptions of the following:

- Controlled blasting techniques.
- Mitigation and monitoring measures to address potential noise and vibration impacts associated with blasting, including the scheduling and timing of blasting activities to avoid displacement of nesting birds and other types of disruption to wildlife at critical life stages.
- The need to contact NAVCANADA and the Prince Rupert Airport Authority of blasting activity so that warnings can be broadcast to active aircraft in the area.
- Procedures to be followed after each blast with respect to inspection and removal of flyrock to ensure public and worker safety.

21.2.9 Environmental Monitoring Plan

The environmental management team will be responsible for assessing and reporting on on-site compliance with the terms and conditions of the EIS as well as all regulatory permits, approvals and licences, and Owner's Commitments and Assurances related to pre-construction, construction and decommissioning of temporary construction-related facilities. The team will consist of experienced, independent monitors/inspectors, including specialists who are qualified to conduct water quality, archaeological, erosion and sediment control, site restoration, and other on-site monitoring programs as required during the preconstruction and construction phases of the Project.

Since work on different Project components will proceed concurrently, the Plan will provide for a sufficient number of monitors and back-up monitors to ensure adequate coverage throughout the Project area.

Members of the environmental management team will have the authority to issue a stop work order when continued activity poses an immediate detrimental risk to the environment and/or contravene the intent of the construction EMP, regulatory requirements, terms and conditions of permits, licences or approvals, and/or the Owner's Commitments and Assurances. They will also have the authority to direct site-specific corrections, as warranted and in consultation with the construction manager.

21.2.10 Erosion and Sediment Control Plan

The Erosion and Sediment Control Plan will describe detailed measures to be used to protect fish and aquatic habitat, control run-off, minimize erosion on exposed slopes and substrates, and prevent inputs of silt, sediment or other deleterious materials into watercourses and the marine environment during all clearing and site development activities. The Plan will comply with applicable federal legislation, permits, licences and approvals, and reflect BMPs.

The Plan will identify limitations to clearing and equipment operation in riparian areas, and measures to be used to stabilize excavated material and treat any material that is to be placed on or within the active channel of a watercourse. It will set out the nature and frequency with which erosion and sediment control measures are to be inspected, relative to specific construction activities, weather conditions and site-specific environmental conditions. The Plan will provide for the timely cleaning, repair, and/or removal and replacement of erosion and sediment control measures

21.2.11 Weed Control Plan

During construction, weed management will focus on measures to control the establishment and spread of undesirable and invasive species within the Project footprint and along associated access roads.

The Plan will address control measures for weed species, such as bull thistle and Scotch broom, based on their distribution within and adjacent to the Project footprint. In particular the Weed Management Plan will emphasize the importance of rapid revegetation of disturbed areas in minimizing the establishment and spread of noxious and nuisance weed species.

21.3 Decommissioning and Reclamation Plan

Towards the end of the terminals lifespan, a decommissioning and abandonment plan will be developed and implemented in accordance with the regulations in force at that time and in consultation with regulatory agencies. All other projects components, including the road, rail and utility corridor or the marine causeway, trestle and berth will remain operational indefinitely.

21.4 Follow-up and Monitoring Program

Monitoring and follow-up programs have been proposed in some cases to verify the accuracy of effects predictions or effectiveness of mitigation. In addition to several VEC-specific monitoring programs, a qualified Environmental Monitor will oversee general construction activities and ensure compliance with environmental requirements. Habitat compensation monitoring will also be conducted to monitor effectiveness of compensation projects in the marine and freshwater environments. The proponents will undertake to adaptively manage adverse environmental effects identified through monitoring.

Monitoring and Follow-up commitments are outlined in the commitments table (Section 22).

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22 BENEFITS TO CANADIANS

As part of the environmental assessment process the CEA Agency, with the assistance of Responsible Authorities and Federal Authorities, has rigorously evaluated and assessed the proposed Project with respect to potential environmental effects on Valued Environmental Components and other criteria of concern to Canadians. As a result of this process the Project has been designed to ensure that adverse effects of the Project on the environment are reduced or eliminated and, where necessary, that mitigations, monitoring, and follow-up protocols are in place. Management of environmental issues through Project design and the environmental assessment process improves the net benefit to Canadians considering environmental and economic factors.

The public have been given the opportunity to participate in this process through public review at key points in the assessment. First Nations engagement has been undertaken through various processes with respect to the assessment by the proponents and government. As a result of these initiatives the proponents have made efforts to modify Project design to accommodate issues and concerns wherever feasible, including identification of a new disposal at sea site.

Field studies were completed to determine biological, physical and human characteristics of the receiving environment potentially affected by the Project. Collection of these data have increased local knowledge in such areas as: 1) archaeological and heritage resources on and around Ridley Island; 2) wildlife and vegetation communities; 3) aquatic environment; and, 4) air and noise quality. This data will be available for future assessments in the Prince Rupert area thus potentially enhancing the sustainable development opportunities for future development as well as providing residents with greater insight into Prince Rupert's biological and physical environment. The environmental assessment exercise also uncovered several opportunities to compensate for the loss of fish habitat and wetlands where opportunities were previously unknown.

The assessment process has also provided insight into the capacity for furthering economic development in the Prince Rupert area and providing industrial and transportation infrastructure that will provide direct and indirect benefits (e.g., labour and expenditures) for Prince Rupert as well as the supply chain for Canadian potash globally.

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23 SUMMARY OF COMMITMENTS

Table 22.1: Commitments Table

No.	Commitment	Project Phase | Timing	Party Responsible
1	The Proponent must ensure a construction Environmental Management Plan (EMP) is prepared and adhered to, and will be made up of the following component plans: ▪ Human and Safety Management Plan ▪ Air Quality and Dust Control Plan ▪ Noise, Vibration and Ambient Light Management ▪ Spill Prevention and Emergency Response Plan ▪ Water Management Plan ▪ Habitat Compensation Plan ▪ Archaeological Resources Monitoring Plan ▪ Blast Management Plan ▪ Erosion and Sediment Control Plan ▪ Weed Management Plan.	Construction	PRPA and Canpotex
2	Towards the end of the Project life, the Proponent must develop and implement as required a decommissioning and abandonment plan in accordance with the regulations in force at that time and in consultation with regulatory agencies to the satisfaction of relevant regulatory agencies.	Decommissioning	Canpotex EC DFO TC
3	Canpotex and the PRPA must prepare a marine Habitat Compensation Plan to the satisfaction of DFO and finalize options following agency review to fully compensate for predicted residual effects and uncertainty of effects. The Plan must be developed prior to the start of construction. The Habitat Compensation Plan must be based on the following: ▪ Site visit prior to commissioning to quantify and report on the actual footprint loss associated with construction ▪ Like-for-like habitat criteria as per direction from DFO for off-site areas selected for intertidal and subtidal (substrate, eelgrass, and kelp bed) compensation/restoration where possible ▪ A monitoring plan to measure and evaluate the effectiveness of the compensation plan. Post-construction verification plan to measure actual marine habitat loss and ensure that appropriate mitigation and compensation has been provided for all affected habitats, including as-built-drawings for all Project elements.	Pre-Construction	Canpotex PRPA DFO

No.	Commitment	Project Phase | Timing	Party Responsible
4	The proponents will ensure on land blasting is completed in accordance with the Blast Management Plan (see Commitment 1). Blasting warning signals must be used prior to every blast.	Construction	PRPA Canpotex
5	The proponent will ensure in water blasting is completed in accordance with the Blast Management Plan (see Commitment 1), which must include mitigation measures for blasting in the marine environment (including a 500 m exclusion zone for whales). Blasting warning signals must be used prior to every blast. The Blast Management Plan will be provided to DFO prior to construction.	Construction	Canpotex DFO EC
6	The Proponent must attempt to complete clearing activities outside of the nesting season for birds (April 1 to July 31), subject to Commitment 9 below.	Construction	PRPA Canpotex
7	If clearing during the nesting season is unavoidable, a nest survey will be conducted in advance of the clearing by a certified professional to ensure compliance with the *Migratory Birds Convention Act*.	Construction	PRPA Canpotex
8	To avoid destruction and reduce potential abandonment of the 2 eagle nests the Proponent must avoid construction activities, where practicable, within 50 m of active nests.	Construction	PRPA
9	During construction western toads will be salvaged and relocated during their migration between terrestrial and breeding habitats. The need to salvage and relocate will be reassessed prior to commissioning.	Construction	PRPA Canpotex EC
10	The Proponent must reduce the risk of invasive species introduction by inspecting all construction equipment arriving on the Project site with the goal of ensuring it is clean and weed-free. Equipment that is not weed-free must be cleaned before being brought on site.	Construction	PRPA Canpotex
11	The Proponent must manage invasive species in accordance with the Weed Management Plan (see Commitment 1).	Construction Operations	PRPA Canpotex
12	The Proponent must prohibit feeding and harassment of wildlife by construction and operations personnel.	Construction Operations	PRPA Canpotex
13	Drivers of project vehicles must follow posted speed limits and be trained to use extra caution in areas frequented by wildlife and people.	Construction Operations	PRPA Canpotex
14	The Proponent must position stationary noise emission sources (e.g., rock crusher, diesel generators, pumps, compressors) as far as is practical from sensitive receptors.	Construction	PRPA Canpotex
15	The Proponent will use grid (rather than generator set) electrical power for equipment wherever feasible.	Construction	PRPA Canpotex

No.	Commitment	Project Phase | Timing	Party Responsible
16	The Proponent must use clean fuels such as ultra-low-sulphur diesel and bio-diesel (if available) in dump trucks and other heavy-duty diesel vehicles and/or equipment, in conjunction with the use of particulate trap control devices (as well as catalytic converters) to avoid excessive diesel emissions.	Construction	PRPA Canpotex
17	During construction, the Proponent must sweep paved routes adjoining unpaved traffic areas in the construction zone. Visual inspections will be conducted to identify and address potential dust emissions, and to ensure procedures are implemented to document the inspections, respond to complaints, and document the responses and actions taken.	Construction	PRPA Canpotex
18	The Proponent must minimize dust by using suppressants (e.g., water) and minimizing the area of activity.	Construction Operations	PRPA Canpotex
19	The Proponent must make reasonable efforts to utilize the available Prince Rupert skilled labour force and contribute to regional employment during construction.	Construction	PRPA Canpotex
20	The Proponent must develop an Archaeological Resources Monitoring Plan describing measures to protect, monitor and, where necessary, assess and, under the direction of a qualified archaeological professional, recover artefacts from archaeological sites that are found in the Project area during construction.	Construction	PRPA Canpotex
21	The Proponent will employ best practices during construction to minimize air and sound emissions as specified in the Air Quality and Dust Control Plan (see Commitment 1). Vehicles and off-road construction equipment must be properly tuned and maintained.	Construction	PRPA Canpotex
22	The Proponent must maintain a log of any noise complaints received during Project construction and operation, investigate to assess whether they relate to Project activities, and if so, identify and implement practical measures that will be taken to address them.	Construction Operations	PRPA Canpotex
23	CMTs will be protected from damage or destruction caused by Project activities where feasible. If avoidance of CMTs is not feasible, systematic recording, including stem-round sampling, will be conducted within the Project footprint. A detailed final report will be completed to ensure that the collected data and the results of all analytical processes are available to other archaeologists and First Nations. A copy of the report will also be submitted to the Archaeology Branch.	Construction	PRPA Canpotex Archaeology Branch
24	A water quality monitoring program (see commitment 1) will be implemented to ensure all discharged water into the marine environment meets provincial and federal guidelines.	Operations	Canpotex PRPA
25	Nearby residents will be advised of significant noise-causing construction activities and these will be scheduled to create the least disruption to receptors. A communication and complaint documentation and resolution plan will be developed. If noise complaints related to traffic occur, they will be logged and investigated to assess whether they are linked to Project activities	Construction	PRPA Canpotex

No.	Commitment	Project Phase | Timing	Party Responsible
26	All construction equipment and vehicles and conveyor components will be properly maintained.	Construction	PRPA Canpotex
27	Construction activities will be avoided during night-time and weekends where practicable	Construction	PRPA Canpotex
28	Wetland compensation will be addressed through consultation with CWS.	Not Applicable	PRPA Canpotex
29	A marine communication plan will be developed to ensure that other vessels are aware of construction activities in the area and protection zones (no-go areas) will be identified.	Construction	Canpotex
30	All shipping within the Port of Prince Rupert will be conducted following the rules of shipping established by the Port under the *Canada Marine Act* and in compliance with the requirements of the Canadian Coast Guard (CCG), and with the Port Authority Operations Regulations.	All phases	Canpotex
Follow-up and Monitoring			
31	Noise: Should complaints of excessive noise be received during construction or operations, the root cause of these complaints should be determined, and corrective action will be taken as warranted. In the event of complaints, ambient monitoring of noise may be conducted if required to identify the source or extent of such problems	Construction Operations	Canpotex PRPA
32	Ambient Light: A qualified Environmental Monitor will be hired to oversee general construction and any other activities that could be disruptive concerning light. Follow-up monitoring during all phases of the Project will be on a complaint-driven basis so that specific light trespass issues can be addressed.	All phases	Canpotex PRPA
33	Vegetation: The wetland compensation plan will include a detailed monitoring plan to confirm the achievement of Project goals	Operations	Canpotex PRPA
34	For wildlife, details of the follow-up program will be developed through communication with Environment Canada but will include: • Western toad mitigation plan (habitat compensation, salvage and relocation, fencing of ponds) • Marine bird stationary counts and vessel transect surveys (to ensure 1 year with of data has been collected).	Construction	Canpotex PRPA
35	A trained environmental monitor will be onsite to observe and document all in-water construction activities to ensure that all in-water activities are carried out using best management practices, and that the specified mitigation measures are followed. A post-construction site assessment will also be carried out to verify the areal extent of marine habitats lost or disturbed by the Project. These values will be cross-referenced with the HCP.	Construction	Canpotex PRPA

No.	Commitment	Project Phase | Timing	Party Responsible
36	To compensate for the loss and alteration of marine fish habitats, Canpotex and PRPA will develop an HCP in consultation with DFO. Compensation measures may include the rehabilitation of existing, disturbed marine fish habitats, and the creation of new marine fish habitats. To ensure that compensation measures are successful, a monitoring program will be developed. This program will include construction monitoring and effectiveness monitoring. Effectiveness monitoring will entail three annual surveys of the habitat compensation features to ensure that they are being utilized by the intended marine biota. The specifics of this monitoring program will be provided in the habitat compensation plan.	Construction Operations	Canpotex PRPA
37	Water discharged into the marine environment will be collected bi-annually by a trained environmental monitor and sent for analysis at a certified laboratory. This water will be analyzed for total suspended solids (TSS), turbidity, fecal coliforms, and contaminants (i.e., metals, PCBs, BTEX, and PAHs). This water monitoring program will ensure that all discharged water meets provincial and federal guidelines.	Operations	Canpotex
38	Routine construction monitoring during in-water works will be conducted to ensure there are no impacts to local marine water and sediment quality that could result in chemical effects to biota and to human consumers of potentially affected country foods.	Construction	Canpotex PRPA
39	If an archaeological site is identified, archaeological monitoring and/or SDR studies will be completed.	Construction	Canpotex PRPA

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24 CLOSURE

The EA has assessed the potential interactions between the Project and components of the biophysical and socio-economic environment. As per the requirements of the CEAA, potential environmental effects arising from accidental events and cumulative effects were considered. The EA determined that the environmental and socio-economic effects associated with the Project can be mitigated with standard environmental protection measures. Mitigation has been developed to reduce the extent and duration of potential effects and contingency measures have been developed to address all foreseeable potential unplanned events that may have associated environmental effects. Based on this analysis, the environmental and socio-economic effects of the Project are predicted to be not significant.

Canpotex and the PRPA are committed to environmental management and have standard environmental policies and procedures in place for construction and operation activities. In addition, implementation of the mitigation measures presented in the EA and involvement in the design and planning of the Project by environmental specialists (including consultants), will help to ensure compliance with Canpotex's and PRPA's environmental commitments and minimize the potential for adverse environmental effects.

The conclusion of this assessment is that with the implementation of the outlined mitigation, the adverse environmental and socio-economic effects of the Project will be not significant. In addition, it is concluded that the effects of the environment on the Project will be not significant.