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4 ENVIRONMENTAL AND SOCIO-ECONOMIC ASSESSMENT

BACKGROUND

The marine and human environment

In seeking to understand and address the project's potential effects on the marine and human environment, Northern Gateway considered feedback from its consultation process to determine what the Environmental and Socio-economic Assessment (ESA) should address.

For the Kitimat terminal, 14 topics were assessed, and the information gathered to date is presented here in chart form. As additional topics are identified during the ongoing environmental review and Aboriginal and stakeholder engagement process, they will be addressed in a potential supplemental filing.

For the routine activities associated with the project, each chart covers the following:

- Geographic and time boundaries set for the assessment
- Physical works and activities considered in the study (Note: see Figure 3.3 in *section 3, Project description*)
- Study methods used in the assessment
- Values and resources identified as being of greatest importance to regulators, Aboriginal people and stakeholders. These values and resources are referred to as Valued Environmental Components (VECs)
- Key issues related to the project that were identified through consultation with regulators, Aboriginal people and stakeholders
- Key Indicator Resources (KIRs) – species, groups of species, resources or ecosystem functions that represent components of the broader valued environmental components
- Baseline results determined from past scientific studies and surveys, Aboriginal traditional knowledge and field studies conducted specifically for the project
- Measurable parameters that were selected to provide a way of determining the level or amount of change to a VEC or KIR
- Potential project effects on the VECs – how the project's activities and actions might potentially result in an environmental effect
- Proposed mitigation – means to ensure that environmental effects are reduced as much as possible
- Residual effects – the remaining environmental effects after all mitigation and environmental management measures have been applied
- Cumulative effects –the potential to act in concert with similar environmental effects from other past, present and reasonably foreseeable projects and human activities are assessed after the residual project effects have been described and assessed

Please note that the assessment of spill prevention and response is discussed in *section 3, Project description*.

ENVIRONMENTAL AND SOCIO-ECONOMIC ASSESSMENT

Valued environmental components: The criteria for selecting VECs includes:

- Were they identified in the draft terms of reference for the Joint Panel Review?
- Do they represent a broad environmental, ecological or human environment component that may be affected by the project?
- Are they vulnerable to the environmental effects of the project and other activities in the region?
- Have they been identified as important issues or concerns by regulators, Aboriginal people or stakeholders or in other assessments of the region?

VECs for the marine environment include aspects such as sediment and water quality, marine fish, marine mammals and various fisheries that might be altered by the project. They are widely recognized as important for ecological reasons.

Representative VECs for the human environment include aspects such as the economy, employment and business, traditional land and resource use, non-traditional marine use, and communities and community life.

Geographic and time boundaries: Three geographic study areas have been used for the environmental assessment for the marine aspect of the project. They are:

- The Project Development Area (PDA) that will be directly affected by the actual footprint of the facilities and activities associated with the marine terminal.
- The project effects assessment area (PEAA) over which the direct and indirect environmental effects of the project can be measured or are expected to occur. For the marine terminal, the PEAA for most VECs included all of Kitimat Arm and, in some cases, the northern portion of Douglas Channel.
- The regional effect assessment area (REAA) is where effects of the project are likely to interact with similar effects from other human activities and projects. The REAA differs among VECs and even among different effects for a VEC.

For marine transportation, an additional geographic boundary has been defined, the Confined Channel Assessment Area (CCAA), which is the area where measurable environmental effects of shipping are viewed as most likely to occur. The CCAA includes the marine and shoreline area of Kitimat Arm, Douglas Channel to Caamaño Sound, and Principe Channel to Browning Entrance.

Time or temporal boundaries are based on when an effect could most likely occur during the project, such as the three phases of the project: construction, operations and decommissioning.

The environmental assessment equation

Finally, the following equation explains how all the components of the assessment relate to one another. The equation is the sum of our **baseline knowledge of environmental factors**, and our **assessment of a project's potential effects**, minus the **effects of mitigation and protection measures**. This set of knowledge is equal to the other side of the equation – namely the **project's residual effects** combined with the **cumulative effects of other activities on the environment**.

MARINE ATMOSPHERIC ENVIRONMENT

Study geographic boundaries: The climate PEAA is an elliptically shaped area approximately 36 km long and 10 km wide stretching southwest to northeast. It includes land on both sides of the Kitimat Arm in Douglas Channel, from southwest of the terminal to the northeast, and includes the District Municipality of Kitimat and Kitamaat Village.

Study time boundaries: Construction and operations phases.

Project works and activities considered in the study*: Hydrocarbon storage tanks at the terminal and marine vessel operations while at berth.

Study methods: Baseline air quality was established by examining ambient air quality data sets at sites located near the pipeline Right-of-Way (RoW) and near the Kitimat terminal. Baseline climate was delineated through a statistical summary of climate and meteorology parameters at sites near the Kitimat terminal using 30 year climate normals (1971 to 2000). The potential air quality effects of the marine terminal's construction and operations on the health of humans, wildlife, vegetation and other life forms were assessed using dispersion modeling. This science-based system explains how air emissions will likely behave in a particular environmental setting. The predicted air concentrations for each air contaminant are assessed through comparison with provincial and federal ambient air quality objectives and standards.

VEC	Key Issues	KIR	Baseline Results	Measurable Parameter	Potential Project Effects**	Proposed Mitigation	Residual Effects	Cumulative Effects
Climate	Environmental effects of added greenhouse gas emissions.	n/a	Canada, Alberta, British Columbia and the Territories total greenhouse gas emissions (in tonnes per year of CO_2 equivalents), from 1990 to 2000, with projections for the years 2005-2020 were summarized to provide a broad greenhouse gas emission baseline. The data was based on information provided by Natural Resources Canada in 2005.	Changes to provincial and federal greenhouse gases.	The GHG (CO_2e) emissions from operations activities from the terminal are minor when compared with total Canadian CO_2e emissions for 2005. It is anticipated that the marine terminal operations will not result in any substantive interaction with the climate in a way that will result in discernible changes to regional, national, or global climate patterns. Therefore, the marine terminal is not expected to result in any significant adverse environmental effects on climate.	Wherever possible, the Best Available Technology Economically Achievable (BATEA) will be incorporated into the terminal's design to reduce greenhouse gas emissions. These measures will help ensure compliance with federal and provincial air quality guidelines throughout all phases of the project. In addition, best practices will be employed at all times to minimize dust and vehicle emissions.	Currently being assessed.	Currently being assessed.

*Refer to Figure 3.3 in *section 3, Project description*, for the full list of physical works and activities. **The effects of spills and malfunctions will be included in the update for the supplemental filing.

continued...

VEC	Key Issues	KIR	Baseline Results	Measurable Parameter	Potential Project Effects**	Proposed Mitigation	Residual Effects	Cumulative Effects
Air Quality	Environmental effects of added Criteria Air Contaminant (CAC) emissions. Environmental effects of added Hazardous Air Pollutants (HAP) emissions.	n/a	Kitimat has a relatively heavy industrial base and the proposed Kitimat terminal will be close to several industrial sources of air contaminants. Air quality near the Kitimat terminal, while good, is reflective of that proximity. Kitimat's industrial area is primarily located on the western side of the valley, opposite the residential and commercial district. It includes Alcan's aluminium smelter and casting facility and Eurocan's unbleached kraft pulp and paper mill. A decommissioned methanol-ammonia manufacturing facility is now being retrofitted as a condensate import facility. Other industries include an asphalt plant and a cement batch plant. There are also smaller commercial and industrial sources of air contaminants, as well as vehicle and residential emissions. Monitoring results taken from 2000 to 2008 at the Kitimat railway station indicate that the ambient air quality in the terminal area is generally good, with little year-to-year variability. That being said, concentrations of particulate matter (PM), sulphur dioxide (SO_2) and hydrogen sulphide (H_2S) have occasionally exceeded the most stringent ambient air quality objectives.	Changes to Criteria Air Contaminants (CCAC) • Sulphur Dioxide (SO_2) • Nitrogen Dioxide (NO_2) • Carbon Monoxide (CO) • Total Suspended Particulates (TSP) • Inhalable Particulate Matter (diameter less than 10 microns - PM10) • Respirable Particulate Matter (diameter less than 2.5 microns - PM2.5) • Hydrogen Sulphide (H_2S)	The modeling has shown that Kitimat marine terminal has the potential to cause measureable changes in air quality, however, none of these changes are considered to be of concern to human or environmental health. Heavy equipment operating onsite during the construction phase will be responsible for the majority of CAC emissions around the terminal. Light trucks and tugs and barges will also contribute to these emissions, but to a much lesser extent. During operations, the only substantial operational source of CAC emissions will be from the operation of marine vessels loading oil and off-loading condensate at two separate, dedicated tanker berths. Any changes to air quality are expected to occur primarily within the immediate vicinity of the terminal. Offsite concentrations of emissions from the project will not exceed Ambient Air Quality Objectives (AAQO). However, the maximum predicted three-hour and 24-hour average ground-level SO_2 concentrations may occasionally exceed the applicable objectives immediately adjacent to the marine vessels under certain calm weather conditions. Use of low sulphur fuels will help minimize this potential effect.	Steps to minimize CAC emissions will ensure compliance with federal and provincial air quality standards throughout all phases of the project. Wherever possible, the BATEA will be incorporated into the terminal's design to reduce air contaminants. In addition, best practices will be employed at all times to minimize dust and vehicle emissions.	Currently being assessed.	Currently being assessed.
				Changes to Hazardous Air Pollutants (HAP) • Total Volatile Organic Compounds (VOCs) • Benzene, Toluene, Ethylbenzene, Xylene (BTEX) • Hydrogen Fluoride	While HAPs will be generated by marine vessels at the berthing facilities and from the hydrocarbon storage area, predicted concentrations are well below the AAQO standards. Predicted changes also will occur primarily in the vicinity of the Kitimat terminal.	Wherever possible, the BATEA will be incorporated into the terminal's design to reduce hazardous air pollutants. These measures will help ensure compliance with federal and provincial air quality guidelines throughout all phases of the project. In addition, best practices will be employed at all times to minimize dust and vehicle emissions.	Currently being assessed.	Currently being assessed.

MARINE ACOUSTIC ENVIRONMENT

Study geographic boundaries: Kitimat Arm, Douglas Channel and other areas within the CCAA.

Study time boundaries: Construction, operations and decommissioning phases.

Project works and activities considered in the study*: In-water infrastructure site preparation and construction, construction support vessels, in-water infrastructure operations, moored tankers, tanker and tug traffic.

Study methods: An acoustic study with both field and modeling components was performed to measure ambient noise levels. These studies measured underwater acoustic transmission loss (the rate at which noise levels decrease with distance from a source such as a vessel), and to identify vocalizations of wildlife species present in the area. Computer models were used to predict the extent of underwater noise produced by marine vessels associated with the project.

In autumn 2005, background underwater acoustic levels were measured at four sites within the CCAA. A variety of man-made, natural and biological sounds were captured during this study. Recorded sound levels covered a broad range and spanned low to higher frequencies.

VEC	Key Issues	KIR	Baseline Results	Measurable Parameter	Potential Project Effects**	Proposed Mitigation	Residual Effects	Cumulative Effects
Marine Acoustic Environment	Vessels moving through the CCAA will generate in-air sound that could potentially disturb marine animals.	Northern resident killer whale Canadian North Pacific humpback whale Steller sea lion	Background in-air noise levels are low, as expected in the BC wilderness – dense forest acts as an effective noise absorber.	In-air sound	In-air acoustic emissions from passing vessels were modeled. The models showed that in-air sound from vessels decreased in intensity quickly. Since audible noise would be restricted to a small area around a vessel and would only last for a brief time as a vessel passes, effects on marine life are expected to be highly localized and short-term.	Currently being assessed.	Currently being assessed.	Currently being assessed.
	Marine species, particularly marine mammals, rely heavily on the use of sounds for various life functions. They use sound to communicate and coordinate hunting, navigate (using echolocation), avoid predators, and detect prey. The introduction of anthropogenic sounds (sounds from human activities) therefore has the potential to disturb or even physically harm marine animals both directly and indirectly.	Northern resident killer whale Canadian North Pacific humpback whale Steller sea lion	Background in-water noise levels were measured near the Kitimat Terminal and were determined to be low. Underwater noise from passing vessels was also captured.	Underwater sound	Underwater sound will be produced by construction activities such as dredging and pile drilling and by operational activities, such as tankers moored on standby. Vessels moving through the CCAA will also generate underwater sound that could potentially result in disturbances to marine species. Given the anticipated frequency of vessels, their noise is expected to have little effect other than temporary avoidance of the immediate vicinity of the vessel by some marine life. Long-term effects, particularly cumulative underwater noise effects such as prolonged avoidance of important foraging areas, alteration of migratory routes, or increased energetic costs, are difficult to predict and are not well understood.	Currently being assessed.	Currently being assessed.	Currently being assessed.

*Refer to Figure 3.3 in *section 3, Project description*, for the full list of physical works and activities. **The effects of spills and malfunctions will be included in the update for the supplemental filing.

MARINE SEDIMENT AND WATER QUALITY

Study geographic boundaries: Marine Terminal PDA and PEAA.

Study time boundaries: Construction and operation phases.

Project works and activities considered in the study*: All Kitimat Terminal physical works and activities as listed under construction and operations.

Study methods: Sediment quality was measured by looking at characteristics such as the size of particles, levels of organic matter, and presence of specific contaminants (including hydrocarbons, metals, dioxins and furans). Water quality was measured by looking at turbidity, total suspended solids or TSS (solids that can be trapped in a filter), salinity, temperature, pH, and various chemical compounds (such as nutrients, metals and hydrocarbons). Existing sediment and water conditions in Kitimat Arm were assessed through literature review and a field study in the proposed terminal area in winter 2006. In the Marine ERA, the potential environmental effects of Kitimat Terminal Operations on water and sediment quality over a 50 year period were modeled; chemicals of potential concern include benzene, toluene, ethylbenzene, xylenes (BTEX), total petroleum hydrocarbon (TPH) fractions; polycyclic aromatic hydrocarbons (PAH), volatile organic carbons (VOC), phenolics, and trace elements.

VEC	Key Issues	KIR	Baseline Results	Measurable Parameter	Potential Project Effects**	Proposed Mitigation	Residual Effects	Cumulative Effects
Marine Sediment and Water Quality	Altered suspended sediment levels. Altered sediment and water chemistry.	n/a	The sediment of Kitimat Arm and Douglas Channel is influenced by fjord and estuarine circulation patterns. Total suspended solids levels are highest in surface waters during the spring freshet period of high runoff from the Kitimat River and other rivers in the area.	Altered suspended sediment levels.	In the area to be dredged for the marine terminal, sediment generally met the criteria set by Environment Canada for disposal of dredged materials in the ocean. Most of the parameters measured also met the sediment quality guidelines set by the Canadian and BC governments to protect marine life. Dredging for construction of the marine terminal may release sediment into the water, resulting in a temporary increase in total suspended sediments (TSS) and turbidity levels, and subsequent resettlement of the sediment.	Use of specific dredging equipment and silt curtains	The potential environmental effects are expected to be localized, of short duration and reversible. Computer modeling of TSS levels shows a plume may develop to the northwest of the dredge area. Changes in TSS levels are expected to be difficult to distinguish from existing conditions at most water depths.	Currently being assessed.
			The general water chemistry of Kitimat Arm and Douglas Channel is influenced by fjord and estuarine circulation patterns. Salinity levels are lowest in surface waters during the spring freshet period of high runoff from the Kitimat River and other rivers in the area. Activities in the Kitimat Arm area have released contaminants over several decades through effluent discharges and air emissions. Activities include the Alcan smelter, the Eurocan pulp and paper mill and sawmill, the former Methanex methanol facility, the municipal wastewater treatment plant, and stormwater discharges. Contaminants of concern include PAH, metals, and dioxins and furans. Sediment PAH levels are high in some areas of Kitimat Arm, due mainly to historic and, to a lesser extent, current air emissions from the Alcan smelter.	Altered sediment and water chemistry.	Sublethal toxicity tests were conducted in the laboratory using two common marine organisms (amphipod and polychaete worm) and did not indicate any toxicity effects of sediment from the project area. The sediment released during dredging for construction may contain contaminants that would result in changes to sediment quality and water quality. During routine operations, the terminal will discharge surface water to Kitimat Arm, away from the terminal.	The discharged water will be treated and at air temperature.	The potential effects will be localized, short-term and reversible, with limited effect on marine organisms. The differences between seawater and effluent temperature and salinity will be localized, of short duration and reversible.	Currently being assessed.

*Refer to Figure 3.3 in *section 3, Project description*, for the full list of physical works and activities. **The effects of spills and malfunctions will be included in the update for the supplemental filing.

MARINE VEGETATION

Study geographic boundaries: Marine terminal PDA, PEAA, CCAA.

Study time boundaries: Construction and operations phases.

Project works and activities considered in the study*: Construction – on-shore infrastructure site preparation (clearing, burning, grading, blasting): in-water infrastructure site preparation (dredging, blasting, pile drilling); in-water infrastructure construction (marine terminal, permanent jetty, construction jetty, pile installation); construction support vessels (barges, tugs, ocean disposal barges); ocean disposal (waste overburden, drill cuttings); on-shore site restoration; in-water infrastructure site restoration; decommissioning support vessels. Operations – physical footprint of in-water infrastructure; marine vessel traffic, tanker traffic, tug traffic.

Study methods: Intertidal surveys were completed in 2005/6 and 2008 to characterize the shoreline communities along approximately two kilometres of the shoreline near the marine terminal. A standard quadrat and transect methodology was used to collect information. No specific fieldwork was undertaken for marine riparian vegetation; rather, a review of literature and aerial photographs were used to determine the presence and extent of riparian vegetation along the shoreline around the terminal.

VEC	Key Issues	KIR	Baseline Results	Measurable Parameter	Potential Project Effects**	Proposed Mitigation	Residual Effects	Cumulative Effects
Marine Vegetation	Eelgrass is an ecologically important species to the region. The plants can form extensive sub-tidal beds that serve as habitat for juvenile and adult invertebrates and fish. Eelgrass beds provide cover from predation, reduce local current regimes (allowing for settlement of organisms) and add to overall ecosystem productivity. Eelgrass beds are extremely sensitive and are threatened by coastal development worldwide. Out of all the seaweed species on the North Central Coast, rockweed has the largest biomass in the region. It provides food and shelter to a number of near-shore organisms that make up intertidal and subtidal communities in the region. Despite being located on the land, marine riparian vegetation plays an important role as incubation, rearing and migratory habitat for several commercially important fish species, such as salmonids. Although there is limited research on marine riparian vegetation, it is thought to be important for food production, temperature regulation, wave energy absorption and provision of habitat structure in coastal environments.	Eelgrass	The surveys revealed small patches of eelgrass close to the terminal, but no eelgrass beds in the immediate vicinity of the terminal. The largest eelgrass bed found during surveys was in the Bish Creek Estuary.	Direct mortality. Changes in habitat quality. Change in habitat availability.	Changes in water quality resulting from increased sedimentation or exposure to contaminants from re-suspended sediments, bilge water or runoff may affect the growth, survival and recovery potential of eelgrass.	Currently being assessed.	No eelgrass beds are located near the terminal, and computer modeling indicates that the dredging sediment plume will not extend to sensitive areas such as the eelgrass bed in Bish Cove.	Not applicable.
		Rockweed	The surveys also indicated that rockweed populations are widespread and abundant. Rocky shores were found to be common, providing ample rockweed habitat. Additionally, rockweed is capable of growing on man-made structures and is expected to grow on the underwater terminal structures.	Direct mortality. Changes in habitat quality. Change in habitat availability.	Changes in water quality resulting from increased sedimentation or exposure to contaminants from re-suspended sediments, bilge water or runoff may affect the growth, survival and recovery potential of rockweed. Construction activities present the greatest risk in terms of potential disturbance to marine vegetation.	Currently being assessed.	Because rockweed is very common in the region and dredging activities will be a considerable distance away from the largest eelgrass bed in the area, no measurable environmental effects on marine vegetation is anticipated.	Not applicable.
		Marine riparian vegetation	Marine riparian vegetation was found on a steep, rocky shoreline well above the high water mark, but is known to receive saltwater spray during storms. The marine riparian zone adjacent to the marine terminal is densely populated by vegetation including Western hemlock, Western red cedar, Amabilis fir and Sitka spruce, with some occurrence of Douglas fir.	Direct mortality.	Currently being assessed.	With the exception of specific sites where access is required to the berths, marine riparian habitat will be retained along the length of the terminal site. A suite of sediment management measures and general construction guidelines will also be implemented to limit soil erosion and freshwater runoff from the terminal site into the marine environment.	Effects on marine riparian vegetation are expected to be site-specific, long -term and reversible after decommissioning	Currently being assessed.
				Changes in habitat quality.	Currently being assessed.			
				Change in habitat availability.	Construction activities present the greatest risk in terms of potential disturbance to marine vegetation.			

*Refer to Figure 3.3 in *section 3, Project description*, for the full list of physical works and activities. **The effects of spills and malfunctions will be included in the update for the supplemental filing.

MARINE INVERTEBRATES

Study geographic boundaries: Marine terminal PDA, PEAA, CCAA.

Study time boundaries: Construction and operations phases.

Project works and activities considered in the study*: Construction – on-shore infrastructure site preparation (clearing, burning, grading, blasting); in-water infrastructure site preparation (dredging, blasting, pile drilling); in-water infrastructure construction (marine terminal, permanent jetty, construction jetty, pile installation, docking berth, underwater structures); construction support vessels (barges, tugs, ocean disposal barges); construction marine vessel traffic (wake, noise). Operations – moored tankers and associated combustion emissions, inert gas exchange, prop wash, noise, boom deployment; tanker traffic (wake, noise); tug traffic (wake, noise, prop wash).

Study methods: Blue mussels are generally representative of sessile invertebrates (those that attach themselves to other things) in the terminal area because of their wide distribution and high biomass in the region. Dungeness crabs are representative of native motile (free swimming) invertebrate species. Hexactinellid sponges aggregations serve as nursery habitat for fish and invertebrates.

Intertidal surveys, using a standard quadrat methodology, were completed in 2005/6 and 2008 along approximately two kilometres of shoreline near the terminal. Additionally, subtidal underwater video surveys were conducted by local experts at three sites. An underwater camera was towed just above the seabed and surface technicians recorded data using state-of-the art technology and geo-referencing.

VEC	Key Issues	KIR	Baseline Results	Measurable Parameter	Potential Project Effects**	Proposed Mitigation	Residual Effects	Cumulative Effects
Marine Invertebrates	Blue mussels are ecologically important as a food source for numerous species, including marine birds. The dense mats they form provide protection and a place for other intertidal animals including barnacles, crabs and snails. Dungeness crab is the most important crab species harvested in BC. Their eggs are an important food source for Pacific herring, Pacific sardine, rockfish and chinook salmon. They are also dominant predators on the seabed, feeding on clams, other crustaceans and small fish. Benthic sponges were chosen because sponge aggregations are sensitive to disturbance and serve as nursery habitat for fishes and invertebrates. Some species such as those present in Hecate Strait are unique to the western Canadian continental shelf and are ecologically important contributors to species diversity.	Blue mussel Dungeness crab Benthic sponges	The blue mussel is native to the Pacific Northwest, and dominates the hard shoreline of the sheltered coasts of BC, including the terminal area. Blue mussels are common in habitats such as rock shelves, estuaries and boulder beaches, and this was confirmed by observations from the intertidal surveys. No dungeness crabs were captured during a nearshore trapping survey in June 2006. The subtidal camera survey revealed a low abundance of crabs at the marine terminal, suggesting the general area is most likely not primary habitat for dungeness crab in Kitimat Arm. Results of a subtidal video survey of the terminal area in May 2007 indicated a scattered distribution of benthic sponges throughout the survey area. The sponges were present at both ends of the site, but absent from the central region and appeared to be associated with the steep, rugged cliffs found at either end of the site.	Risk of direct mortality.	Construction activities such as blasting and dredging present the greatest risk in terms of direct mortality and disturbances to blue mussels.. During operations, project vessels may crush some mussels living on the mooring facilities.	Currently being assessed.	During operation, project vessels may crush some mussels living on the mooring facilities. This is not expected to affect the viability of local mussel populations. Dungeness crabs and hexactinellid sponges are not expected to be killed during operations. The marine terminal will provide increased material for mussels to grow.	Currently being assessed.
				Changes in habitat quality.	Computer modeling indicates that the dredging sediment plume will not extend beyond a few hundred metres and will have low concentrations of suspended solids.	Currently being assessed.	Altered water quality from dredging is expected to have few effects on the abundance and distribution of mussels, crabs and sponges in the area.	Currently being assessed.
				Changes in habitat availability.	Construction activities such as blasting and dredging present the greatest risk in terms of potential disturbances to marine benthic invertebrates. Changes in habitat may occur due to vessel wake and/or vessel noise during routine operations. Increases in underwater sounds may temporarily and intermittently alter the behaviour and movement patterns of crabs.	Currently being assessed.	While the effects of underwater blasting on marine invertebrates are not well understood, most species appear to be able to tolerate the shock waves of underwater explosions. Increases in underwater sounds may temporarily and intermittently alter the behaviour and movement patterns of crabs, although there is limited overlap between primary dungeness crab habitat and the area in which marine sounds will occur. The wake produced from increased marine transportation is not expected to alter present wave motion characteristics enough to change the distribution or abundance of marine invertebrates.	Currently being assessed.

*Refer to Figure 3.3 in *section 3, Project description*, for the full list of physical works and activities. **The effects of spills and malfunctions will be included in the update for the supplemental filing.

MARINE FISH

Study geographic boundaries: Marine terminal PDA, PEAA, CCAA.

Study time boundaries: Construction and operations phases.

Project works and activities considered in the study*: Construction – on-shore infrastructure site preparation (clearing, burning, grading, blasting); in-water infrastructure site preparation (dredging, blasting, pile drilling); in-water infrastructure construction (marine terminal, permanent jetty, construction jetty, pile installation); construction support vessels (barges, tugs, ocean disposal barges); construction vessel traffic (wake, noise). Operations – in-water infrastructure (marine terminal, docking berth, underwater structures); moored tankers and associated combustion emissions, inert gas exchange, prop wash, noise, boom deployment; tanker traffic (wake, noise); tug traffic (wake, noise, prop wash).

Study methods: Fish surveys were undertaken in 2005/6 and 2008 using beach seine, gillnets and longlines; however, no eulachon, Pacific herring or chum salmon were caught near the terminal site. Underwater surveys were conducted by scuba and with underwater video survey techniques to determine the presence, abundance and locations of aggregations of rockfish. For the most part, the presence of marine fishes was documented through government and scientific reports and Department of Fisheries and Oceans (DFO) landings statistics.

VEC	Key Issues	KIR	Baseline Results	Measurable Parameter	Potential Project Effects**	Proposed Mitigation	Residual Effects	Cumulative Effects
Marine Fish	Eulachon is a culturally and ecologically important species in the region. Many marine species depend on it as a food source and the annual migration contributes to overall ecosystem health and productivity. Eulachon is a staple food source and valuable trade item for many First Nations along the coast, particularly the Haisla, the Nisga'a and the Tsimshian. The government of BC has listed eulachon as a blue-listed species, indicating it requires special attention to ensure it does not become threatened. Pacific herring play a central role in the marine food web, constituting a major portion of the summer diets of salmon, Pacific cod, lingcod and harbour seals. Herring eggs are an important part of the diets of migrating seabirds and grey whales, as well as invertebrates. Pacific herring have been one of the most important components of BC's commercial fishery over the past century. Rockfish are representative of the fish that live near the bottom of the sea and are ecologically important to marine food webs as both predators and prey. They are generally a long-lived, late maturing species that typically remain near where they were born for most of their lives. Because of these traits, rockfish are vulnerable to activities that alter their habitat or interfere with ecosystem dynamics. Chum salmon represent all other salmon because they have a very broad distribution and a lifecycle generally representative of other salmon species. Salmon are economically, culturally and ecologically important in the region. Salmon are fished commercially and recreationally, and for food, social and ceremonial purposes by coastal First Nations. Salmon are also an important food source for animals living on land, acting as a critical link between the land and sea.	Eulachon	The largest density of eulachon will be present in the project area during migration and spawning, which typically occurs in the Douglas Channel and/or Gardner Canal area in February to March.	Change in habitat quality.	Sediment from construction activities could affect habitat quality for eulachon.	Use of specific dredging equipment and silt curtains.	Overall, the localized area of sediment deposition coupled with the high potential for reversibility will limit the TSS effects on eulachon such that no measurable environmental effects are anticipated.	Not applicable.
				Change in habitat availability.	Activities such as blasting, dredging, terracing along the underwater rock face and the introduction of structures (such as piles) will permanently alter eulachon habitat.	Currently being assessed.	Eulachon spawn in freshwater so habitat alteration will not directly affect their spawning habitat.	Not applicable.
				Acoustic disturbance.	Underwater noise will be created by activities such as blasting, dredging, pile construction and ship movement.	Currently being assessed.	Computer modeling indicates that the effects on eulachon will be limited.	Not applicable.
		Pacific herring	Pacific herring are resident in the terminal area; however, they typically spawn in Kitimat Arm and Douglas Channel during March through April, to as late as July.	Change in habitat quality.	Sediment from construction activities could affect habitat quality for Pacific herring.	Use of specific dredging equipment and silt curtains.	Overall, the localized area of sediment deposition coupled with the high potential for reversibility will limit the TSS effects on Pacific herring such that no measurable environmental effects are anticipated.	Not applicable.
				Change in habitat availability.	Activities such as blasting, dredging, terracing along the underwater rock face and the introduction of structures (such as piles) will permanently alter Pacific herring habitat.	Currently being assessed.	Because Pacific herring do not spawn at specific locations, their spawning behaviour should not be greatly affected by the increase in underwater structures.	Not applicable.
				Acoustic disturbance.	Underwater noise will be created by activities such as blasting, dredging, pile construction and ship movement.	Currently being assessed.	Computer modeling indicates that the effects on Pacific herring will be limited.	Not applicable.

*Refer to Figure 3.3 in *section 3, Project description*, for the full list of physical works and activities. **The effects of spills and malfunctions will be included in the update for the supplemental filing.

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VEC	Key Issues	KIR	Baseline Results	Measurable Parameter	Potential Project Effects**	Proposed Mitigation	Residual Effects	Cumulative Effects
Marine Fish		Rockfish	Rockfish are resident in the terminal area. Bocaccio rockfish juveniles tend to settle into coastal and shelf habitat from late spring throughout the summer. Newly hatched and juvenile (young-of-the-year) fish live near the surface for a few months and then settle in nearshore areas.	Change in habitat quality.	Sediment from construction activities could affect habitat quality for rockfish.	Use of specific dredging equipment and silt curtains.	Overall, the localized area of sediment deposition, coupled with the high potential for reversibility, will limit the TSS effects on rockfish such that no measurable environmental effects are anticipated.	Not applicable.
				Change in habitat availability.	Activities such as blasting, dredging, terracing along the underwater rock face and the introduction of structures (such as piles) will permanently alter rockfish habitat.	Currently being assessed.	Rockfish are expected to make use of the new habitats created by the blasting. In fact, environmental effects will be offset by the creation of these new structures, which can provide habitat for young fish to occupy before they disperse to other areas.	Not applicable.
				Acoustic disturbance.	Underwater noise will be created by activities such as blasting, dredging, pile construction and ship movement.	Currently being assessed.	Rockfish will only be disturbed initially by underwater explosions. However, computer modeling indicates that the effects on rockfish will be localized.	Not applicable.
		Chum salmon	Two chum salmon runs occur in the terminal area, in the summer and fall respectively. The summer chum migrate in June, July and August and spawn in September and early October. The fall chum migrate in September, October and November, spawning from October to January.	Change in habitat quality.	Sediment from construction activities could affect habitat quality for salmon.	Use of specific dredging equipment and silt curtains.	Overall, the localized area of sediment deposition, coupled with the high potential for reversibility, will limit the TSS effects on chum salmon such that no measurable environmental effects are anticipated.	Not applicable.
				Change in habitat availability.	Activities such as blasting, dredging, terracing along the underwater rock face and the introduction of structures (such as piles) will permanently alter Chum salmon habitat.	Currently being assessed.	Chum salmon spawn in freshwater so habitat alteration will not directly affect their spawning habitat.	Not applicable.
				Acoustic disturbance.	Underwater noise will be created by activities such as blasting, dredging, pile construction and ship movement.	Currently being assessed.	Computer modeling indicates that the effects on chum salmon will be localized.	

MARINE FISHERIES

Study geographic boundaries: Marine terminal PDA and the CCAA.

Study time boundaries: Construction and operations phases.

Project works and activities considered in the study*: Construction and operations activities. Construction vessels, tanker movements and associated tug escorts.

Study methods: Baseline conditions for portions of the marine fisheries were determined through an assessment of statistics on commercially important fish and invertebrate species within the assessment area for the four component fisheries. DFO was the primary data source and included interviews with DFO personnel in Prince Rupert and searches of posted statistical data and related information from on-line resources. Field work involved a series of interviews with local commercial and subsistence fishermen, based in Kitimat in October 2005. The interviews were held on a voluntary basis and the details of those individuals who provided information remain confidential. Information for the commercial-recreational fishery was gathered through interviews and questionnaires completed by select fishing ventures and individuals. Further documentation of the extent, location and significance of recreational, commercial-recreational and FSC fisheries is required.

VEC	Key Issues	KIR	Baseline Results	Measurable Parameter	Potential Project Effects**	Proposed Mitigation	Residual Effects	Cumulative Effects
Marine Fisheries: Commercial Recreational Commercial recreational Food / Social / Ceremonial	Marine fisheries were chosen as a valued ecosystem component because of their economic and cultural importance to the region. Any changes in marine invertebrate and marine fish populations due to project activities have the potential to affect the livelihood of commercial fishers and community members dependent upon these resources for subsistence and economic gain. Project facilities and activities could also affect access to fishing areas during fishery openings, as well as damage or loss of fishing gear. Commercial fishing provides employment for many coastal communities along BC's north and central coasts (NCC). FSC fisheries are important to local Aboriginal communities as a traditional way of life. While some members of the Aboriginal community depend upon the fishery more than others, all the Aboriginal coastal communities traditionally harvest fish and shellfish from the area. The recreational and commercial recreational fisheries involve a cross-section of community members including Aboriginal groups.	Salmon Dungeness crab Geoduck Pacific herring Horse clam Mussels Octopus Pacific halibut Prawns Red sea urchin Groundfish Shrimp	Baseline information indicates the NCC region produces notable quantities of both fish and shellfish. The marine environment is considered to reflect decent water quality and relatively healthy habitat, strengthening the prospects of continued commercial, FSC, recreational and commercial-recreational fishing activities in this area. In terms of fishing effort and financial value, the commercial salmon fishery is considered the most important near the Kitimat Terminal. Aboriginal communities and their members rely on subsistence fishing for resources. However, the extent of FSC fishing within the terminal area is currently unknown.	Extent to which fisheries are disrupted by exclusion zones and vessel movements (fishing effort, number of fishing vessels, reduced quota, reduced landings).	During construction, commercial fishing will be excluded from the terminal area and a surrounding buffer zone; however, this exclusion area represents only a small proportion of the total area of Kitimat Arm. Fishing may also be hampered by the movement of construction and supply vessels between the marine terminal site and the Port of Kitimat.	Northern Gateway will work with fishers to minimize effects on key fishing sites and fishing seasons. A Fisheries Liaison Committee is proposed to address and discuss issues as they may arise associated with access to fishing grounds, and conflicts between fishing and ship movements. Adaptive management will be a cornerstone of the mitigation process where the effectiveness of mitigation strategies is implemented and improved where needed.	Overall, the potential for interaction with fishing vessels is limited, relative to the total area of Kitimat Arm. Conflicts between vessel movements and fishing are expected to be able to be manage through scheduling of vessel transits, as well as scheduling of fishing activities.	Currently being assessed.
				Loss or damage to fishing gear. Alteration of commercial species distribution and abundance.	Because of the restricted and often unpredictable timing of the salmon fishery, the potential for negative effects because of routine terminal activities is considered greater than for other fisheries. Transits by construction vessels or by tankers and their escort tugs could result in loss or damage to fishing gear.	Northern Gateway will work with fishers to minimize potential for loss or damage to fishing gear. A Fisheries Liaison Committee is proposed to address and discuss issues as they may arise associated with access to fishing grounds, and conflicts between fishing and ship movements.	Conflicts between vessel movements and fishing are expected to be able to be manage through scheduling of vessel transits, as well as scheduling of fishing activities.	Currently being assessed.

*Refer to Figure 3.3 in *section 3, Project description*, for the full list of physical works and activities. **The effects of spills and malfunctions will be included in the update for the supplemental filing.

MARINE BIRDS

Study geographic boundaries: Marine terminal PDA and CCAA. Because marbled murrelet nesting habitat extends inland and to relatively high elevations, a terrestrial study area was included for murrelets.

Study time boundaries: Construction, operations and decommissioning phases.

Project works and activities considered in the study*: Kitimat terminal: construction, operations, and decommissioning. CCAA vessel traffic: construction, operations, and decommissioning.

Study methods: Marbled murrelet, surf scoter and bald eagle are the key indicator resources used to assess environmental effects on marine birds. These species are strong indicators of ecosystem health if breeding and non-breeding populations, relative species abundance and habitat associations are viable. By reducing environmental effects on these species, the health of the marine and terrestrial environments can be monitored and mitigation plans can be developed and adapted based on their responses to mitigation plans.

In 2005/6, vessel and aerial surveys were completed throughout the PDA and CCAA to determine the presence or absence of marine bird species during different seasons. Additional surveys are being completed during 2009. This information was used in conjunction with existing literature to provide an overview of each KIR.

VEC	Key Issues	KIR	Baseline Results	Measurable Parameter	Potential Project Effects**	Proposed Mitigation	Residual Effects	Cumulative Effects
Marine Birds	Habitat loss or alteration during construction. Disturbances and habitat avoidance because of noise and human activities. Possible mortality from collisions with project infrastructure or decreased reproductive success.	Marbled murrelet Surf scoter Bald eagle	Marine birds are generally concentrated in the highly productive estuaries where freshwater meets the sea (such as inlets and sheltered bays) and the shallow waters above the shelf. These areas are particularly important to wintering birds, and to colonial nesting seabirds which forage there to feed their young in the nesting season. Listed as threatened on *Schedule 1* of the *Species at Risk Act*, marbled murrelets are very sensitive to change in marine ecosystems. Using both land and sea habitats, they nest in old growth trees and feed on small fish in the ocean nearby. Taking several years to become mature enough to breed, a pair only produces one egg a year when they do finally nest. As a result, if these birds suffer population declines (from habitat loss, for instance) they require many years for their numbers to increase again. As such, marbled murrelets act as good indicators of ecosystem health. Individuals or pairs of murrelets were observed in protected inlets and bays near Kitimat Terminal and within the CCAA.	Alteration, loss and fragmentation of habitat during construction.	Only small amounts of preferred nesting habitats for marbled murrelet will be lost as a result of the construction of the terminal, although nesting has not been confirmed in this area. Marine foraging habitat for marbled murrelets and surf scoters will be altered around the marine terminal PDA during construction; although better foraging habitat is present in other parts of the CCAA. Operations and decommissioning of the marine terminal are not anticipated to adversely affect bald eagle habitat; however, limited loss, alteration or fragmentation of bald eagle habitat will occur during construction.	Location of the tank terminal has utilized areas already disturbed by recent forestry operations. Site-specific surveys of nests prior to clearing and avoidance of loss of nesting trees wherever possible.	Relatively small numbers of birds will be affected by the activities. Some foraging habitat around the terminal will eventually recover.	Currently being assessed.

*Refer to Figure 3.3 in *section 3, Project description*, for the full list of physical works and activities. **The effects of spills and malfunctions will be included in the update for the supplemental filing.

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VEC	Key Issues	KIR	Baseline Results	Measurable Parameter	Potential Project Effects**	Proposed Mitigation	Residual Effects	Cumulative Effects
Marine Birds	Habitat loss or alteration during construction. Disturbances and habitat avoidance because of noise and human activities. Possible mortality from collisions with project infrastructure or decreased reproductive success.	Marbled murrelet Surf scoter Bald eagle	Surf scoters are on BC's *Blue List* as special concern. The surf scoter population in BC is facing a slow, but steady decline. The reasons for the decline are not well understood. Thousands of these birds use the marine waters during non-breeding periods (wintering and moulting) when they form huge flocks in shallow coastal waters where they forage and seek shelter. Surf scoters occur in the CCAA during the spring, winter and moulting periods. They are regularly observed in groups of approximately 40 to 50 individuals, but larger groups (from 400 to 800) have been observed in the spring – these are typically associated with herring spawning areas. Bald eagles breed in the area and rely on the marine environment for food throughout the year. This species is the only raptor found throughout the area all year and is a good representative for all raptor species. The bald eagle is a top predator that helps regulate other bird populations, although it has no natural predators of its own. Bald eagles eat fish, small mammals, and marine birds and as such are indicators of wildlife sustainability. Bald eagles are present in the CCAA throughout the year where their abundance is considered high, relative to the rest of the province. In coastal habitats, bald eagles nest on islands, in estuaries and at the mouths of rivers and creeks. During fall and winter, they occur along shorelines and estuarine habitat, but their presence is influenced by food availability and presence of roost sites that provide protection from inclement weather and human disturbance.	Disturbances and habitat avoidance because of noise and human activities.	Construction, blasting, dredging, drilling for piles, and shipping of construction materials may affect marine bird habitat and behaviour by increasing sediment levels in the water, creating noise disturbance, creating physical disturbance and altering habitat. Sediment levels may temporarily affect prey abundance and distribution. Blasting will cause loud and unpredictable noise that could disturb birds, but this will occur in a small area over a short period of time and the birds will soon return to the area. Some birds may have to forage, roost and nest elsewhere. Some birds will likely adapt to noise and human activities related to construction. During the breeding season, marine birds may be disturbed by land clearing and construction activities. Bald eagles are particularly susceptible to disturbance during the nesting season and may abandon nests.	Currently being assessed.	While marine birds are sensitive to human disturbance, they have shown the ability to adapt over time. Once activities have been reduced or ended, bald eagles are expected to return to the area to nest.	Currently being assessed.
				Risk of mortality from collisions with project infrastructure or decreased reproductive success.	Some bird mortality may occur from collisions with equipment because birds are attracted to the lights from vessels and construction night-lighting. Vegetation clearing may increase predator access to nests.	Currently being assessed.	Bird collisions are expected to be rare.	Currently being assessed.

MARINE MAMMALS

Study geographic boundaries: Kitimat terminal PDA and CCAA.

Study time boundaries: Construction, operations and decommissioning phases.

Project works and activities considered in the study*: In-water infrastructure site preparation and construction, construction support vessels, in-water infrastructure operations, moored tankers, tanker and tug traffic.

Study methods: Northern resident (NR) killer whales, Canadian north Pacific (CNP) humpback whales and, Steller sea lions were selected as key indicators to assess project effects on marine mammals.

They represent species of the three major groups of marine mammals likely to be seen in the CCAA: toothed whales, baleen whales and pinnipeds (animals with flippers). The viability of killer whales can be considered as a measure of ecosystem health. Humpback whales are by far the most abundant baleen whale found in the CCAA. The existence of numerous long-term studies of the foraging and habitat needs of stellar sea lions makes it a good representative pinniped for the CCAA.

Several field studies, including both aerial and vessel-based surveys, were conducted throughout 2005/06 to determine the seasonal presence and abundance of marine mammals in the CCAA. Additional surveys are being conducted in 2009.

VEC	Key Issues	KIR	Baseline Results	Measurable Parameter	Potential Project Effects**	Proposed Mitigation	Residual Effects	Cumulative Effects
Marine Mammals	Killer whales are listed as threatened on both BC's *Blue List* and on *Schedule 1* of the *Species at Risk Act* (SARA). Humpback whales are listed as special concern on the BC's *Blue List* and are designated as threatened on *Schedule 1* of the SARA. Steller sea lions occur year-round in the CCAA, are listed as a species of special concern on *Schedule 1* of the SARA, and are on BC's *Blue List*.	Northern resident (NR) killer whales Canadian north Pacific (CNP) humpback whales Steller sea lions	In general, marine mammals require a clean environment, healthy prey populations, and a physical and acoustic environment that is large and quiet enough for them to communicate effectively, locate and capture prey, detect predators and maintain other vital life functions. Marine mammals are found throughout the CCAA year round, from Hecate Strait up to the mouth of the Kitimat River. Seasonal changes in marine mammal abundance are generally related to distributions of prey. During field surveys, humpback whales were the most commonly sighted cetacean within the CCAA. Other marine mammal species observed during surveys include killer whales, Steller sea lions, harbour seals, Dall's porpoise, harbour porpoise and Pacific white-sided dolphins. As top predators, killer whales rely on all lower creatures in its food chain and can therefore be viewed as a measure of ecosystem health. Killer whales are well studied and are known to frequent the CCAA. Killer whales are most frequently observed during June and July in pursuit of pre-spawning Chinook salmon, but remain in the area to prey on the large runs of chum salmon that arrive in September and October. Humpback whales are commonly observed and are by far the most abundant baleen whale found in the CCAA. Researchers observing humpback whales in Douglas Channel suggest presence in this region extends from June to November. While humpbacks are seen in BC primarily between May and October, some animals are present year round; therefore, it is possible for humpback whales to occur within the CCAA year-round. Steller sea lions occur year-round in the CCAA, and there are numerous long-term studies on this species' foraging and habitat needs. They are widespread throughout the coastal waters of BC.	Habitat alteration due to acoustic emissions.	Vessel movement in the CCAA and activities associated with marine terminal construction, such as dredging and pile drilling, will generate underwater sound that may result in sensory disturbances to marine mammals. Sound levels produced during construction, operations, and decommissioning or during vessel transit of the CCAA are not expected to cause temporary or permanent hearing damage to marine mammals. The most likely environmental effect is behavioural disturbance and some animals may temporarily move away. Also, underwater acoustic emissions may mask faint calls or biological noises.	Currently being assessed.	Currently being assessed.	Currently being assessed.
				Physical injury due to underwater blasting.	Terminal construction activities will likely include both on-shore and underwater blasting. As shock waves produced by blasting are relatively short, severe injuries are expected to occur only if the animal is extremely close to the explosion source.	Currently being assessed.	Currently being assessed.	Currently being assessed.
				Physical injury due to vessel strikes.	Project vessels transiting the CCAA throughout the life of the project have the potential to collide with marine mammals, leading to injury or direct mortality. The physical presence and movements of the vessels may also frighten or deter marine mammals along the shipping route, thereby resulting in energetic stress. Baleen whales are more prone to vessel strikes than toothed whales, and strikes with pinnipeds are infrequent.	Currently being assessed.	Currently being assessed.	Currently being assessed.

*Refer to Figure 3.3 in *section 3, Project description*, for the full list of physical works and activities. **The effects of spills and malfunctions will be included in the update for the supplemental filing.

MARINE ECOLOGICAL RISK

Study geographic boundaries: PEAA.

Study time boundaries: Operations phase.

Project works and activities considered in the study*: Hydrocarbon storage at terminal; on-shore infrastructure operations (gas venting, minor operational spills); in-water infrastructure operations; moored tankers (and associated combustion emissions, bilge and ballast water management; gas venting at the tanker berth, minor operational spills).

Study methods: The Marine Ecological Risk Assessment (ERA) is being completed to assess the potential environmental effects of routine terminal operations on ecological health. The marine terminal will handle large amounts of hydrocarbons, including condensate and oil. Although the marine terminal will be a state-of-the-art facility, it is possible that over its operating life there will be low levels of hydrocarbon emissions either with stormwater runoff, or as volatile emissions from tanks and other infrastructure. To assess potential effects on ecological health, chronic or long-term effects were modeled over a 50-year period. Note that the marine ERA does not consider the potential environmental effects of construction or decommissioning of the marine terminal, or hydrocarbon spills that could occur as a result of a marine shipping accident. These effects will be considered as part of the assessment of accidents and malfunctions (see Accidental spills, page 16).

To determine whether the potential exists for adverse environmental effects to occur, a standard ERA methodology is being conducted involving the following key steps:

Problem Formulation— a process of defining the characteristics of the ecosystem under consideration, the characteristic flora and fauna, as well as the characteristics of the project that might lead to release of chemicals of potential concern (COPC) and defining what those COPC substances may be.

Exposure Assessment— a formal process of defining COPC concentrations in environmental media such as water, sediment and biological tissues and defining the various pathways by which the individual organisms may be exposed to COPC.

Hazard Assessment— a process through which the toxicities of the various COPC are defined for the individual KIRs.

Risk Characterization— the process by which the risk of harm to KIRs is estimated, taking into consideration their unique exposure and sensitivity to COPC.

Uncertainty Analysis— a final review step in which the various assumptions and calculations leading to the risk characterization are reviewed to evaluate the level of confidence that may be placed on the conclusions.

Baseline concentrations of COPCs in the environment were measured at several locations within Kitimat Inlet, including near the proposed marine terminal. Where appropriate, baseline concentrations of COPCs, including total petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAHs) and trace elements were measured in water, sediment and biota including seaweed, mussels, crabs and fish. The measured baseline COPC concentrations are assumed to integrate the environmental effects of all existing natural conditions and human activities around Kitimat Inlet.

VEC	Key Issues	KIR	Baseline Results	Measurable Parameter	Potential Project Effects**	Proposed Mitigation	Residual Effects	Cumulative Effects
Marine Ecological Risk	Potential effects on ecological health, chronic or long-term, originate from potential exposures to chemical stressors that have been or might be introduced into the environment. Any chemical can have the potential to affect an ecosystem, but it is the concentration, duration of exposure, and mechanisms by which the various organisms are exposed to various chemicals of potential concern (COPC) that determines whether they will experience harm as a result of exposure.	Bald eagle Crabs Harbour porpoise Marbled murrelet Mink Mussels Seaweed Spotted sandpiper Steller sea lion Surf scoter Aquatic community (fish, plankton) Sediment community (benthic infauna)	Chemical concentrations found in seawater were generally non-detectable or consistent with values expected in marine coastal environments. Baseline concentrations of TPH in sediment were generally non-detectable or very low. Low concentrations of PAHs including naphthalene, phenanthrene and acenaphthene, possibly originating from existing industrial facilities in Kitimat, were detected in sediments at concentrations close to the Canadian Council of Ministers of the Environment (CCME) interim sediment quality guideline (ISQG) levels near the marine terminal. Trace element concentrations in sediment were generally below the CCME ISQG values, where such guidelines exist. Concentrations of chemical substances detected in biological tissues were below levels considered to be of concern for human consumers.	Chemicals of potential concern (COPC). Hydrocarbons, including benzene, toluene, ethylbenzene and xylenes (BTEX), total petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAH), selected volatile organic carbons (VOC) and phenols, and trace elements.	Although the marine terminal will be a state-of-the-art facility, it is possible that over its operating life there will be low levels of hydrocarbon emissions either with storm-water runoff, or as volatile emissions from tanks and other infrastructure. The various biological KIRs discussed earlier, which are broadly representative of the marine ecosystem, are assumed to be exposed to a suite of COPCs in water, sediment, and biological tissues that includes hydrocarbons, PAH and trace elements that are constituents of hydrocarbons that will be handled at the marine terminal (such as diluted bitumen, synthetic oil and condensate).	Currently being assessed.	Currently being assessed.	Currently being assessed.

*Refer to Figure 3.3 in *section 3, Project description*, for the full list of physical works and activities. **The effects of spills and malfunctions will be included in the update for the supplemental filing.

MARINE ABORIGINAL TRADITIONAL KNOWLEDGE AND LAND USE

Study geographic boundaries: Communities with traditional lands intersecting the marine terminal PDA and the CCAA, with ATK geographic boundaries defined by each Aboriginal community.

Study time boundaries: Construction, operations and decommissioning phases.

Project works and activities considered in the study*:
Kitimat terminal: construction, operations and decommissioning.
CCAA vessel traffic: construction, operations and decommissioning.

Study methods: The study approach takes into account an Aboriginal group's expressed evaluation of the direct and secondary effects from the project on traditional lands and water, as well as the effects these changes may have on the culture, practices, and ways of life of Aboriginal peoples whose traditional sites and use areas may be affected by the project. Each community determines the level of individual participation in the ATK study, as well as the review, discussion and nature of ATK shared with Northern Gateway and its consultants. The ATK studies address two types of traditional knowledge:

1. Traditional Land Use (TLU) information which focuses on locations of cultural significance and use within the proposed project footprint (such as settlement locations/gathering sites, resource gathering sites/locales, trails, spiritual areas); and
2. Traditional Environmental Knowledge (TEK) which embodies the wisdom and understanding of the particular natural environment within certain areas in the vicinity of the project.

Traditional environmental knowledge, a body of knowledge accumulated over countless generations, may be used to enhance analysis of a proposed project's effects and improve project planning across a range of important areas, as noted in the table below.

Enbridge Northern Gateway will put these community reports to work in a variety of ways. They will be made available to the various disciplines working on the environmental and socio-economic assessment to provide information on potential project environmental effects (biophysical, cultural and socio-economic) that might not otherwise be available through conventional scientific studies. They will also be provided to the engineering team to inform project planning and design. New issues of concern that arise within the context of the ATK studies will also inform the consultation process for the project.

Ultimately, information from the ATK studies will:

- Identify community concerns with the project and potential project effects
- Identify recommendations to lessen project effects
- Identify areas that should be protected
- Inform project planning and design
- Provide opportunities to integrate information and insights into the environmental and socio-economic assessment

VEC	Key Issues	KIR	Baseline Results	Measurable Parameter	Potential Project Effects**	Proposed Mitigation	Residual Effects	Cumulative Effects
Marine Aboriginal Traditional Knowledge	Currently being assessed.	n/a	As of January 2009, nine Aboriginal coastal communities have been approached to be involved in the ATK program but none have yet been initiated.	Harvesting (hunting, trapping, fishing and gathering).	Currently being assessed.	Currently being assessed.	Currently being assessed.	Currently being assessed.
				Traditional sites (including sacred or spiritual sites).	Currently being assessed.	Currently being assessed.	Currently being assessed.	Currently being assessed.
				Community and ecological health and well-being.	Currently being assessed.	Currently being assessed.	Currently being assessed.	Currently being assessed.

*Refer to Figure 3.3 in *section 3, Project description*, for the full list of physical works and activities. **The effects of spills and malfunctions will be included in the update for the supplemental filing.

NON-TRADITIONAL MARINE USE

Study geographic boundaries: Kitimat marine terminal project development area (PDA) and the CCAA.

Study time boundaries: Construction, operations and decommissioning phases.

Project works and activities considered in the study*: Kitimat terminal: construction, operations and decommissioning. CCAA vessel traffic: construction, operations and decommissioning.

Study methods: It is not possible to distinguish the non-traditional marine activities and resource use effects of constructing the tank terminal (part of the Pipeline Summary) from the construction of the marine terminal – therefore those effects are considered in the Pipeline Summary, with the exception of visual and aesthetic resources, which is covered here.

Visual effects were assessed by identifying areas from which the Kitimat terminal site may be observed, and determining if various "viewpoints" from the identified areas would be affected. This analysis was augmented by a review of literature and baseline data on existing land use and interviews relating to marine recreational fishing and leisure activities and related traffic on the Douglas Channel.

A visibility assessment was conducted using three-dimensional "viewshed modeling" for daylight hours and clear weather. A number of scenarios were modeled to reflect what various users might see, including residents and visitors travelling along Kitamaat Village Road, users of the Kitamaat Village Marina, and persons traveling in vessels along Douglas Channel (such as fishers, ecotourism guides and recreational users).

VEC	Key Issues	KIR	Baseline Results	Measurable Parameter	Potential Project Effects**	Proposed Mitigation	Residual Effects	Cumulative Effects
Visual and Aesthetic Resources	Changes to visual and aesthetic resources. Light pollution from Kitimat terminal and other above-ground facilities and infrastructure. Noise disruption from Kitimat terminal and other waterline facilities and infrastructure.	n/a	Kitamaat Village is located approximately 14 kilometres south west of the City of Kitimat at the head of the Douglas Channel. The village itself is the main settlement for the Haisla First Nation and is directly across the Douglas Channel from the proposed terminal area. The Kitamaat Village Marina provides key access to these areas. The marina has a clear view of the opposite side of the Douglas Channel. Vessel movements through the CCAA will be visible to communities such as Kitimaat Village, Hartley Bay, and Kitkatla. Vessel movements will also be visible to users of commercial recreational fishing lodges and charter vessels.	Changes to visual and aesthetic resources.	The Kitimat terminal site will be partially visible and will have a visual effect on the viewpoints on the Douglas Channel and the viewpoints across the channel in Kitamaat Village. Infrastructure development for the Kitimat terminal area, associated power lines and access road upgrades will alter the visual landscape. Construction vessels, tankers and associated tug escorts will be visible along the proposed shipping routes in the CCAA.	Currently being assessed.	Currently being assessed.	Currently being assessed.
				Light pollution from terminal infrastructure.	Light and glare from the project may also cause a visual disturbance at night. Kitimat terminal facilities and infrastructure may be a source of light pollution at night. Lighted vessels will be visible at night.	Currently being assessed.	Currently being assessed.	Currently being assessed.
				Noise disturbance from terminal infrastructure.	Kitimat terminal facilities and infrastructure may be a source of noise. Construction vessels, tankers and associated tug escorts will be a source of noise to several coastal communities.	Currently being assessed.	Currently being assessed.	Currently being assessed.
Marine Recreational Fishing	Disruption to recreational fishing activities. Visual and aesthetic changes to recreational fishing areas.	n/a	The Douglas Channel and the Kitimat Arm area are home to world renowned ocean fishing, as well as some of BC's most popular boating experiences. Seven ocean charters and pleasure boats operating from four different marinas (including the Kitamaat Village Marina) constitute some of the marine traffic on Douglas channel. The Kitamaat Village Marina provides key access to the Douglas Channel. Kingfisher Lodge is located close to the southern shipping route through Camaano Sound.	Changes aesthetically and visually to recreational fishing areas.	Currently being assessed.	Currently being assessed.	Currently being assessed.	Currently being assessed.

*Refer to Figure 3.3 in *section 3, Project description*, for the full list of physical works and activities. **The effects of spills and malfunctions will be included in the update for the supplemental filing.

MARINE SOCIO-ECONOMIC

Study geographic boundaries: North Coast of BC.

Study time boundaries: Construction and operations phases.

Project works and activities considered in the study*: As construction of the marine terminal, tank terminal, pump stations, tunnels and the pipeline spread close to the terminal will occur concurrently, it is not possible to isolate the effects of constructing the terminal. Thus, the socio-economic assessment considers the cumulative effects of all aspects of project construction at a regional level. Similarly, the effects of operating the terminal and marine transportation will be examined in combination.

Study methods: Most of the construction activity will occur concurrently over three to four years. For construction and operations, the assessment examines potential opportunities for hiring and/ or training of regional residents and procurement of goods and services from local businesses. It estimates the number of construction workers that will have to be brought into the region, their potential demands for housing and community infrastructure and services, and the potential social issues that may arise from increased incomes and the additional population brought to the region. As of February 2009, the assessment is focussed on the effects of creating 47 new direct full-time jobs in the region.

VEC	Key Issues	KIR	Baseline Results	Measurable Parameter	Potential Project Effects**	Proposed Mitigation	Residual Effects	Cumulative Effects
Marine Socio-Economic	Direct project employment. Regional business opportunities. Use of unemployed workers and training. Aboriginal employment . Population movement into regions. Increased demand on housing and accommodation. Increased demand on utilities and other infrastructure. Increased demand on recreation and leisure facilities. Increased demand on health, social and educational services. Traffic.	n/a	The North Coast of BC had a population of 41,417 people in 2006, down 10% from 2001. Aboriginal people accounted for 24% of the population, and 85% lived off-reserve. About 11.3% of the labour force was unemployed in 2006, although this includes 40.6% of the on-reserve Aboriginal workforce. Primary industries (resource-based, construction and manufacturing) accounted for 29% of employment. Unemployment in the region has risen since 2006. While 14 major projects are proposed for the region, many of these are on hold due to current economic uncertainty. The region has the highest rental housing vacancy rate in BC. Kitimat reported a vacancy rate of 23.5% in 2008. Due to the shrinking population over the past decade, there are adequate utilities, infrastructure and services to accommodate considerable population growth.	Creation of additional jobs. Hiring and/or training of regional residents. Procurement of materials from local businesses. Demands on housing. Demands on community infrastructure. Demands on community services.	The construction and routine operation of Kitimat terminal and associated marine transportation will affect the economic and social conditions in some communities along the BC coast. The nature of these effects will vary in terms of direction, magnitude, duration and geographic extent, depending on the project phase (construction or operation) and the activity (terminal operations versus marine transportation). The initial effects will occur during project construction as labour and equipment are moved into the Kitimat area to build the marine terminal and related facilities, such as: • the tank terminal • the marine terminal (berths for tankers and tugs) • the pump stations • a 99-kilometre section of pipeline (close to Kitimat and Terrace) Much of this construction activity will occur concurrently over three or more years. Consequently, from the perspective of the community, it will not be possible to distinguish the socio-economic effects of constructing the marine terminal from the socio-economic effects of constructing these other project elements. During peak construction (2013) more than 1200 workers may be employed on various aspects of the project. Once the Northern Gateway project begins operations, it is estimated that about 165 people will be employed in Kitimat and coastal communities along the route. The jobs will be to operate the marine facilities, tank terminal, pump stations and pipeline and associated marine transportation support. There will also be a number of local spin-off jobs created through purchases of goods and services required for operations, such as waste handling, provision of drinking water and office supplies. Tugboat operators will be contracted to escort tankers in Douglas Channel and to assist in docking at the terminal. With an average of 225 tankers calling on the terminal annually, an escort tug (with a crew of three), and a minimum of two pilots will be needed to guide tankers through the channel. When the tankers reach the terminal, three or four harbour tugs (each with a crew of two or three people) and two mooring boats and shore mooring crews will be required to manoeuvre and secure the tankers to the docks. A full-time emergency response team of six people will also be stationed in the area. Additional local spin-off employment will result from environmental monitoring, emergency response, the provision of catering and bulk fuel to the tug operators, maintenance and repair of marine infrastructure, and other support services.	Currently being assessed.	Currently being assessed.	Currently being assessed.

*Refer to Figure 3.3 in *section 3, Project description*, for the full list of physical works and activities. **The effects of spills and malfunctions will be included in the update for the supplemental filing.

HUMAN HEALTH

Study geographic boundaries: Kitimat terminal project development area (PDA).

Study time boundaries: Construction and operations phases.

Project works and activities considered in the study*:
Kitimat terminal: construction, operations and decommissioning.
CCAA vessel traffic: construction, operations and decommissioning.

Study methods: The human health risk assessment will involve estimating intakes using the human health models for different chemicals that may be released into the environment. These intakes are compared with acceptable doses that people can be exposed to daily without risk of health effects. The comparison allows for the derivation of a risk estimate, which is used to determine if health risks exist and if so, whether the risks are within acceptable limits. The human health risk assessment for the routine operation of the pipeline is not complete since the results of the air modeling, ecological risk modeling and spill modeling are pending. Upon receipt of these results, the estimated intakes can be determined and the risk estimates will be calculated.

NOTE: The Human Health assessment is awaiting the results of the air modeling and the ecological risk modeling and therefore the project effects are not yet available.

VEC	Key Issues	KIR	Baseline Results	Measurable Parameter	Potential Project Effects**	Proposed Mitigation	Residual Effects	Cumulative Effects
Human Health	Breathing chemicals in the air. Incidental eating of soil (such as might be encountered when eating food with unwashed hands). Absorption of chemicals through the skin. Drinking water from the rivers and lakes. Collecting and eating vegetation and fish or animals from the water.	n/a	Results pending.	Non-carcinogenic and carcinogenic risk estimates based on metal and hydrocarbon concentrations in the air, surface water, and aquatic life components.	While pipeline construction activities will generate low levels of site-specific emissions, such as those from large construction equipment, exposure to chemicals from these sources will be highly-localized and short term and not expected to result in the release of emissions or discharges that would have a significant effect on human health. Similarly, during routine pipeline operations, the oil and condensate pumps will be electrically driven and few fugitive emissions will occur. Human health concerns associated with spills will be considered as part of the assessment of Accidents and Malfunctions (see Accidental Spills, page 17).	Project design and operational measures will minimize the risks of either air emissions or spills into the environment.	Currently being assessed.	Currently being assessed.

*Refer to Figure 3.3 in *section 3, Project description*, for the full list of physical works and activities. **The effects of spills and malfunctions will be included in the update for the supplemental filing.