

Environmental Assessment Certificate Application

LNG Canada Export Terminal

Section 5 – Assessment of Potential Environmental Effects

October 2014



LNG CANADA

Opportunity for British Columbia. Energy for the world

Joint venture companies



5 ASSESSMENT OF POTENTIAL ENVIRONMENTAL EFFECTS

5.1 Environmental Background

5.1.1 Geology and Soils

The Project is located in an area characterized by the intrusive igneous rocks of the Kitimat Ranges of the Coast Mountains (Western System) and the volcanic and sedimentary rocks of the Hazelton Mountains of the Central Plateau and Mountain Area (Interior System) of BC (Holland 1976). The surficial geology of the area is a product of its proximity to the Kitimat Arm and the morphology of the Kitimat-Terrace trough along with active and historic sediments from Kitimat River, Skeena River and their tributaries. The valley floor that stretches from the head of Douglas Channel to Terrace is blanketed in glaciofluvial, fluvial, and glaciomarine deposits, ranging in thickness from veneers of 0.5 m, to terraces and deltas more than 10 m thick (Clague 1983). The central trough is bounded to the west and east by the till- and colluvium-mantled Coast (west boundary) and Hazelton (east boundary) mountains. Organic materials, typically in swamps or wetlands, are found throughout the area, particularly in association with the dominantly fluvial, glaciofluvial, and glaciomarine deposits on the valley bottom.

The soils in the area are primarily moderately well to well drained, acidic Brunisols and Podzols developed from coarse textured fluvial and glaciofluvial deposits and finer-textured glaciomarine parent materials on the valley bottom (Farstad and Laird 1954). Interspersed within valley floor mineral soils are moderately decomposed organic Mesisols within poorly drained, localized depressions (Farstad and Laird 1954; Stantec Consulting Ltd. 2014b). Extensive areas of these organic soils occur south of the Terrace–Kitimat Airport and Lakelse Lake. Fine textured, imperfectly drained Gleysols and moderately well drained Brunisols, developed from glaciomarine and glaciolacustrine parent material, are in the western portion of the area, north and southwest of Terrace and south of Kitimat. Lower to middle slopes are blanketed in moderately well drained to well drained Brunisols and Podzols. At higher elevations on moderately-steep to steep slopes, shallow Regosols have formed on colluvial material and bedrock outcrops (Stantec Consulting Ltd. 2014b).

5.1.2 Climate

The Kitimat area is influenced by a westerly storm track across the North Pacific that results in a wet, temperate climate. Seasonal mean temperatures range from just below freezing in winter to approximately 16°C in summer; temperatures seldom are greater than 30°C in summer or less than -15°C in winter. Mean annual precipitation in the Kitimat area ranges from 2,200 to 2,800 mm. The wettest months are during autumn and early winter, while dry periods are most common in summer.

Approximately 200 days per year have measureable precipitation. Mean annual snowfall amounts in the Kitimat area are approximately 300 cm, while extreme daily snowfall events of over a metre have been recorded. The average annual wind speed reported at the Kitimat townsite climate station is 18 km/h. The prevailing winds are strongly influenced by topography and tend to be from the south during summer and from the north in winter (Environment Canada 2014).

5.1.3 Air Quality

A number of industrial facilities have been built in Kitimat since the 1950s, and as a result, Kitimat has several continuous air quality monitoring stations associated with BC's air quality monitoring network. The Riverlodge and Whitesail air quality monitoring stations are located in the Kitimat townsite on the east side of Kitimat River and the Haisla Village air quality monitoring station is located farther south on Kitimat Arm in the Haisla community of Kitamaat Village. The Haul Road air quality monitoring station is in the industrial area west of Kitimat River. The Kitimat Rail air quality monitoring station, which was also in the industrial area, was decommissioned in 2010.

Air quality monitoring is currently being conducted in the Kitimat area to measure concentrations of SO₂, inhalable particulate matter (PM₁₀), and respirable particulate matter (PM_{2.5}). Historically, there have been exceedances of the 1-hour and 24-hour objectives for hydrogen sulphide (H₂S), but those measurements were taken while a pulp mill was still operating in Kitimat. Hydrogen sulphide exceedances have not been repeated since the closure of the pulp mill. Data from monitoring stations in both the industrial and residential neighbourhoods of Kitimat indicate that air quality is good, with few instances of observed concentrations exceeding the most stringent BC and federal objectives for some substances.

5.1.4 Sediment Quality

Sediment quality in Kitimat Arm has been influenced by a variety of past and currently operating industries, including the Methanex Corporation methanol and ammonia production facility (operational from 1982 to 2005, now closed), the Eurocan pulp and paper mill (operational from 1969 to 2010, now closed), the District of Kitimat wastewater treatment plant, the RTA facility, and log handling and storage activities. Polycyclic aromatic hydrocarbons (PAH) in the sediment are the most studied of contaminants in Kitimat Arm. Additional contaminants of potential concern in Kitimat Arm are metals, dioxins and furans, and fluoride from a variety of sources.

5.1.5 Vegetation

The area surrounding lower Kitimat River is in the Submontane Coastal Western Hemlock Very Wet Maritime biogeoclimatic variant (CWHvm), which occupies the inlets and river valleys along the west side of the Coast Mountains (Banner et al. 2003). CWHvm is characterized by relatively mild temperatures and heavy rainfall. It includes portions of the floodplain and estuary of Kitimat River at the head of Kitimat Arm as well as adjacent uplands. Western hemlock (*Tsuga heterophylla*) and amabilis fir (*Abies amabilis*) dominate the canopy of mature forest stands. Sitka spruce (*Picea sitchensis*) is common on alluvial soils. Red alder (*Alnus rubra*) and black cottonwood (*Populus balsamifera* ssp. *trichocarpa*) are the most common deciduous tree species in the CWHvm and are often located on floodplains or other recently disturbed sites.

Old forests are quite common in this zone due to the rarity of forest fires; however, logging is a frequent disturbance to the area. The Project is located primarily within an area zoned for industrial land use (Stantec Consulting Ltd. 2008) where much of the forested area is second growth or is composed of existing disturbance from industrial infrastructure. Within wetter areas of the lower portions of Kitimat River valley, vegetation cover ranges from herbaceous to young forest. There is a predominance of shrubby habitat in the lowlands where common understorey species include devil's club (*Oplopanax horridus*), salmonberry (*Rubus spectabilis*), lady fern (*Athyrium filix-femina*), oak fern (*Gymnocarpium dryopteris*), skunk cabbage (*Lysichiton americanus*), and peat mosses (*Sphagnum* spp.). Forested and non-forested swamps, non-forested fens, marshes and estuarine wetlands are the most common wetland types that occur in the vicinity of the Project. Upper, middle, and low bench floodplains are also common along Kitimat River.

5.1.6 Wildlife Resources

The Kitimat River estuary supports a number of large and small mammal species, including black-tailed deer (*Odocoileus hemionus*), moose (*Alces americanus*), grizzly bear (*Ursus arctos*), black bear (*Ursus americanus*), Pacific marten (*Martes caurina*), and snowshoe hare (*Lepus americanus*). Amphibian species occurring in the estuary include coastal tailed frog (*Ascaphus truei*), Columbia spotted frog (*Rana luteiventris*), northwestern salamander (*Ambystoma gracile*), long-toed salamander (*Ambystoma macrodactylum*), and western toad (*Anaxyrus boreas*). The estuary also supports migrating and resident species of songbirds, raptors, waterfowl, and seabirds. It is an important staging and overwintering site for birds during migration and the estuary supports large seasonal concentrations of shorebirds and waterfowl (Horwood 1992; Horwood 2013). Species of conservation concern observed around the Project facility site include grizzly bear, great blue heron (*Ardea herodias fannini*), marbled murrelet (*Brachyramphus marmoratus*), rusty blackbird (*Euphagus carolinus*), barn swallow (*Hirundo rustico*), western screech-owl (*Megascops kennicottii kennicottii*), western toad, and coastal tailed frog. Five of

these species are designated federally under Schedule 1 of SARA and all eight species are provincially blue-listed.

The north coast of BC supports large and diverse populations of seabirds with fifty species of seabird identified during baseline studies (Stantec Consulting Ltd. 2014a). Many species breed at established nesting sites on islets and shores from Haida Gwaii to the mainland coast. Species of conservation concern potentially occurring along the marine access route include four species designated under Schedule 1 of SARA: ancient murrelet (*Synthliboramphus antiquus*), marbled murrelet (*Brachyramphus marmoratus*), pink-footed shearwater (*Puffinus creatopus*) and red knot (*Calidris canutus*). There are 24 species in the area that are provincially red- or blue-listed.

5.1.7 Aquatic Resources

Kitimat River and its tributaries support regionally important populations of salmon, trout, and char. All five species of Pacific salmon, including chinook salmon (*Oncorhynchus tshawytscha*), chum salmon (*O. keta*), pink salmon (*O. gorbuscha*), coho salmon (*O. kisutch*), and sockeye salmon (*O. nerka*; river ecotype), are found in the river and its tributaries, as are rainbow/steelhead trout (*O. mykiss*), cutthroat trout (*O. clarkii clarkii*), and Dolly Varden char (*Salvelinus malma*). Moore Creek and Anderson Creek are the two larger creeks flowing into Kitimat estuary near the Project and Beaver Creek is the main tributary of Anderson Creek. These streams are considered tributaries of Kitimat River, but do not interact with the river above the estuary due to a 2 km long dike that isolates the surface drainage patterns on either side.

Moore Creek supports coho salmon and pink salmon. Anderson Creek supports chum salmon, pink salmon, coho salmon, sockeye salmon (river ecotype), rainbow trout, and Dolly Varden char. Beaver Creek supports Coho salmon, rainbow trout, Dolly Varden char, and cutthroat trout. Juvenile chinook salmon have been observed in Beaver Creek following the spring freshet. Cutthroat trout is on the provincial blue list (BC CDC 2014a). Eulachon (*Thaleichthys pacificus*) use the Kitimat River, but in the early 1990s there was a major decline in the local population and it has yet to recover. The population decline has been attributed to effluent outfalls installed in the Kitimat River during the 1970s and 1980s (Derksen 1981; Moody 2008). Eulachon is currently listed as *endangered* by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2011) and is on the provincial blue list (BC CDC 2014b).

The Project is on the BC north coast, and intersects the North Coast Fjords, Hecate Strait, Queen Charlotte Sound, and Dixon Entrance ecodistricts (Harding 1997). The North Coast Fjords ecodistrict is characterized by turbid, low productivity surface layers, estuarine circulation, hypoxic deep waters, attached invertebrate and soft bottom benthic communities, and seasonal salmon migrations. The Hecate Strait ecodistrict is characterized by shallow waters, coarse bottom sediments, and strong tidal currents. It is a nursery area for Pacific salmon and herring and feeding grounds for marine mammals and is

characterized by abundant benthic invertebrates. The Queen Charlotte Sound ecodistrict is characterized by a wide shelf with water depths typically greater than 200 m. It contains a mixture of plankton communities. It is the northern range of many temperate fish species and has lower benthic invertebrate productivity than neighbouring ecodistricts. The Dixon Entrance ecodistrict is characterized by deep waters, typically greater than 300 m, and strong freshwater influence from mainland river runoff. It is a migration corridor for salmon and provides nursery areas for juvenile fish and invertebrates.

Common marine habitat types on the BC north coast include riparian habitats, intertidal habitats, subtidal habitats, estuaries, and kelp and eelgrass beds. A total of 409 species of marine fish have been reported in the coastal and offshore waters of BC (Hart 1973; Peden 2013). Over 75 species of marine fish and 100 species of marine invertebrates occur in Kitimat Arm. A number of these species are captured in CRA fisheries, including groundfish, pelagic fish, anadromous fish, crab, shrimp, and bivalve molluscs (Lucas et al. 2007). Upwards of 15 marine fish and invertebrate *species at risk* may occur along the marine access route (COSEWIC 2009; Government of Canada 2012; BC MOE 2013).

Marine mammals are abundant on the BC north coast, and many species are found either year-round or seasonally along the marine access route. Baleen whales commonly observed in the region include humpback (*Megaptera novaeangliae*), grey (*Eschrichtius robustus*), fin (*Balaenoptera physalus*) and minke whales (*Balaenoptera acutorostrata*). Toothed whales that frequent waters around the marine access route include northern resident and Bigg's killer whales (*Orcinus orca*), Pacific white-sided dolphins (*Lagenorhynchus obliquidens*), Dall's porpoise (*Phocoenoides dalli*) and harbour porpoise (*Phocoena phocoena*). Harbour seals (*Phoca vitulina richardii*), Steller sea lions (*Eumetopias jubatus*) and sea otters (*Enhydra lutris*) are also found in the marine access route area.

Eight marine mammal *species at risk* are present in varying degrees of density along the marine access route. Humpback whale critical habitat overlaps with the marine access route around Gil Island. Potential critical habitat for northern resident killer whales and DFO Important Areas for humpback whales, northern resident killer whales and fin whales also overlap with the marine access route.