SNC·LAVALIN

SECTION 6

ENVIRONMENTAL EFFECTS ASSESSMENT

Bear Head LNG

A subsidiary company of Liquefied Natural Gas Limited

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6 ENVIRONMENTAL EFFECTS ASSESSMENT

6.1 Physical Environment

6.1.1 Groundwater

Groundwater is important because of its vital role in the hydrologic cycle, its ecological function (i.e., surface water discharge) and as a water supply. Precipitation and surface water infiltrate the ground, where it fills voids in unconsolidated materials and fractures in consolidated materials. Interaction between surface water and groundwater can occur where the water table (upper surface of the saturated zone) meets the surface at springs, lakes, and streams. Based upon the potential effects of further Project activity, groundwater is considered a VEC for the following reasons:

- Changes to the groundwater table and groundwater usage have the potential to affect other environmental components including terrestrial habitat (particularly wetlands), freshwater fish and fish habitat, and surface water quantity and quality;
- Contamination of groundwater sources can cause long-term adverse effects on the environment;
- Potential risk to human health in the event of groundwater contamination; and
- Because groundwater can be a pathway for contaminant migration to other environmental components, i.e., aquatic and terrestrial receptors.

6.1.1.1 Boundaries and Threshold

Spatial

The spatial boundaries are based upon:

- Hydraulic properties of the aquifer;
- Flow direction;
- Distance between wells, Project activities (construction, operation, or decommissioning) and ecological receptors;
- Aquifer capture area; and
- Geological characteristics, as related to seismic properties and response to damage from vibration (wells in soft bedrock, such as sandstones and shales, are less susceptible to damage from vibration and seismic activity).

As described in the 2004 Bear Head LNG environmental assessment, a typical domestic (low-yield) water well capture zone is less than 100 m. Minimal damage from blasting and vibration is expected to

occur to these wells at any distance greater than 200 m. To provide commentary on risk to damaging water wells and in accordance with the *Nova Scotia Environment Procedure for Conducting a Pre-Blast Survey*, a value of 800 m was chosen as a spatial boundary (NSE, 2009). A pre-blast survey is required for any well within this zone.

Temporal

Most construction-related physical effects on groundwater resources will be temporary in nature, while the potential for chemical effects from spills exists through all phases of the Project. Spill impacts may be short or long-term, depending on factors such as the type of substance and quantity of the substance spilled. It could take many years to remediate a severely contaminated site. The major components contributing to risk of a groundwater contamination are petroleum, oil and lubricants (POL), and chemicals used in the construction, operation or decommissioning phases of the Project.

Administrative

The following guidelines, standards and regulatory requirements pertaining to water and water quality apply to all operations at the Bear Head LNG site that may generate spills of potential contaminants, including hydrocarbons:

- CEPA
- Atlantic RBCA (Risk-Based Corrective Action) for Petroleum Impacted Sites in Atlantic Canada, Version 3 (January 2015)
    - For potential health and environmental issues involving petroleum hydrocarbon spills
    - Nova Scotia standard for evaluating petroleum hydrocarbons in groundwater is the Risk-Based Screening Level (RBSL)
- CCME Canadian Environmental Quality Guidelines (2007)
    - Water supplies, recreational water, Canadian water quality guidelines, water quality guidelines for the protection of aquatic life and agricultural uses
- Health Canada Guidelines for Canadian Drinking Water Quality (2014)
    - Drinking water quality parameters
        - Applicable only for water being withdrawn and used as potable water
- Nova Scotia *Water Resources Protection Act*

Although consideration has been given to drilling wells to provide potable water at the facility, it is more likely that drinking water will be trucked from adjacent municipal water supplies. Process water, however, may be provided by wells and treated as necessary to ensure compliance with provincial

regulations. This will include obtaining a Water Withdrawal Approval from NSE. If production wells are drilled, all necessary steps will be taken to protect the nature and quality of the aquifer and watershed.

Technical

As described in the Baseline Environmental Site Assessment (ESA) (JW, 2007), there are a number of boreholes and monitoring wells on the Project site as shown on Figure 4-2. On October 22nd, 2014, a site visit was conducted in search for these wells. The only one that was found was MW-5. It is believed that many were buried during the construction and subsequent maintenance of the existing infrastructure (roads, ditches and site clearing). Monitoring wells located along the property boundaries could not be located although there are still clearly marked cut-lines. The cut-lines along the property boundaries were used to locate the previous surface water sampling locations. It is pertinent that the aquifer below the Project site does not provide water to either a municipal supply or to a residential well.

Thresholds

The following evaluation criteria are used to determine whether a residual environmental effect on groundwater is significant, not significant, or positive:

A **significant adverse effect** would occur should groundwater on site be impacted by petroleum hydrocarbons above criteria stipulated by Partners in RBCA Implementation (PIRI); and/or physical or chemical changes to the aquifer is such that interaction with surface water alters stream flow or chemistry, in turn adversely affecting aquatic life. The results of water quality analysis will be checked against the CCME Water Quality Guidelines to ensure the protection of relevant water uses, but specifically for aquatic life and the supply of drinking water. The results shall be used as the basis for evaluating the significance of any measured change.

An **adverse affect** that does not exceed the stipulated criteria is considered not significant.

A **positive effect** is one that enhances the quality of the aquifer or groundwater-fed surface water.

The relative magnitude ratings defined below are used to establish the magnitude of a residual effect on groundwater:

High: A change in groundwater relative to baseline, which causes exceedances of standards and guidelines, or extends beyond the Project site.

Medium: A change in groundwater relative to baseline, which is within the Project site and within standards and guidelines.

Low: A change in groundwater that is within the normal variability of baseline conditions.

6.1.1.2 Interactions and Potential Effects

Construction

Construction and site work may involve clearing, grubbing and stripping of topsoil. A large portion of this preparatory site work has already been performed, but the tasks remaining will likely require some additional grading work and the placement of excess material to temporary piles. As shown in Figure 4-2, all residential wells are located more than 800 m away from the Project site, substantially minimizing any risk of damage from blasting, should the latter prove necessary, or vibration during construction. Figure 4.2 also shows that there are no residential or community wells within the depicted watershed. In the unlikely event that contaminants did enter the aquifer below the Project site, there would be no impact on private wells or community water supply.

The main source of contamination during construction is associated with the accidental spill of POL or chemicals from equipment and their operation. There is also a risk of contamination occurring from the wastewater used to clean the concrete truck troughs, or wastewater generated by an onsite concrete batch plant, if this option is selected for the Project.

Operations and Maintenance

LNG vapourizes at -160^{o}C which means that there is very little risk of LNG entering the aquifer and groundwater table in the event of an accident. The main source of potential contamination during the normal operation and maintenance of the facility would be related to the accidental spill of POL or chemicals from equipment and their operation. Contaminants, for example, could be transported over the site to aquifer points of entry by storm water. Should on-site production wells be used to supply process or potable water, the quantity of water in the aquifer(s) may also be affected.

Accidents and Malfunctions

Accidents and malfunctions may affect groundwater by exposing aquifers to chemical and POL contamination from spills. The risk of these contaminants impacting groundwater is present during all phases of the Project, i.e., construction, operation and decommissioning.

Decommissioning

Activities during the decommissioning phase of the Project are expected to present the same risks to groundwater as during the construction phase. Potential effects to groundwater during this phase will be considered and addressed in a decommissioning plan which would be developed prior to decommissioning and incorporate future relevant standards and regulations.

6.1.1.3 Mitigation

Best management practices will be detailed in the Environmental Management Plan (EMP) and associated EPPs to prevent spillages and accidents that would impact the aquifer and groundwater. Detailed mitigation measures to be executed in response to an accidental spillage of hydrocarbon or other hazardous agent will be explicit in the EPP; they will include the following:

- Handling of chemical and hazardous substances and hazardous wastes storage in accordance with manufacturers' recommendations and applicable federal and provincial regulations;
- Secondary containment for tanks in which diesel fuel is stored;
- Training in chemical storage and handling for all on-site staff;
- Installation of safety measures including leak alarms, emergency shutdown systems, spill containment and provisions to protect piping from the effects of transient pressure variations;
- Maintenance of equipment in good working order and execution of efficient monitoring protocols for leaks;
- Storage, stockpiling and use of fuel, lubricant and other hazardous substances in designated areas outside of buffer zones designed to protect sensitive habitats including surface water and wetlands;
- Development and implementation of a Spill Management Plan to include the immediate clean-up, containment and removal of impacted groundwater and the removal and proper disposal of impacted soil; and
- The restoration of any damage to residential wells in the surrounding area that can be shown to have resulted from activities at the Project site and the provision, if needed, of a temporary source of potable water.

In the event that groundwater wells are established on site, the necessary authorizations will be sought from NSE and the wells will be operated in accordance with accepted best management practices. Entry to groundwater wells will be controlled and limited in order to prevent potential contamination of groundwater resources.

Any effects occurring during the decommissioning phase of the Project will be mitigated as prescribed in the Decommissioning Plan, which would be developed prior to decommissioning and incorporate the current standards and regulations.

6.1.1.4 Potential Residual Effects

With the implementation of the identified mitigation measures, significant adverse residual effects to groundwater are not likely to occur. A matrix depicting the potential effects to groundwater, associated mitigation measures and determination of residual effects is presented in Table 6-1.

6.1.1.5 Monitoring and Follow-up

Baseline monitoring will be performed prior to any additional site work, and a groundwater monitoring program will be maintained over the life of the Project in accordance with requirements stipulated by NSE. Monitoring locations will be established down-gradient of hazardous materials storage areas and at the property boundaries. Two monitoring wells will be established upstream of the Project site to monitor background concentrations in groundwater.

6.1.2 Surface Water

Surface water is a VEC because of its contribution to the health of fish and fish habitat and wetlands, and its linkage to terrestrial and marine ecosystem components, recreational activities and groundwater. Any changes to surface water flows, quantity or quality, could potentially affect groundwater recharge, aquatic life, terrestrial and marine ecosystems, and human health.

6.1.2.1 Boundaries and Threshold

Spatial

The development on the Project site affects three watershed areas and two small surface water streams, namely Stream A (west) and Stream B (east). Stormwater has been rerouted around the north side of the Project site using open channel hydraulics. This reconnects to a small wetland, Stream B, and the estuary. Rerouting storm water away from Project activities minimizes the risk of any contamination to surface water bodies. Stormwater that is not diverted and runs over the Project site will be channelled to the jetty sedimentation pond. Although the property borders the coast, Streams A and B extend beyond the property boundary downstream an additional 350 and 450 m respectively. Surface water analysis included surface waters from within the property boundary, downstream portions of Streams A and B and their estuaries. Increased runoff from the site would be expected to increase the flow in the streams to the east and west of the site. Based on the comparative catchment area of theses streams, the predicted increase in runoff as a result of the proposed development is expected to be on the order of 2% of the annual mean flow at the western stream, and 5% of the annual mean flow at the eastern stream. Best management practices for quality control can be implemented to balance site runoff to pre-development levels.

Table 6-1: Potential Environmental Effects Assessment Matrix for Groundwater

Activity	Effect	Mitigation	Significance Criteria					Significance
			Magnitude	Geographic Extent	Duration/ Frequency	Reversibility	Eco/Socio Context	
Construction and Commissioning								
Clearing, grubbing, and grading (majority of which is complete)	• Spill of POL or chemicals from construction equipment or wastewater may enter the aquifer • Grading may expose additional points of entry to the aquifer • Building/construction of roads (i.e. blasting) could cause fracture of nearby underground infrastructure, geology and impact ground water quality	• Avoid blasting within 800 m of residential wells • Perform a pre-blast well survey • Restore damaged wells and provide temporary water to residents affected • Follow emergency spill and POL cleanup procedures	Low	1 km around Project area	1-36 months/ < 11 events/year	Reversible	Developed area with no residential wells within 1 km around Project site	Not significant
Operation and Maintenance								
Operation of LNG liquefaction trains, supporting infrastructure and LNG storage. Wastewater treatment system Stormwater management system	• Spill of POL or chemicals from equipment and operations (leaks, malfunctions or system backups) may enter the aquifer • Should on-site production wells be employed to supply process or potable water requirements, the quantity of water in the aquifer(s) may also be affected • Domestic wastewater effluent may enter aquifer if not disposed of properly • Stormwater running over Project site could be contaminated and follow a point of entry to the aquifer	• Attain necessary approvals • Follow Operations Manual • Create stormwater bypass for water to minimize potential for contamination • Ensure stormwater passing over site is diverted to sedimentation ponds • The wastewater (sewage) treatment system will be designed (operation and disposal) based upon provincial and national standards	Low	1 km around Project area	>72 months Continuous	Reversible	Developed area with no residential wells within 1 km around Project site	Not significant
Accidents and Malfunctions								
Sedimentation or erosion, particularly during construction Spills or accidents Accidental explosions (vibrations)	• Majority of earthwork has been performed • Additional work being perform could release sediments to surface water and contaminate aquifers and surface water with spills (POL and chemical) • Accidental explosions could cause damage to wells and underground infrastructure	• Restore damaged wells and provide temporary water to residents affected • Follow emergency spill and POL cleanup procedures as prescribed in the EPP	Low	1 km around Project area	>72 months Continuous	Reversible	Developed area with no residential wells within 1 km around Project site	Not significant
Decommissioning								
Facility decommissioning	• Effects expected to be similar to those during construction • POL from construction equipment may enter the aquifer (contamination of aquifer)	• Restore damaged wells and provide temporary water to residents affected • Follow emergency spill and POL cleanup procedures as prescribed in the EPP • Follow a decommissioning plan	Low	1 km around Project area	1-12 months < 11 events/year	Reversible	Developed area with no residential wells within 1 km around Project site	Not significant

Temporal

Vehicular movements and exposed soils are the most likely sources of contamination during construction to surface waters. Such construction-related physical effects on surface waters will be temporary in nature and can be addressed through good management practices. The potential for chemical effects from spills exists through all phases of the Project. Depending on various factors, spill impacts may be short or long-term, e.g., the substance spilled, the quantity spilled and the time to detection; the nature of the spill will be determine the remediation timeline necessary to return the impacted surface waters to a pre-impacted state.

Administrative

Increased runoff presents a potential for increased sediment loading and higher temperatures. To reduce environmental risk and protect existing habitat from contaminants entrained in stormwater runoff, it is important to establish quality objectives for the proposed development. In large measure these have been established by federal and provincial authorities. The *Fisheries Act,* for example, prohibits the release of deleterious substances into waters frequented by fish or that may eventually enter waters frequented by fish.

The following guidelines, standards, and regulatory requirements related to surface water will apply to the Project:

- CCME Canadian Environmental Quality Guidelines (2007)
  - Water supplies, recreational water, Canadian water quality guidelines, water quality guidelines for the protection of aquatic life and agricultural uses
- *Fisheries Act* - Deleterious Substance Provisions
- CEPA
- Nova Scotia *Environment Act*
- Nova Scotia *Water Resources Protection Act*
- Nova Scotia Environment Erosion and Sedimentation Control Handbook for Construction Sites, 1988 and updates
- Nova Scotia Department of Transportation and Infrastructure Renewal Standard Specifications, 2011

According to the *Canadian Water Quality Guidelines for the Protection of Aquatic Life* (CCME, 1999), the most important parameters to consider to protect aquatic life in surface waters are TSS and turbidity. Table 6-2 describes the guideline values of each of these parameters.

Table 6-2: CCME Guidelines for the Protection of Aquatic Life[1]

Parameter	Guideline Value	
	Clear Flow	High Flow
Total Suspended Solids (TSS)	Maximum increase of 25 mg/L from background levels for a 24 hour period; and Maximum average increase of 5 mg/L from background levels for exposure between 24 hours and 30 days	Maximum increase of 25 mg/L from background levels at any time when background levels are between 25 and 250 mg/L. Should not increase more than 10% of background levels when background is greater than 250 mg/L.
Turbidity	Maximum increase of 8 Nephelometric Turbidity Units (NTUs) from background levels for a 24 hour period; and Maximum average increase of 2 NTUs from background levels for levels of exposure between 24 hours and 30 days.	Maximum increase of 8 NTU from background levels at any one time when background levels are between 8 and 80 NTUs. Should not increase more than 10% of background levels when background levels are above 80 NTU.

Stormwater quality objectives for the proposed development will be established that adhere to the most stringent municipal, provincial and federal recommendations. In the absence of applicable site-specific guidelines, methods developed for other Canadian jurisdictions may be considered. For example, the *Stormwater Management Planning and Design Manual* developed by the Ontario Ministry of the Environment quantifies TSS removal based on existing conditions and habitat sensitivity. Existing site conditions may require enhanced protection for the post-development stormwater management scenario. This level of protection requires removal of 80% of TSS in stormwater runoff. A number of methods can be used to help reduce water quality concerns and meet the minimum water quality targets.

Stormwater Best Management Practices (BMP) to meet water quality and quantity targets can take many forms including the creation of wet or dry detention ponds, the construction of wetlands, underground storage, roof leaders to surface storage or ponding areas, vegetated swales, the installation of filter strips, infiltration chambers or oil/grit separators. The existing site development includes two (2) sedimentation detention ponds and extensive surface water controls.

[1] *Reference: http://ceqg-rcqe.ccme.ca/en/index.html#void*

Technical

There is sufficient data and knowledge regarding the surface water at the Project site to adequately conduct the effects assessment.

Thresholds

The following evaluation criteria are used to determine whether a residual environmental effect on surface water is significant, not significant or positive:

A **significant adverse effect** would occur if surface water was impacted by petroleum hydrocarbons above the CCME Guidelines for the Protection of Aquatic Life; or alteration of stream flow or chemistry resulted in adverse effects to aquatic life. Increased levels of turbidity or TSS are also of concern and may have an adverse effect if levels described in Table 6-2 are exceeded.

An **adverse effect** that does not exceed the above criteria is considered not significant.

A **positive effect** is one that enhances the quality of the surface water.

The relative ratings defined below are used to establish the magnitude of a residual effect on surface water:

High: A change in surface water relative to baseline, which causes exceedances of standards and guidelines, or extends beyond the Project site.

Medium: A change in surface water relative to baseline within the Project site that is within standards and guidelines.

Low: A change in surface water, that is within the normal variability of baseline conditions.

6.1.2.2 Interactions and Potential Effects

The key interactions between the Project and surface water with the potential to result in adverse effects include:

- Construction-related land disturbance resulting in erosion and leading to increased levels of TSS and turbidity in surface water;
- Contaminated stormwater discharges resulting from rerouted water or water flowing over the Project site;
- Wastewater discharge from construction activities, operations and maintenance, and decommissioning; and
- Sanitary wastewater discharge.

Construction

Initial site work, i.e., clearing, grubbing and stripping of topsoil, has been largely completed. The tasks remaining may require the placement of excess material on temporary piles and, perhaps, limited blasting. These activities have the potential to cause erosion and sediment transport into surface waters.

Any impacts to on-site surface waters, including wetlands and streams, will most likely be a result of erosion, sediment transport or chemical contamination from stormwater runoff. There is also a risk of contamination from alkaline wastewater used to rinse concrete troughs.

Off-site surface water contamination, if any, is not expected to be significant as the site-grading provides that runoff from the site is directed to one of two sedimentation ponds currently existing on site (the Jetty and Eastern Sedimentation Ponds). This water will be discharged to the marine environment once it has been shown to meet provincial and federal regulatory requirements.

Operation and Maintenance

Once constructed and in operation, the Project may impact surface waters through stormwater runoff (POL from spills, chemicals and sediments from erosion), increased stormwater flows resulting from a change in surface porosity, the discharge of sanitary wastewater and the discharge of water from demineralization units.

Accidents and Malfunctions

Accidents and malfunctions may affect surface waters by causing them to be exposed to chemicals, POL spills and stormwater runoff. The risk of accidental events or malfunctions impacting surface waters is present during the construction, operation and decommissioning phases of the Project.

Decommissioning

The effects of the decommissioning process on surface waters are expected to be similar to those incurred during the construction process. These will be addressed in a decommissioning plan which would be developed prior to decommissioning and incorporate future relevant standards and regulations.

6.1.2.3 Mitigation

The potential contributors to adverse effects on surface waters are stormwater runoff and construction and sanitary wastewaters. Each of these has the potential to carry contaminants, such as POL, chemicals and sediments from erosion. Stormwater diversion has been created such that water upstream from site will be diverted to Stream B and water flowing over the site will be diverted to

sedimentation ponds. Additional mitigation measures, such as silt fences, sedimentation and erosion controls, soil and stockpile covers, sedimentation ponds and appropriate wastewater treatment methods will be employed as warranted to minimize the likelihood of such effects. The alkaline waters used to wash concrete truck troughs will be collected in a basin and neutralized to a pH range acceptable for discharge to the Strait. Construction may need to be suspended during extreme weather events, such as high precipitation.

Mitigation measures and BMP to prevent and respond to a petroleum or hydrocarbon spill will be detailed in the EPP and will include the following:

- Chemical storage and handling in accordance with manufacturers' recommendations and applicable federal and provincial regulations;
- Secondary containment for diesel storage tanks;
- Training in chemical storage and handling for all on-site staff;
- Installation of safety measures including leak alarms, emergency shutdown systems, spill containment and provisions to protect piping from the effects of transient pressure variations;
- Provision of accessible spill kits;
- Maintenance of equipment in good working order and execution of efficient monitoring protocols for leaks;
- Storage, stockpiling and use of fuel, lubricant and other hazardous substances in designated areas outside of buffer zones designed to protect sensitive habitats including surface water and wetlands;
- Development and implementation of a Spill Management Plan to include the immediate clean-up, containment and removal of impacted surface water and the removal and proper disposal of impacted soil; and
- Installation of concrete wash containment.

Any effects during the decommissioning phase of the Project will be mitigated as prescribed in the Decommissioning Plan, which would be developed prior to decommissioning and address the prevailing standards and regulations.

6.1.2.4 Potential Residual Effects

With the implementation of the identified mitigation measures, significant adverse residual effects to surface water are not likely to occur.

A matrix depicting the potential effects to surface water, associated mitigation measures and the determination of residual effects is presented in Table 6-3.

6.1.2.5 Monitoring and Follow-up

Baseline monitoring will be performed prior to any additional site work, and a surface water monitoring program will be maintained over the life of the Project in accordance with requirements stipulated by NSE. Monitoring locations will be established, for example, at streams A and B and in the vicinity of POL storage. Any additional monitoring required to achieve environmental compliance will be outlined in the EPP. A baseline surface water monitoring program was undertaken in 2014, providing analytical results for general chemistry. Once onsite activities resume, a water monitoring program will be coordinated in NSE.

6.1.3 Climate

Climate change refers to the observed rise in the average temperature of the Earth's climate systems over the past 100 years, driven by increasing concentrations of GHGs produced by human activities (IPCC, 2013). Climate change is a public concern in Nova Scotia due to the expected impacts on sea levels, weather patterns (including extreme events), fish stock distributions, and snow and ice extents (Climate Change Nova Scotia, 2009).

This section outlines a GHG assessment related to the proposed Project. It includes a discussion of the proposed Project boundary with respect to anticipated emissions, Project emission inventory and facility emission intensity, and expected mitigations through the application of best available control technologies (BACTs). This GHG assessment follows provincial guidance on considering climate change:

- Guide to Considering Climate Change in Environmental Assessments in Nova Scotia (Nova Scotia Environment, February 2011); and
- Guide to Considering Climate Change in Project Development in Nova Scotia (Nova Scotia Environment, February 2011).

Table 6-3: Surface Water Environmental Effects Assessment Matrix

Activity	Effect	Mitigation	Significance Criteria					Significance
			Magnitude	Geographic Extent	Duration/ Frequency	Reversibility	Eco/Socio Context	
Construction and Commissioning								
Clearing, grubbing, and grading (majority of which is complete) Wastewater resulting from construction process (i.e. concrete wash waters)	• The construction process may lead to increased levels of TSS, turbidity or high pH values in surface watercourses or bodies • Clearing and grubbing could contribute to land erosion, thus, affecting the quality of surface waters • Grading could change surface water courses • Spills of POL and chemicals from construction equipment in runoff to surface water	• Diversion of stormwater runoff (upstream from site) to Stream B • Diversion of stormwater runoff (on-site) to sedimentation ponds • Implementation of EPP, which shall include erosion and sediment control, buffer zones, stormwater management plan, and spill prevention and emergency response plan • Designated fueling site for equipment located away from surface areas • Installation of silt fences and berms • Restrict the removal of riparian plants to appropriate setbacks from surface waters • Concrete wash waters will be collected and treated prior to discharge	Low	On-site 1-10 km	1-36 months/ < 11 events/year	Reversible	Developed area Municipal supply not close to Project site Sedimentation ponds have been construction Note: Majority of this work has already been performed	Not significant
Operation and Maintenance								
Operation of LNG liquefaction trains, supporting infrastructure and LNG storage. Wastewater treatment system Stormwater management system	• Contamination of surface water from runoff and spills (POL, chemicals, and TSS) • Contamination of surface water from wastewater effluent/discharge	• Diversion of stormwater runoff (upstream from site) to Stream B • Diversion of stormwater runoff (on-site) to sedimentation ponds • Implementation of EPP, which shall include erosion and sediment control, buffer zones, stormwater management plan, and spill prevention and emergency response plan • Re-vegetation of disturbed soils, if required • Designated fueling site for equipment located away from surface waters • Installation of silt fences and berms • Treatment of wastewater compliant with provincial and federal requirements	Low	On-site 1-10 km	>72 months Continuous	Reversible	Developed area Municipal supply not close to Project site Sedimentation ponds have been construction	Not significant
Accidents and Malfunctions								
Spills or accidents	• Contamination of surface water from runoff and spills (POL, chemicals) • • •	• Diversion of stormwater runoff (on-site) to sedimentation ponds • Spill kits accessible at all times • Implementation of EPP, which includes spill prevention and emergency response plans	Low	1 km around Project area	>72 months Continuous	Reversible	Developed area Municipal supply will not close to the Project site Sedimentation ponds	Not significant
Decommissioning								
Facility decommissioning	• Effects expected to be similar to those during construction. • The decommissioning process may lead to increased levels of TSS or turbidity in surface watercourses or bodies • Spills of POL and chemicals from construction equipment in runoff to surface water	• Implementation EPP, including spill prevention and emergency response plans • Diversion of stormwater to appropriate areas • Re-vegetation of disturbed areas, if required • Follow a decommissioning plan	Low	1 km around Project area	1-12 months < 11 events/year	Reversible	Developed area Municipal supply not close to Project site Sedimentation ponds have been construction	Not significant

6.1.3.1 Boundaries and Threshold

Spatial Boundaries

The spatial boundary of the GHG assessment includes all activities on the proposed Project footprint, from feedstock gas entering the facility (at the gas metering station) to the berthing operations of the LNG marine tankers. The following activities are not included in the GHG assessment because they are outside the control of the proponent of the proposed Project:

- Marine LNG tankers while underway and all tug associated activities;
- Upstream natural gas extraction and transportation to the facility;
- GHG emissions associated with electricity generation for electricity consumed on site; and
- Downstream LNG transportation and usage.

Although impacts to climate change caused by GHG emissions can have far reaching effects that span the globe, these are hard to quantify and impossible to link to a single project. It is assumed that if impacts to climate change are negligible at the national scale, then they will not have a significant impact globally. Therefore, GHG emissions associated with the proposed Project will be evaluated on a regional (Nova Scotia) and national scale (Canada).

Temporal Boundaries

The temporal boundaries for the GHG assessment include the construction, operation and decommissioning phases of the Project. Construction is expected to last approximately 3 years. Operational emissions will be constant over the life of the Project.

Administrative Boundaries

The Province of Nova Scotia passed the *Environmental Goals and Sustainable Prosperity Act* in 2007, which requires GHG emissions to be reduced to 10% below 1990 levels by 2020. To reach this goal, the Greenhouse Gas Emissions Regulations, passed in 2009 under the *Environment Act,* established absolute GHG targets for the electricity sector, which produces half of the province's GHG emissions. No provincial GHG regulations currently exist for the LNG industry; the proposed Project has taken a "Beyond No Regrets" approach in technology selection.

The "Beyond No Regrets" approach involves the implementation of BACTs to ensure that the facility meets any future regulatory requirements to the degree possible. NSE is currently in the preliminary stages of investigating best management practices for GHG emissions from LNG facilities within the framework of the 2007 *Environmental Goals and Sustainable Prosperity Act*. Mitigation measures may be defined and the proponent of the proposed Project commits to continue to collaborate with NSE on relevant GHG policies as the latter are finalized.

Threshold for Significance

A relative magnitude rating was also established for climate impacts. The following criteria are considered when determining the significance of an effect:

High: An environmental effect that can significantly impact regional GHG emissions by greater than 5%.

Medium: An environmental effect that can impact regional GHG emissions by between 1-5%.

Low: An environmental effect that does not impact regional GHG emissions (less than 1%)

6.1.3.2 Interactions and Potential Effects

The Project related interactions with the climate due to the combustion of fossil fuels and the removal of CO_2 entrained in the feedstock gas. Diesel will be the primary fuel used during construction and decommissioning and natural gas will be the primary fuel used during operation. This section outlines the GHG emissions associated with construction, operation and decommissioning.

The GHG species considered in the assessment include CO_2, CH_4 and N_2O. Other GHG species such as HFCs, CFCs and SF6 were not included because no emissions of these species are expected given the technology proposed for the facility. All GHG emissions are reported in tonnes (or kilotonnes) of CO_2 equivalent (CO_2e), which accounts for the different global warming potential (GWP) values of the GHG species.

Construction

Construction of the proposed Project is expected to last approximately 3 years. The GHG source included in the proposed Project's construction GHG emissions inventory was diesel combustion associated with construction equipment. Activity levels, emission factors and emissions are summarized in Table 6-4. Emission factors are sourced from the Environment Canada 2012 National Inventory Report and activity levels were provided by the proponent. GHG emissions associated with land clearing were not included because the site has already been largely cleared and the expanded footprint requires less than 5% of additional clearing of existing carbon sink vegetation. Therefore, any climate change impact would be insignificant.

Table 6-4: Baseline greenhouse gas emissions for the 3-year construction phase of proposed Project.

Emission source	Activity level	Emission factor	GHG emissions (t CO_2e)
Construction diesel consumption	24,000,000 L	2.994 kg CO_2/L	71,900
		TOTAL	**71,900**

Operation

The following GHG sources were included in the proposed Project's operations GHG emissions inventory:

- Stationary combustion of natural gas for compressors, auxiliary heaters and thermal oxidizers;
- Stationary combustion of diesel for emergency equipment, e.g., generators, water pumps, etc.;
- Flaring of natural gas in three flares (cold, warm, and marine flares);
- Fugitive emissions of CO_2 and CH_4 from onsite infrastructure, piping and equipment;
- Removal of CO_2 entrained in the natural gas feedstock; and
- LNG tankers maneuvering in and out of dock, and auxiliary engine activities at berth.

Data was provided by the proponent based on the expected activities at the facility based on 4 LNG trains operating at a production level of 8 mtpa. Table 6-5 summarizes the baseline facility GHG emissions.

The GHG calculation methodology used to develop the inventory was the Western Climate Initiative (WCI) reporting requirements (World Climate Initiative, 2011). The WCI methodology is the GHG calculation methodology used for mandatory GHG reporting by facilities in California, British Columbia, Ontario and Quebec. The GWP values used in the WCI methodology are from the Fourth Assessment Report of the United Nations Intergovernmental Panel on Climate Change (IPCC, 2007).

For comparison, Table 6-6 lists the GHG emissions for Nova Scotia and Canada for 2012 (the last available year), grouped by emission category (Environment Canada, 2012). As can be seen, the proposed Project will increase provincial GHG emissions by approximately 10.3% and Canadian emissions by only 0.3%.

Table 6-5: Baseline annual greenhouse gas emissions for operations phase of Proposed Project.

Emission source	GHG emissions ($t CO_2e$)	Notes
Natural gas liquefaction compressors	1,230,600	High pressure (HP) fuel gas at 13.05 t/h per train
Natural gas boilers and oxidizers	199,200	Low pressure (LP) fuel gas at 2.14 t/h per train
Diesel emergency equipment	200	5 pieces of equipment, ~500 hrs per year total
Removal of entrained CO_2	488,300	Assumes 1.8% concentration in feedstock gas
Flaring	31,800	Includes warm, cold and marine flares
Fugitives	400	
LNG tanker manoeuvring and hotelling	3,900	
TOTAL	**1,954,500**	

Table 6-6: Regional and national GHG emission inventories for 2012, compared to proposed Project annual operation GHG emissions.

Emission category	**Nova Scotia** (kt CO2e)	**Canada** (kt CO2e)
Energy	17,700	566,000
Industrial processes	505	56,500
Solvent & other product use	8	310
Agriculture	360	56,000
Waste	450	21,000
TOTAL	**19,000**	**699,000**
Proposed Project annual operations GHG emissions	**1,954**	**1,954**
Proposed Project as percentage of TOTAL	**10.3%**	**0.3%**

The design of the Proposed Project follows the patented OSMR® LNG liquefaction process. Developed by LNG Limited LLC in the mid 2000s, OSMR® combines several proven technologies into an integrated system with the following control technologies:

- Gas turbine waste heat steam generation: waste heat is recovered and transformed into mechanical energy through steam production (combined heat and power);
- Closed loop anhydrous ammonia pre-cooling of inlet and mixed refrigerant (MR) streams: direct cooling of inlet air in gas turbine improves both the output of the turbine and also the operational stability. The inlet MR stream is cooled with ammonia such that the MR returns to the main compressor at a lower temperature which improves compressor performance (and LNG production). The power to drive the ammonia pre-cooling system is primarily derived from the gas turbine waste heat exhaust;
- Use of General Electric LM2500+G4 aero-derivative gas turbines: The first generation of LNG export plants built used single cycle gas turbine (SCGT) technology for compression drives. While SCGT is a mature technology, more fuel efficient technologies such as combined cycle gas turbines (CCGT) and aero-derivatives (adapted from aerospace gas turbines) are now considered the best in class compression drive technologies for recently built and in development LNG export plants;

- BOG will be re-liquefied instead of flared: this is an OSMR® patented process where BOG is lightly compressed and re-liquefied in the liquid methane separator, which separates flash gas out before LNG is delivered to the storage tanks (flash gas is used as a lean LP fuel gas in the auxiliary boiler);
- Optimized modular design: Each LNG train is divided into five main process modules, which can be fabricated off site at a fabrication facility and transported to the proposed Project site by ocean barge or similar method. The fabrication facility approach ensures a more reliable product and is inherently safer; and
- Improved flare, venting and fugitives management (described in more detail in the following sections).

The use of OSMR® is considered implementation of "Best Available Control Technology". Given OSMR®'s efficiencies, the proposed Project is expected to have a world class LNG GHG emission intensity; a benchmark of LNG export plant GHG performance that measures GHG emissions per unit of production. No consistent reporting standard yet exists so reported GHG emission intensities can vary widely depending upon what emission sources LNG export plant projects include in their GHG emission inventories. Using the baseline GHG emissions listed in Table 6-5 and a production value of 8 mtpa of LNG, the proposed Project's emission intensity is 0.24 t CO_2e/t LNG.

Accidents and Malfunctions

The proposed Project will be designed with two primary flares, warm and cold, as well as a secondary marine flare. It is expected that flaring will only be required during start-up, shutdown, plant upset and emergency conditions. Emergency overpressure conditions include power and instrument failures, fires, entrapment of cold liquids and exchanger tube ruptures. A pilot runs on each flare so emergency flows are combusted rather than vented. The warm flare handles wet or warm relief fluids while the cold flare is designed for fluids lower than ambient temperature. Both flares include knockout drums where liquids are collected into a sump. Sump components will be periodically vacuumed out and trucked to an approved offsite disposal facility. The design capacity of the flares will be determined during final design, but a hydrocarbon destruction efficiency of at least 99.5% is expected. This destruction efficiency exceeds Environmental Protection Agency (EPA) guidance on current BACT for flares and as such the proposed Project flare system satisfies BACT (EPA 40, CFR 60.18). Flaring during upset conditions is preferable to venting since flaring converts most of the CH_4 (GWP of 25) into CO_2 (GWP of 1).

Decommissioning

A decommissioning plan will be completed at the end of the proposed Project prior to decommissioning that incorporates regulations and best practices at the time. Effects are expected to be similar to those of the construction phase of the Project.

Mitigation

The design of the proposed Project will lead to significant reduction in GHG emissions compared to most other LNG facilities considered or in operation today. Technical documentation suggests that the OSMR® technological improvements such as waste heat recovery, the use of ammonia and BOG recovery in aggregate, resulting in a significant reduction in GHG emissions.

Another mitigation measure is the use of natural gas compressor turbines instead of electrically driven turbines where electricity is supplied from the provincial grid. The gas turbines generate approximately 2,250 GWh of energy per year of operation. Given the baseline GHG emissions associated with the turbines is 1,230,600 t CO_2e, this corresponds to a GHG intensity of approximately 540 t CO_2e/GWh. The 2012 grid intensity in Nova Scotia is approximately 790 t CO_2e /GWh (Environment Canada, 2012). As such, the use of aero-derivative compressor drives is an improvement of approximately 32% over conventional grid electricity.

During the FEED for the proposed Project, a detailed GHG management plan will be developed that includes the following elements:

- Detailed inventory of the proposed Project's baseline GHG sources;
- Definition of annual GHG reporting requirements, including boundary definition, source identification and auditing requirements;
- Detailed flaring and venting management program (described under "Accidents and Malfunctions" above);
- Fugitive management program following best practices: A Directed Inspection and Maintenance (DIM) program that includes leak definition, detection and repair methods, component targeting and tagging (accounting for inaccessible components), monitoring frequencies, personnel training, equipment calibrations, record keeping, and performance objectives; and
- Identification of a facility energy efficiency program.

The GHG management plan will be updated annually and will be designed to meet any future NSE regulatory requirements.

6.1.3.3 Potential Residual Effects

A matrix depicting the potential effects on GHG emissions is provided in Table 6.7 GHG emissions from operations are considered a significant residual effect at a provincial level as they are estimated to contribute approximately 10.3% of Nova Scotia's GHG emissions. The proposed Project is following a "Beyond No Regrets" approach by implementing the BACTs to mitigate GHG emissions and further mitigation may be considered both in response to the provincial policies once they have been adopted and to Project specific monitoring results. The provincial government is currently developing GHG policies for the LNG industry within the framework of the 2007 *Environmental Goals and Sustainable Prosperity Act*. The proponent commits to collaborate and work with NSE on the development and application of these GHG policies.

6.1.3.4 Monitoring and Follow-Up

As part of the detailed GHG management plan, annual GHG reporting will be performed, including boundary definition, source identification and auditing requirements.

6.1.4 Air Quality

The link between air pollution and human health has been understood for quite some time, with air pollution affecting the health of humans and animals and causing soiling and deterioration of buildings (Lave, 1970). Health effects of air pollution vary depending on the contaminants in question ($PM_{2.5}$, NO_x, SO_x, O_3, CO, est.), but short term effects can include reductions in lung function, respiratory inflammation, chest pains, coughing, nausea, and pulmonary congestion. Long term effects can include effects on breathing and respiratory systems, damage to lung tissue, cancer, and premature death (EPA, 2014).

6.1.4.1 Boundaries and Threshold

Spatial Boundaries

Atmospheric transport of Project emissions may have far reaching effects on air quality that can span the globe. These effects, however, are hard to quantify and model. As a result, impacts will be considered on a more regional scale (Nova Scotia). If impacts to air quality are avoided or negligible at the regional scale, then they are not expected to have a significant impact on global air quality. Dispersion modelling considered effects over a distance of approximately 10 km.

Table 6-7: Potential Environmental Effects Assessment Matrix for Climate

Activity	Effect	Mitigation	Significance Criteria					Significance
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Eco/Socio Context	
Construction and Commissioning								
Construction activities, use of equipment	• Emissions of GHGs	• - Limit vehicle idling • - Where available, use fuel efficient equipment • - Vehicle and equipment maintenance according to manufacturer's recommendations. • - Use of appropriate vehicles/equipment for each task	Low	>10km	3 years, during construction hours (07:00 – 19:00)	Non reversible	Developed area	Not significant
Operation and Maintenance								
Operation and general maintenance	• Emissions of GHGs	• - GHG management plan • - Implementation of best available control technologies • - Limit vehicle idling • - Where available, use fuel efficient equipment • - Conduct vehicle and equipment maintenance according to manufacturer's recommendations • - Use of appropriate vehicles/equipment for each task	High	>10km	Continuous emissions over the life of the Project	Non reversible	Developed area	Significant (provincially) Not-significant (nationally, globally)
Accidents and Malfunctions								
Flaring and venting	• Emissions of GHGs	• - Venting and flaring management program • -Conduct equipment maintenance according to manufacturer's recommendations.	Low	>10km	Intermittent over the life of the Project	Non reversible	Developed area	Not significant
Decommissioning								
Facility decommissioning	• Emissions of GHGs	• - Limit vehicle idling • - Where available, use fuel efficient equipment • - Conduct vehicle and equipment maintenance according to manufacturer's recommendations. • - Use of appropriate vehicles/equipment for each task	Low	>10km	To be determined	Non reversible	Developed area	Not significant

Temporal Boundaries

Temporal boundaries will include the construction and operation phases of the Project. Construction is expected to last approximately 3 years, while operation emissions will span the life of the Project.

Administrative Boundaries

The Nova Scotia AQS under the *Environment Act* outlines maximum permissible concentrations for SO_2, NO_2 and O_3 and the Canadian Ambient Air Quality Standards (CAAQS) from the CCME outlines maximum permissible concentrations for O_3 and $PM_{2.5}$. The Nova Scotia AQS and CAAQS are outlined in Tables 6-8 and 6-9 respectively.

Table 6-8: Nova Scotia Air Quality Standards

Contaminant	Averaging Period	Maximum Permissible Ground Level Concentration	
		µg/m³	pphm
Carbon Monoxide (CO)	1 hour	34,600	3,000
	8 hours	12,700	1,100
Hydrogen Sulphide (H_2S)	1 hour	42	3
	24 hours	8	0.6
Nitrogen Dioxide (NO_2)	1 hour	400	21
	Annual	100	5
Ozone (O_3)	1 hour	160	8.2
Sulphur Dioxide (SO_2)	1 hour	900	31
	24 hours	300	11
	Annual	60	2
Total Suspended Particulates (TSP)	24 hours	120	-
	Annual	70*	-

* *Geometric mean µg/m³ – micrograms per cubic meter phm – parts per hundred million*

Table 6-9: Canadian Ambient Air Quality Standards

Pollutants	Old Standards	New Standards	
		2015	2020
$PM_{2.5}$ annual	-	10 µg/m³	8.8 µg/m³
$PM_{2.5}$ for 8-hour	30 µg/m³	28 µg/m³	27 µg/m³
Ozone for 8-hour	69 ppb	63 ppb	62 ppb

** ppb – parts per billion*

Other emissions standards applicable to the Project are federal emissions standards from the *Multi-Sector Air Pollutants Regulations* and the *Canadian Base Level Industrial Emissions Requirements*

(BLIER). These regulations impose mandatory performance standards on industrial equipment. Specifically, the *Multi-Sector Air Pollutants Regulations* imposes limits on the amount of NO_x that can be emitted from boilers. A working group formed under the Canadian Air Quality Management System in 2011 developed new BLIERs for NO_x emissions from combustion turbines.

The Project will be required to meet these regulations. A summary of the Project design criteria compared with these air emissions standards for boilers and combustion turbines is presented below in Table 6-10.

Table 6-10: Comparison of Project's Emissions with NO_X Air Emissions Limits

Equipment	Regulations	Regulated Activities	Project Design Criteria	Emission Limits
Boiler	Multi-Sector Air Pollutants Regulations	Alternative gas combustion with an efficiency higher than 90%(3)	23 g/GJ	≤23 g/GJ*
Combustion Turbine	Canadian BLIER	Natural gas combustion	25 ppmvd at 15% O_2 dry	≤25 ppmvd at 15% O_2 dry

* *If the boiler's thermal efficiency is less than 80%, the air emission limit is reduced to 20.8 g/GJ for an alternative gas. If the efficiency ranges between 80% and 90%, then the limit is linearly proportional to the efficiency and is bounded by the upper and lower limit for an alternative gas, 23 g/GJ and 20.8 g/GJ respectively.*

Threshold for Significance

The following evaluation criteria are used to determine whether a residual environmental effect on air quality is significant, not significant or positive:

A significant adverse effect would occur should emissions increase pollution levels beyond regulated limits, or show the potential to do so.

An adverse effect that does not exceed the above criteria is considered not significant.

A positive effect is one that enhances air quality.

A relative magnitude rating was established for air quality impacts. The following criteria are considered when determining the significance of an effect:

High: An environmental effect that can increase pollution levels beyond regulated limits.

Medium: An environmental effect that shows the potential to increase pollution levels beyond

regulated limits (brings pollution concentrations to within 90%).

Low: An environmental effect that does not increase pollution levels beyond regulated limits, or show the potential to do so.

6.1.4.2 Interactions and Potential Effects

Construction

As previously outlined, most of the site preparation work has already been performed. As a result, a large part of the footprint of the Project has been established and additional construction related emissions due to land clearing will be minimal. Further construction will include the installation of foundations, equipment settings, ancillary equipment, piping and structures. Marine terminal works will include the installation of a jetty platform, vessel berthing trestle, loading facilities, temporary wharf and work surface and will require the installation of piles.

Project construction is projected to last approximately three (3) years. This would be classified as long term construction and temporary increases in ambient noise levels would be expected. Construction has potential to take place 24 hours a day, seven days a week. The various equipment used during construction (combustion engines, cranes, backhoes, pavers, trucks, welders, generators, air compressors, pumps, pile drivers, heavy construction equipment and workers personal vehicles) will result in air emissions including NO_X, SO_2, CO, PM_{10}, $PM_{2.5}$, and VOCs. Short term emissions of air pollutants will accompany this construction period; however, significant adverse impacts are not expected.

Vehicle traffic during construction, as well as wind erosion of displaced soil (prior to paving and re-vegetation) will result in fugitive dust emissions.

Operations - Air Emissions Inventory

An air emissions inventory was developed from the major elements of the Project for use in the air emissions modelling. The model run benefitted from advanced studies conducted on the similar 8 mtpa Magnolia LNG plant to be built in Lake Charles, Louisiana. Emissions data for Magnolia was adapted to the Project, taking into account stream flows and their components outlined in the mass balance developed for Bear Head. Estimated emissions from the Project were compared to the emissions inventory for the Province of Nova Scotia. Table 6-11 summarizes the emissions sources. For more detailed information on the inventory and how it was developed, as well as fugitive emissions modelled and assumptions see Appendix G. The following documents were used to develop the air emission inventory:

- Magnolia LNG Project Application to Federal Energy Regulatory Commission – dated 30 April 2014. Responses to FERC in September, 2014.

- Bear Head LNG Project's Heat and Material Balance Sheet (Document BH-DP-10-001 rev C – 28 November 2014).

Table 6-11: Estimated Annual Emissions – Proposed Natural Gas Liquefaction Plant (Tonnes/Year)

Sources	NO_X	CO	VOC	PMt	PM_{10}	$PM_{2.5}$	SO_2	NH_3
	t/y	t/y	t/y	t/y	t/y	t/y	t/y	t/y
Continuous Sources (per train – 2 mtpa)								
Gas Turbine A	118.6	72.2	4.6	8.5	8.5	8.5	0	N.A.
Gas Turbine B	118.6	72.2	4.6	8.5	8.5	8.5	0	N.A.
Thermal Oxidizer	10.0	7.2	3.2	1.2	1.2	1.2	37.9	N.A.
Auxiliary Boiler	18.9	13.0	0.13	2.6	2.6	2.6	0	N.A.
Ammonia Vent	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	0.52
Each LNG train	266.1	164.6	12.5	20.7	20.7	20.7	37.9	0.52
LNG Vessels (105 vessels/y)	85	10.1	4.3	1.3	1.3	1.1	2.3	N.A.
Fugitive Emissions (Piping Components)			12.2					1.3
Total 8 mtpa	**1149**	**669**	**66**	**84**	**84**	**84**	**154**	**3.4**
Intermittent Sources								
Warm Flare	7.5	40.6	0.65	0.82	0.91	0.91	0	0
Cold Flare	9.1	49.6	0.011	1.00	1.00	1.00	0	0
Marine Flare	0.13	0.71	0.0003	0.014	0.014	0.014	0	0
Emergency Generator (1 MW)	0.64	0.35	0.065	0.020	0.016	0.016	0.0005	0
Firewater Pump Eng. (250 kW)	0.21	0.18	0.021	0.011	0.009	0.009	0.0004	0
Seawater pump Eng. (600 kW)	0.77	0.42	0.077	0.024	0.020	0.020	0.0006	--
TOTAL	1213	788	69	90	90	89	160	3.4

Annual atmospheric emissions of major air contaminants from industrial and power installations in Port Hawkesbury and Point Tupper are summarized in Table 6-12. Values are shown as reported to the NPRI for the year 2013.

Table 6-12: Summary of Industrial Atmospheric Emissions in the Study Area (2013)[2]

NPRI Sources	Contaminants (metric tonnes per annum)						
	SO_2	NOx	CO	VOC	PMT	PM_{10}	$PM_{2.5}$
ExxonMobil Canada Properties - Point Tupper Fractionation Plant	na	32	42	81	Na	1.5	1.2
Nova Scotia Power Inc. Point Tupper Generating Station	6758	1,340	78		117	82	36
Port Hawkesbury Paper LP/ Port Hawkesbury Paper	237	442	421	333	112	61	21
Nova Scotia Power Inc. Port Hawkesbury Biomass Cogeneration Power Plant	47	774	251	na	81	62	33
Total 2013	7042	2588	792	414	310	207	91
Bear Head LNG (8 mtpa)	160	1,213	788	69	90	90	89
Total with Project	7178	3801	1580	483	400	297	180

Operations - Air Quality Modelling Methodology

Emission sources were modelled as point sources. The LNG facility, LNG vessels (during docking, hotelling, and docking out) and emergency flaring emissions were all considered in the air emissions modelling.

Modelling guidelines from Newfoundland and Labrador and Quebec were used, as specific air dispersion modelling guidelines do not exist in Nova Scotia (DOEC, 2012; Leduc, 2005). The CALMET/CALPUFF air dispersion modelling system was employed (EarthTech, 2000a, 2000b). It was selected over the American Meteorological Society/Environmental Protection Agency Regulatory Air Dispersion Model (AERMOD) due to the location of the Project in a coastal region. CALPUFF calculates the concentration of pollutants at all receptors on an hourly basis, summing the individual contributions from each source when multiple sources are present. The model requires inputs of:

- Gridded topographical and land use data.
- Hourly meteorological surface observations, upper air observation soundings (at least twice per day) and/or 3D meteorological fields generated by an advanced prognostic meteorological model (temperature, wind speed and direction, etc.).
- Source emission characteristics: emission rates of contaminants in the exhaust gas, the gas exit temperature and velocity, stack coordinates, configuration, diameter and height.

[2] Source: National Pollutant Release Inventory for 2013.

- Location and elevation of receptors.
- Dimensions and coordinates of buildings on-site that present wake effects causing plume downwash.

For ground elevations of receptors, the Canadian Digital Elevation Model (CDEM, Natural Resources Canada, 2013) topographic data was used. Land use classifications (circa 2000 – Vector) from Natural Resources Canada Land Cover (NRC, 2014) were gridded for the CALMET meteorological domain. Meteorological observations from Port Hawkesbury showed gaps in data completeness. CALMET generated wind data was used instead as it showed good agreement with observed wind fields from Port Hawkesbury.

The *Weather Research and Forecast* (WRF) meteorological model for the 2009 to 2013 period was used to provide all meteorological information for CALMET, based on inputs from Lakes Environmental.

Results from the Port Hawkesbury monitoring site for the NAPS for SO_2, NO_2 and $PM_{2.5}$ were used for background concentrations of air pollutants. Monitoring results from the NAPS station in Sydney (Cape Breton) were considered for CO. PM_t was modelled as 4 times the $PM_{2.5}$ concentration. Monitoring results for the last available years (2010-2012) were considered, but year 2010 was not integrated because of lower data availability (65% or less). The conversion of NO to NO_2 was modelled using the "*ozone limiting method"* (Cole and Summerhays, 1979).

More detailed information on the model run and air emissions parameters are available in the full report contained in Appendix G.

Operations - Air Quality Monitoring Results

The model was run with the 2009 – 2013 meteorological data. Maximum predicted concentrations for each year of the model run are in compliance with air quality guidelines when considered alongside ambient pollutant concentrations, both during normal operation and with an LNG vessel hotelling. Short term averaging conditions (24 hours or less) are closest to exceeding the AAQS, but remain within guidelines. Table 6-13 presents maximum concentrations for each year of the modelling period during normal operation and with an LNG vessel hotelling with consideration of ambient concentrations.

Maximum concentrations are localized to specific locations and do not occur over the entire modelling domain. In order to illustrate this point, maximum concentration of NO_2 and $PM_{2.5}$ are shown in Figure 6-9 of the report contained in Appendix G, and are modelled over the entire domain. NO_2 and $PM_{2.5}$ were modelled as they are closest to exceeding guidelines.

Table 6-13: Maximum Predicted Concentrations in Ambient Air for the LNG Plant, including LNG Vessel Hotelling and Background Concentrations at Normal Operation.

Pollutant	Period	Maximum Predicted (2009-2013)		Background		Total		AAQS (µg/m³)
		(µg/m³)	% AAQS	(µg/m³)	% AAQS	(µg/m³)	% AAQS	
NO_2	1 h *	235	59%	24	6.1%	259	65%	400
	Annual	26	26%	3.8	3.8%	30	30%	100
SO_2	1 h	118	13%	31	3.5%	149	17%	900
	24 h	20	6.6%	16	5.2%	36	12%	300
	Annual	3.9	6.5%	2.6	4.4%	7	11%	60
CO	1 h	203	0.59%	458	1.3%	661	1.9%	34,600
	8 h	77	0.60%	458	3.6%	535	4.2%	12,700
PMt	24 h	9.0	7.5%	60	50%	69	58%	120
	Annual	1.3	1.8%	26	37%	27	39%	70
$PM_{2.5}$	24 h	9.0	33%	15	54%	23	87%	27*
	Annual	1.3	14%	6.5	74%	7.8	88%	8.8*

**New Canadian Standard for 2020*

Accidents and Malfunctions

In order to account for upset conditions at the plant, modelling was performed for the case where all continuous sources for the LNG plant, an LNG vessel hotelling and flaring at maximum capacity at all flares (hot, cold and marine flare) occur simultaneously. This situation is unlikely to occur, and would only be for a short duration. As a result, only 1, 8, and 24 hour situations were modelled. Significant increases are observed, but results remain below guidelines.

Temporal Boundaries

Temporal boundaries will include the construction and operation phases of the Project. Construction is expected to last approximately 3 years, while operation emissions will span the life of the Project.

Administrative Boundaries

The Nova Scotia AQS under the *Environment Act* outlines maximum permissible concentrations for SO_2, NO_2 and O_3 and the Canadian Ambient Air Quality Standards (CAAQS) from the CCME outlines maximum permissible concentrations for O_3 and $PM_{2.5}$. The Nova Scotia AQS and CAAQS are outlined in Tables 6-8 and 6-9 respectively.

Table 6-8: Nova Scotia Air Quality Standards

Contaminant	Averaging Period	Maximum Permissible Ground Level Concentration	
		µg/m³	pphm
Carbon Monoxide (CO)	1 hour	34,600	3,000
	8 hours	12,700	1,100
Hydrogen Sulphide (H_2S)	1 hour	42	3
	24 hours	8	0.6
Nitrogen Dioxide (NO_2)	1 hour	400	21
	Annual	100	5
Ozone (O_3)	1 hour	160	8.2
Sulphur Dioxide (SO_2)	1 hour	900	31
	24 hours	300	11
	Annual	60	2
Total Suspended Particulates (TSP)	24 hours	120	-
	Annual	70*	-

* *Geometric mean µg/m³ – micrograms per cubic meter phm – parts per hundred million*

Table 6-9: Canadian Ambient Air Quality Standards

Pollutants	Old Standards	New Standards	
		2015	2020
$PM_{2.5}$ annual	-	10 µg/m³	8.8 µg/m³
$PM_{2.5}$ for 8-hour	30 µg/m³	28 µg/m³	27 µg/m³
Ozone for 8-hour	69 ppb	63 ppb	62 ppb

** ppb – parts per billion*

Other emissions standards applicable to the Project are federal emissions standards from the *Multi-Sector Air Pollutants Regulations* and the *Canadian Base Level Industrial Emissions Requirements*

(BLIER). These regulations impose mandatory performance standards on industrial equipment. Specifically, the *Multi-Sector Air Pollutants Regulations* imposes limits on the amount of NO_x that can be emitted from boilers. A working group formed under the Canadian Air Quality Management System in 2011 developed new BLIERs for NO_x emissions from combustion turbines.

The Project will be required to meet these regulations. A summary of the Project design criteria compared with these air emissions standards for boilers and combustion turbines is presented below in Table 6-10.

Table 6-10: Comparison of Project's Emissions with NO_X Air Emissions Limits

Equipment	Regulations	Regulated Activities	Project Design Criteria	Emission Limits
Boiler	Multi-Sector Air Pollutants Regulations	Alternative gas combustion with an efficiency higher than 90%(3)	23 g/GJ	≤23 g/GJ*
Combustion Turbine	Canadian BLIER	Natural gas combustion	25 ppmvd at 15% O_2 dry	≤25 ppmvd at 15% O_2 dry

* *If the boiler's thermal efficiency is less than 80%, the air emission limit is reduced to 20.8 g/GJ for an alternative gas. If the efficiency ranges between 80% and 90%, then the limit is linearly proportional to the efficiency and is bounded by the upper and lower limit for an alternative gas, 23 g/GJ and 20.8 g/GJ respectively.*

Threshold for Significance

The following evaluation criteria are used to determine whether a residual environmental effect on air quality is significant, not significant or positive:

A significant adverse effect would occur should emissions increase pollution levels beyond regulated limits, or show the potential to do so.

An adverse effect that does not exceed the above criteria is considered not significant.

A positive effect is one that enhances air quality.

A relative magnitude rating was established for air quality impacts. The following criteria are considered when determining the significance of an effect:

High: An environmental effect that can increase pollution levels beyond regulated limits.

Medium: An environmental effect that shows the potential to increase pollution levels beyond

regulated limits (brings pollution concentrations to within 90%).

Low: An environmental effect that does not increase pollution levels beyond regulated limits, or show the potential to do so.

6.1.4.2 Interactions and Potential Effects

Construction

As previously outlined, most of the site preparation work has already been performed. As a result, a large part of the footprint of the Project has been established and additional construction related emissions due to land clearing will be minimal. Further construction will include the installation of foundations, equipment settings, ancillary equipment, piping and structures. Marine terminal works will include the installation of a jetty platform, vessel berthing trestle, loading facilities, temporary wharf and work surface and will require the installation of piles.

Project construction is projected to last approximately three (3) years. This would be classified as long term construction and temporary increases in ambient noise levels would be expected. Construction has potential to take place 24 hours a day, seven days a week. The various equipment used during construction (combustion engines, cranes, backhoes, pavers, trucks, welders, generators, air compressors, pumps, pile drivers, heavy construction equipment and workers personal vehicles) will result in air emissions including NO_X, SO_2, CO, PM_{10}, $PM_{2.5}$, and VOCs. Short term emissions of air pollutants will accompany this construction period; however, significant adverse impacts are not expected.

Vehicle traffic during construction, as well as wind erosion of displaced soil (prior to paving and re-vegetation) will result in fugitive dust emissions.

Operations - Air Emissions Inventory

An air emissions inventory was developed from the major elements of the Project for use in the air emissions modelling. The model run benefitted from advanced studies conducted on the similar 8 mtpa Magnolia LNG plant to be built in Lake Charles, Louisiana. Emissions data for Magnolia was adapted to the Project, taking into account stream flows and their components outlined in the mass balance developed for Bear Head. Estimated emissions from the Project were compared to the emissions inventory for the Province of Nova Scotia. Table 6-11 summarizes the emissions sources. For more detailed information on the inventory and how it was developed, as well as fugitive emissions modelled and assumptions see Appendix G. The following documents were used to develop the air emission inventory:

- Magnolia LNG Project Application to Federal Energy Regulatory Commission – dated 30 April 2014. Responses to FERC in September, 2014.

- Bear Head LNG Project's Heat and Material Balance Sheet (Document BH-DP-10-001 rev C – 28 November 2014).

Table 6-11: Estimated Annual Emissions – Proposed Natural Gas Liquefaction Plant (Tonnes/Year)

Sources	NO_X	CO	VOC	PMt	PM_{10}	$PM_{2.5}$	SO_2	NH_3
	t/y	t/y	t/y	t/y	t/y	t/y	t/y	t/y
Continuous Sources (per train – 2 mtpa)								
Gas Turbine A	118.6	72.2	4.6	8.5	8.5	8.5	0	N.A.
Gas Turbine B	118.6	72.2	4.6	8.5	8.5	8.5	0	N.A.
Thermal Oxidizer	10.0	7.2	3.2	1.2	1.2	1.2	37.9	N.A.
Auxiliary Boiler	18.9	13.0	0.13	2.6	2.6	2.6	0	N.A.
Ammonia Vent	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	0.52
Each LNG train	266.1	164.6	12.5	20.7	20.7	20.7	37.9	0.52
LNG Vessels (105 vessels/y)	85	10.1	4.3	1.3	1.3	1.1	2.3	N.A.
Fugitive Emissions (Piping Components)			12.2					1.3
Total 8 mtpa	**1149**	**669**	**66**	**84**	**84**	**84**	**154**	**3.4**
Intermittent Sources								
Warm Flare	7.5	40.6	0.65	0.82	0.91	0.91	0	0
Cold Flare	9.1	49.6	0.011	1.00	1.00	1.00	0	0
Marine Flare	0.13	0.71	0.0003	0.014	0.014	0.014	0	0
Emergency Generator (1 MW)	0.64	0.35	0.065	0.020	0.016	0.016	0.0005	0
Firewater Pump Eng. (250 kW)	0.21	0.18	0.021	0.011	0.009	0.009	0.0004	0
Seawater pump Eng. (600 kW)	0.77	0.42	0.077	0.024	0.020	0.020	0.0006	--
TOTAL	1213	788	69	90	90	89	160	3.4

Annual atmospheric emissions of major air contaminants from industrial and power installations in Port Hawkesbury and Point Tupper are summarized in Table 6-12. Values are shown as reported to the NPRI for the year 2013.

Table 6-12: Summary of Industrial Atmospheric Emissions in the Study Area (2013)[2]

NPRI Sources	Contaminants (metric tonnes per annum)						
	SO_2	NOx	CO	VOC	PMT	PM_{10}	$PM_{2.5}$
ExxonMobil Canada Properties - Point Tupper Fractionation Plant	na	32	42	81	Na	1.5	1.2
Nova Scotia Power Inc. Point Tupper Generating Station	6758	1,340	78		117	82	36
Port Hawkesbury Paper LP/ Port Hawkesbury Paper	237	442	421	333	112	61	21
Nova Scotia Power Inc. Port Hawkesbury Biomass Cogeneration Power Plant	47	774	251	na	81	62	33
Total 2013	7042	2588	792	414	310	207	91
Bear Head LNG (8 mtpa)	160	1,213	788	69	90	90	89
Total with Project	7178	3801	1580	483	400	297	180

Operations - Air Quality Modelling Methodology

Emission sources were modelled as point sources. The LNG facility, LNG vessels (during docking, hotelling, and docking out) and emergency flaring emissions were all considered in the air emissions modelling.

Modelling guidelines from Newfoundland and Labrador and Quebec were used, as specific air dispersion modelling guidelines do not exist in Nova Scotia (DOEC, 2012; Leduc, 2005). The CALMET/CALPUFF air dispersion modelling system was employed (EarthTech, 2000a, 2000b). It was selected over the American Meteorological Society/Environmental Protection Agency Regulatory Air Dispersion Model (AERMOD) due to the location of the Project in a coastal region. CALPUFF calculates the concentration of pollutants at all receptors on an hourly basis, summing the individual contributions from each source when multiple sources are present. The model requires inputs of:

- Gridded topographical and land use data.
- Hourly meteorological surface observations, upper air observation soundings (at least twice per day) and/or 3D meteorological fields generated by an advanced prognostic meteorological model (temperature, wind speed and direction, etc.).
- Source emission characteristics: emission rates of contaminants in the exhaust gas, the gas exit temperature and velocity, stack coordinates, configuration, diameter and height.

[2] Source: National Pollutant Release Inventory for 2013.

- Location and elevation of receptors.
- Dimensions and coordinates of buildings on-site that present wake effects causing plume downwash.

For ground elevations of receptors, the Canadian Digital Elevation Model (CDEM, Natural Resources Canada, 2013) topographic data was used. Land use classifications (circa 2000 – Vector) from Natural Resources Canada Land Cover (NRC, 2014) were gridded for the CALMET meteorological domain. Meteorological observations from Port Hawkesbury showed gaps in data completeness. CALMET generated wind data was used instead as it showed good agreement with observed wind fields from Port Hawkesbury.

The *Weather Research and Forecast* (WRF) meteorological model for the 2009 to 2013 period was used to provide all meteorological information for CALMET, based on inputs from Lakes Environmental.

Results from the Port Hawkesbury monitoring site for the NAPS for SO_2, NO_2 and $PM_{2.5}$ were used for background concentrations of air pollutants. Monitoring results from the NAPS station in Sydney (Cape Breton) were considered for CO. PM_t was modelled as 4 times the $PM_{2.5}$ concentration. Monitoring results for the last available years (2010-2012) were considered, but year 2010 was not integrated because of lower data availability (65% or less). The conversion of NO to NO_2 was modelled using the "*ozone limiting method"* (Cole and Summerhays, 1979).

More detailed information on the model run and air emissions parameters are available in the full report contained in Appendix G.

Operations - Air Quality Monitoring Results

The model was run with the 2009 – 2013 meteorological data. Maximum predicted concentrations for each year of the model run are in compliance with air quality guidelines when considered alongside ambient pollutant concentrations, both during normal operation and with an LNG vessel hotelling. Short term averaging conditions (24 hours or less) are closest to exceeding the AAQS, but remain within guidelines. Table 6-13 presents maximum concentrations for each year of the modelling period during normal operation and with an LNG vessel hotelling with consideration of ambient concentrations.

Maximum concentrations are localized to specific locations and do not occur over the entire modelling domain. In order to illustrate this point, maximum concentration of NO_2 and $PM_{2.5}$ are shown in Figure 6-9 of the report contained in Appendix G, and are modelled over the entire domain. NO_2 and $PM_{2.5}$ were modelled as they are closest to exceeding guidelines.

Table 6-13: Maximum Predicted Concentrations in Ambient Air for the LNG Plant, including LNG Vessel Hotelling and Background Concentrations at Normal Operation.

Pollutant	Period	Maximum Predicted (2009-2013)		Background		Total		AAQS (µg/m³)
		(µg/m³)	% AAQS	(µg/m³)	% AAQS	(µg/m³)	% AAQS	
NO_2	1 h *	235	59%	24	6.1%	259	65%	400
	Annual	26	26%	3.8	3.8%	30	30%	100
SO_2	1 h	118	13%	31	3.5%	149	17%	900
	24 h	20	6.6%	16	5.2%	36	12%	300
	Annual	3.9	6.5%	2.6	4.4%	7	11%	60
CO	1 h	203	0.59%	458	1.3%	661	1.9%	34,600
	8 h	77	0.60%	458	3.6%	535	4.2%	12,700
PMt	24 h	9.0	7.5%	60	50%	69	58%	120
	Annual	1.3	1.8%	26	37%	27	39%	70
$PM_{2.5}$	24 h	9.0	33%	15	54%	23	87%	27*
	Annual	1.3	14%	6.5	74%	7.8	88%	8.8*

**New Canadian Standard for 2020*

Accidents and Malfunctions

In order to account for upset conditions at the plant, modelling was performed for the case where all continuous sources for the LNG plant, an LNG vessel hotelling and flaring at maximum capacity at all flares (hot, cold and marine flare) occur simultaneously. This situation is unlikely to occur, and would only be for a short duration. As a result, only 1, 8, and 24 hour situations were modelled. Significant increases are observed, but results remain below guidelines.

Table 6-14: Maximum Predicted Concentrations in Ambient Air for the LNG Plant with Flaring, including LNG Vessel Hotelling and Background Concentrations at Normal Operation.

Pollutant	Period	Maximum Predicted (2009-2013)		Background		Total		AAQS (µg/m³)
		(µg/m³)	% AAQS	(µg/m³)	% AAQS	(µg/m³)	% AAQS	
NO_2	1 h	235	59%	24	6.1%	259	65%	400
SO_2	1 h	118	13%	31	3.5%	149	17%	900
	24 h	20	6.6%	16	5.2%	36	12%	300
CO	1 h	1,711	5.0%	458	1.3%	2,169	6.3%	34,600
	8 h	514	4.1%	458	3.6%	972	7.7%	12,700
PMt	24 h	10	8.5%	60	50%	70	59%	120
$PM_{2.5}$	24 h	10	38%	15	54%	25	92%	27*

**New Canadian Standard for 2020*

Again, maximum concentrations are localized and do not occur over the entire modelling domain. Maximum concentrations of NO_2 and $PM_{2.5}$ can be seen in Figures 10-11 of the report contained in Appendix G, modelled over the entire domain. NO_2 and $PM_{2.5}$ were modelled as they are closest to exceeding guidelines.

There is potential for fires and explosions, vessel accidents, related spills and accidental releases of LNG to occur, however these accidents are unlikely. These events would impact air quality, but the situation would be rapidly controlled; the effects would be localized and temporary. Fires and explosions, vessel accidents, related spills and accidental releases are not expected, and their occurrence is unlikely. Significant effects on air quality from these events are not expected.

Decommissioning

A decommissioning plan will be developed prior to decommissioning that complies with all regulations and best management practices at that time. Effects on air quality are expected to be similar to those during construction. Mitigation measures proposed for the decommissioning phase would likely be similar to those employed during the construction phase.

6.1.4.3 Mitigation

Bear Head LNG is committed to ensuring that adverse environmental impacts from the Project are avoided or minimized wherever possible. Mitigation measures for the potential effects described above will be employed during construction, operation and decommissioning of the Project. Potential effects described above that may require mitigation include:

- Fugitive dust emissions from activities such as vehicle traffic during construction periods and the decommissioning (including demolition activities);
- Impacts to the airshed from exhaust emissions from LNG carrier vessels, compressors, gas turbines and flares, during the operation of the LNG plant and marine terminal; and
- Impacts to the airshed from fugitive emissions related to plant operation.

The proposed mitigation measures are described below for construction, operation and decommissioning.

Mitigation during Construction Phase

Mitigation measures during construction will include:

- Requiring that contractors meet all provincial air quality regulations and emission standards applicable to their equipment. All construction equipment, including stationary (generators, compressors, etc.) are mobile (heavy vehicle) equipment should be maintained in accordance with equipment maintenance schedules to ensure exhaust emissions are representative of good operational practices. Water or dust suppressants will be applied to disturbed areas, as necessary, to reduce vehicle traffic dust. Oil will not be used as a dust suppressant.
- Covering open hauling trucks with tarps, as necessary.
- Using paved roads for construction vehicle traffic, wherever practical.
- Using best practices to limit track out onto paved sections.
- Limiting vehicle speeds as required, thereby reducing dust generation.
- Limiting unnecessary idling of vehicles and machinery. Diesel powered construction machinery will not be permitted to idle unless required.
- Responding promptly to any significant particulate emission concerns that occur during construction by evaluating the source of emissions and ensuring all practicable mitigation measures are being implemented.
- Activities resulting in dust will cease and immediate dust suppression actions will be taken in the event that visible dust extends beyond the property boundary.

- Upon completion of construction activity, disturbed areas will be stabilized.
- A land based work plan, including dust control measures, will be updated as part of the EPP.

Mitigation during Operation Phase

Mitigation measures to minimize air quality effects during operation of the facility will include:

- All equipment used on-site will be properly maintained to ensure exhaust emissions are typical for each piece of equipment;
- Current and future emissions standards for natural gas combustion engines will be met;
- Leak Detection and Repair program (LDAR) will be implemented (See Section 6.1.4.2);
- Normal industry practices reducing emissions, such as the use of auxiliary engines for LNG tanker hoteling, will be employed. The International Marine Organization has developed limits for NO_x, SO_x and VOCs. By 2016, marine diesel engines are required to reduce NO_x levels by 80% compared to 2010 levels; and
- A Flare Management Plan will be developed as part of the EPP.

Mitigation during Decommissioning Phase

Impacts to air quality during decommissioning are expected to be similar to those expected from the construction phrase. Therefore, mitigation measures imposed will also be similar. Full mitigation measures will be outlined in a decommissioning plan.

6.1.4.4 Potential Residual Effects

Impacts to local air quality during construction and operation of the Project are not expected to be significant. Short term emissions of air pollutants will accompany the construction period; but significant adverse impacts are not expected. Due to the location of the site in an area zoned for industrial use and far from local residents, businesses and schools, the impact to the public is expected to be minimal. Emissions will comply with ambient air quality standards during normal operation conditions as well as during potential upset conditions.

Table 6-15: Potential Environmental Effects Assessment Matrix for Air Quality

Activity	Potential Effects	Mitigation	Significance Criteria					Residual Effects Significance
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Eco/Socio Context	
Construction and Commissioning								
Site preparation (blasting, clearing, grading, est.) and construction of onshore facilities and marine terminal	• Air emissions from equipment related to combustion (NOX, SO2, CO, PM10, PM2.5, and VOCs), as well as fugitive dust emissions	• Best management practices will be employed during construction • Activities resulting in dust will cease and immediate dust suppression actions taken should site conditions cause the release of visible dust beyond the property boundary • A dust contingency plan will be developed	Low	> 10 km	To the end of construction, approximately 3 years	Irreversible	Emissions from construction equipment and fugitive dust emissions are not expected to negatively impact air quality in the area Due to the location of the site in an area zoned for industrial use and far from local residents, businesses and schools the impact to the public is expected to be minimal	Not significant
Operation and Maintenance								
Plant operation	• Air emissions from plant operation are expected; however, emissions will comply with ambient air quality standards	• All equipment used on-site will be properly maintained • Current and future regulated emissions standards for state of the art natural gas combustion engines will be met • Normal industry practices will be employed • CAC monitoring during operation • LDAR Program	Low	> 10 km	Life of the Project (approximately 25 years). Air emissions will be constant during this time	Irreversible	Emissions will comply with ambient air quality standards during normal operation conditions as well as during potential upset conditions Adverse effects to the community are not expected	Not significant (Emissions will comply with ambient air quality standards during normal operation conditions as well as during potential upset conditions)
Accidents and Malfunctions								
Flaring and venting Fires and explosions Vessel accidents Spills and accidental releases	• Modelling for flaring shows significant increases in air emissions, but results remain below guidelines • Remaining events would impact air quality but significant effects on air quality are not expected and their occurrence is unlikely	• LDAR Program	Med (24 hour concentrations of $PM_{2.5}$)	> 10 km	Potential for accidents and malfunctions exists through construction, operation and decommissioning of the Project Flaring and venting are not expected during regular operations	Irreversible	Flaring and venting not expected during regular operations The occurrence of fires and explosions, vessel accidents, related spills and accidental releases are unlikely and significant effects on air quality from them are not expected	Not significant (Emissions will comply with ambient air quality standards during normal operation conditions as well as during potential upset conditions)
Decommissioning								
Expected to be similar to construction. A detailed plan will be developed prior to works being undertaken	• Air emissions from equipment related to combustion (NOX, SO2, CO, PM10, PM2.5, and VOCs), as well as fugitive dust emissions	• Mitigation measures similar to construction will be employed Decommissioning plan to be developed prior to decommissioning	Low	> 10 km	Decommissioning plan to be developed prior to decommissioning	Irreversible	Emissions from decommissioning equipment and fugitive dust emissions are not expected to negatively impact air quality in the area Due to the location of the site in an area zoned for industrial use and far from local residents, businesses and schools the impact to the public is expected to be minimal	Not significant (Emissions will comply with ambient air quality standards during normal operation conditions as well as during potential upset conditions)

6.1.4.5 Monitoring and Follow-up

Monitoring of the main stacks will be conducted as per federal guidelines and emission standards. The Bear Head LNG facility will have the capability to measure energy flows and emissions. The following monitoring programs will be implemented:

- Gas turbines (33 MW output capacity)
  - Monitoring or energy flows including fuel consumption, electricity and shaft power;
  - Regular monitoring of fuel properties including heating value;
  - NO_x emissions will be measured for each gas turbine as part of the initial commissioning; and
  - Once annually, one gas turbine per train will be monitored.
- Auxiliary Boiler (89 GJ/h input heat)
  - Regular monitoring of fuel properties including heating value;
  - Federal regulations require an initial stack testing for boilers less than 105 GJ/h (each auxiliary boiler) comprised of 3 tests of at least 30 minutes in 48 hours, for a steady-state operation of at least 60% of its rating capacity;
  - During each test run, the concentration of NO_x (ppmvd) and oxygen (%) must be measured simultaneously;
  - The average of the 3 test runs must comply with regulated emissions intensities; and
  - If the selected boiler has a rating capacity of more than 105 GJ/h, then a stack monitoring campaign will be repeated on an annual basis, as per federal regulations.
- Thermal Oxidizers
  - Monitoring of energy flows including fuel consumption, electricity and shaft power;
  - Regular monitoring of fuel properties including heating value and sulfur content of the stream to be incinerated; and
  - Initial stack testing for each oxidizer similar to auxiliary boilers.

An LDAR will be implemented to monitor fugitive emissions. Results of the LDAR will be provided with the annual atmospheric emissions sampling report to Environment Canada and NSE. Components of the LDAR Program include:

- Quarterly measurements (from April 1 to December 31) for pump, compressor and agitator seals and once a year for all other parts;
- Bear Head LNG will repair any major leakage within a prescribed 45 day period. Its objective will be to repair any major leak within 5 days;
- Bear Head LNG will consider a major leak one that is of more than 10,000 ppm;
- If repairing the leak requires the interruption of an on-going process, the repair will be carried out no later than the next scheduled shutdown of the process involved; and
- Several different leak detectors and monitoring equipment will be strategically placed to detect LNG leakage and to facilitate a quick and efficient response. The LDAR aims to detect micro leaks at much lower levels than those requiring an emergency response. Ammonia leak detectors will be utilized.

6.1.5 Acoustic Environment

It is important to determine impacts to the acoustic environment associated with Project activities. Sufficient scientific evidence exists to find that noise exposure can have negative health effects, including hearing impairment, hypertension and ischemic heart disease, annoyance, sleep disturbance, and decreased school performance (Passchier-Vermeer et al., 2000). Effects on the acoustic environment will be considered as they relate to human health.

6.1.5.1 Boundaries and Threshold

Spatial Boundaries

Noise generated by Project activities has the potential to impact the Project site, the surrounding communities of Point Tupper and Port Hawkesbury, and the rural area of Guysborough County (across the Strait). The Project site is located in an area zoned for industrial use; the nearest residences are located across the Strait, approximately 1.8 km from the site.

Temporal Boundaries

Temporal boundaries will include the construction and operation phases of the Project. Construction is expected to last approximately 3 years, while operational noise emissions will span the life of the Project.

Administrative Boundaries

Permissible sound levels from the Project are governed by provincial and municipal noise assessment criteria. Health Canada provides additional information to complement these regulations.

According to NSE noise criteria (NSE, 1989), sound shall not exceed the following levels:

- 07:00 to 19:00 65 dBA
- 19:00 to 23:00 60 dBA
- 23:00 to 07:00 55 dBA

Municipal By-law #8 from Richmond County prohibits disturbing noise in the vicinity of any public place. The bylaw also states that between the hours of 12:00 and 24:00 on any week day, loud speakers, amplifiers or other sound transmitting device shall not be operated in the Municipality such that the sound is projected beyond a distance of 300 feet.

The Guysborough County Noise Control By-Law prohibits disturbance of peace and tranquility, the operation of sound systems that can be heard at neighbouring dwellings and continuous noise levels that exceed when measured on any property:

- 06:00 to 23:00 65 dBA
- 23:00 to 06:00 55 dBA

Construction noise is permitted between 07:00 and 21:00. If NSE noise criteria are met, Noise Control By-Laws from Guysborough County will also be met.

Health Canada has developed an approach to noise assessment that takes into account recognized standards, including those from the U.S. Environmental Protection Agency and the International Organization for Standardization. Useful Information for Environmental Assessments (Health Canada, 2010) is a document outlining steps to consider noise impacts. Some of the effects considered include hearing loss, sleep disturbance, interference with speech, complaints and the change in the percent highly annoyed of the community. Assessments of noise on human receptors should include and consider:

- Distance of receptors to the Project site and the expectation of "peace and quiet";
- Establishment of ambient baseline sound levels, both daytime (07:00 to 22:00) and nighttime (22:00 to 7:00), of the area prior to the Project;
- Identification of potential noise sources, tonal, low frequency and impulsive types of noise over the life of the Project;
- Prediction of Project sound levels;

- Comparison of baseline sound levels with projected sound levels;
- An estimate of the expected duration of noise; and
- Evaluation of the severity of the predicted changes in noise.

As part of the Health Canada approach to noise assessment, a day-night (24 hours) sound level (L_{dn}) is calculated to reflect the higher sensitivity of communities during the night. It is calculated by energy averaging day and night time sound levels, with a bias of 10 dBA applied to night time sound levels. Annoyance is calculated from the Schultz Curve (ISO1996-2, 2003). The percent highly annoyed (%HA) is calculated for both the ambient and baseline sound levels and then the change in %HA determined. When sound levels are in the range of 45-75 dBa the change in %HA should be < 6.5%. If it is greater, or sound levels exceed 75 dBa, then mitigation methods should be proposed. For temporary construction noise (<2 months) community consultation is advised. For short term construction noise (2 – 12 months) mitigation should be proposed if levels are predicted to result in complaints. For long-term construction noise (> 1 year), as well as operational noise where sound levels are in the L_{dn}: 45 – 75 dBA range, the %HA should be used to evaluate the impacts. Finally, for long-term construction or operational noise where sound levels are in excess of 75 dBA, the L_{dn} should be used to evaluate the impacts. A summary of the Health Canada approach to noise assessment is presented in Table 6-16.

Table 6-16: Health Canada Approach to Noise Assessment

Duration	Criterion	Limit
Temporary (<2 months) Construction noise lasts less than two months at receptors	Community consultation is advised	--
Short-term (2 - 12 months) Construction noise lasts less than twelve months at receptors	Mitigation should be proposed if the sound levels are predicted to result in widespread complaints based on U.S. EPA [U.S. EPA 1974, Michaud et al. 2008]	--
Long-term (> 1 year) Construction noise lasts more than one year, and operational noise, where sound levels are in the range of L_{dn}: 45 – 75 dBA.	% HA	Predicted change in %HA is greater than 6.5 %
Long-term (> 1 year) Construction noise lasts more than one year, and operational noise, where the Project related sound level is in excess of L_{dn}: 75 dBA.	L_{dn}	75 dBA

A noise assessment was performed to determine if noise generated by the Project will have any adverse effects on human health and comply with relevant standards. Sound level changes were evaluated with mitigation measures applied to determine residual impacts. The Noise Assessment is provided in Appendix H.

Threshold for Significance

The evaluation criteria defined below are used to determine whether a residual environmental effect on noise is significant, not significant or positive:

A significant adverse effect would occur if effects are expected to regularly cause increases in noise above guidelines at sensitive receptors.

An adverse effect that does not exceed the above criteria is considered not significant.

A positive effect is one that minimizes nuisance noise.

A relative magnitude rating was also established for ambient sound impacts. The following criteria are considered when determining the significance of an effect:

High: An environmental effect that can increase noise levels beyond regulated limits.

Medium: An environmental effect that shows the potential to increase noise levels beyond regulated limits.

Low: An environmental effect that does not increase noise levels beyond regulated limits, or show the potential to do so.

6.1.5.2 Interactions and Potential Effects

Construction

Most of the site preparation has been completed. Further construction will include the installation of foundations, equipment settings, ancillary equipment, piping and structures. Marine terminal works will include the installation of a jetty platform, vessel berthing trestle, loading facilities, temporary wharf and work surface and the installation of piles. Project construction is projected to last approximately 3 years. This would be classified as long term construction and temporary increases in ambient noise levels would be expected. Construction hours will vary, but work will likely take place on site twenty-four hours a day, seven days a week.

Noise levels depend on the number and type of equipment in operation, noise emission levels, usage factors and the distance/topography between the noise source and receptor. The Roadway Construction Noise Model (Federal Highway Administration, 2006) and information from the literature were used to produce noise emission levels for modelling. Expected construction equipment,

quantities and their related sound levels can be found in the Noise Assessment (Appendix H).

Construction noise levels at the site boundary are expected to exceed noise assessment criteria during the day. The Project site is located in the Point Tupper / Bear Head Industrial Park, an area zoned for Port Industrial (I-2) use including bulk terminals, marine terminals and fuel bunkering facilities.

It was assumed for modelling purposes that all construction equipment would be operating at the same time. The closest receptors are located across the Strait, approximately 1.8 km from the Project site. The potential impact of sound levels on sensitive receptors is shown in Table 6-17.

Table 6-17: LNG Facility Construction Sound Levels at Off-Site Receptors

Receptor	LNG Construction		Existing Baseline	Combined	NSE Criteria	Expected Increase
	LAeq (dBA)	Ldn * (dBA)	Ldn (dBA)	Ldn (dBA)	dBA	%HA
Construction at the facility site						
R1	48	46	55	56	65	0.3 %
R2	56	54	55	58	65	1.5 %
R3	52	50	54	55	65	0.7 %
Construction with vibratory hammers at marine terminal						
R1	48	46	55	56	65	0.3 %
R2	55	53	55	57	65	1.3 %
R3	52	50	54	56	65	0.7 %
Construction with impact hammers at marine terminal						
R1	48	58 **	55	60	65	3.3 %
R2	55	65 **	55	65	65	10.4 %
R3	52	62 **	54	63	65	6.9 %

* : Construction operating hours would take place from 7:00 to 19:00

**: +12 dBA correction was included for the highly impulsive nature of pile driving noise, in accordance with ISO 1996-2:2007.

The sound levels associated with pile installation at the marine terminal are presented in (LAeq, Table 7). To mitigate noise levels, vibratory hammers will be used in the construction to the extent possible. The sound level at the nearest receptors is lower than the noise assessment criteria for the day period (65 dBA). The increase in Day-Night sound level is lower or equal to 2 dBA and the predicted change in the percent highly annoyed (0.3 to 1.3 %HA) is lower than 6.5 %HA. In the event that impact (drop) hammers are used, the sound level at the nearest receptors is lower than the noise assessment criteria for the day period (65 dBA). Driving piles by the drop hammer method generates highly impulsive noise, and a correction factor of +12 dB was included in the calculation of the Day-Night sound level (Ldn), in accordance with ISO 1996-2: 2007. The increase in Day-Night sound level

is high and the predicted change in the percent highly annoyed (up to 10.4 %HA) is higher than 6.5 %HA. The residual impact would be low, reversible and temporary. The significance of the residual impact would be minor. Additional noise mitigation will be considered if required to attenuate noise.

Sensitive receptors are not expected to be impacted by noise from construction activities. Pile driving, however, as part of the marine works is expected to create an adverse temporary effect (increase in the percent highly annoyed). Mitigation measures will be employed during pile driving to reduce or eliminate this as described below. Following the finalization of the design and construction techniques are established, the noise assessment will be remodelled and the requirement for mitigation measures will be further evaluated.

Operation

Operation of the LNG facility and associated marine infrastructure will generate noise. The LNG facility has process equipment including gas and steam turbine compressors, BOG compressors, air coolers, pumps, piping and utility equipment, most of which will be continuous sources of noise. Intermittent sources of noise will also exist, including sounds generated by flaring and venting during emergency operation. The main source of noise from marine activities will be the noise generated by the LNG vessels.

Noise dispersion modelling of Project operations was performed using the International Organization for Standardization Standard 9613-2 (ISO 1996) with SoundPLAN V7.3 software to simulate the propagation of sound under favorable meteorological conditions. This methodology takes into account sound wave divergence due to distance, atmospheric and ground absorption, reflection from objects (buildings), and sound attenuation due to topography and barriers. The sound level is calculated for individual receptors. The calculated sound level represents the "A" weighted continuous sound level (L_{Aeq}). An absorption coefficient of 0.1 was used for area within the site boundary, 0.9 for areas outside the boundary and 0.0 for water. Ambient conditions of 10 °C with 70% relative humidity were used. Land topographic data was obtained from the Nova Scotia Geomatics Center (NSGC, 2011).

Manufacturer data, estimations based on similar equipment and data from the literature were used to estimate noise emission levels of noise-producing equipment. The sound levels of primary noise producing equipment, and the mitigation measures included in the modelling, can be found in the Noise Assessment (Appendix H), Results of the modelling are shown in Table 6-18.

Predicted noise levels at the boundary of the Project site exceed noise assessment criteria for the day, evening and night periods. The Project site, however, is located in the Point Tupper / Bear Head Industrial Park, an area zoned for Port Industrial (I-2) use including bulk terminals, marine terminals and fuel bunkering facilities.

Table 6-18: LNG Facility Operation Sound Levels at Site Boundary and Off-Site Receptors

Receptor	LNG Facility		Existing Baseline	Combined	Expected Increase
	LAeq (dBA)	Ldn (dBA)	Ldn (dBA)	Ldn (dBA)	%HA
North Boundary *	70	NA	NA	NA	NA
West Boundary *	68	NA	NA	NA	NA
South Boundary *	64	NA	NA	NA	NA
East Boundary *	68	NA	NA	NA	NA
R1	38	44	55	55	0.2%
R2	46	52	55	57	1.1%
R3	42	48	54	55	0.5%
*: Relative to the Facility main axis, +25° from true north					

Predicted noise levels at all sensitive receptors across the Strait of Canso are below noise assessment criteria for the day, evening and night periods. The increase in Day-Night sound level is lower than 2 dBA and the predicted change in the percent highly annoyed (0.2 to 1.1 %HA) in the community is lower than 6.5 %HA.

The results of noise modelling show that noise impacts from operations are not expected to significantly affect sensitive receptors.

Accidents and Malfunctions

Flaring and venting will be required during start up and shutdown processes and during upset conditions. These noise sources will be intermittent and occur over a short period of time. Noise levels can be expected to be high during these times. Overall, impacts from accidents and malfunctions are not expected to be significant.

Fires and explosions, vessel accidents, related spills and accidental releases of LNG are unlikely to occur. These events would impact the acoustic environment, but would be rapidly controlled and the effects would be localized and temporary. Fires and explosions, vessel accidents, related spills and accidental releases are unlikely to occur; significant effects on the acoustic environment related to these events are not expected.

Decommissioning

A decommissioning plan will be developed that will address noise related impacts. The effects of decommissioning are expected to be very similar to those arising during construction. Overall, impacts from decommissioning are not expected to be significant.

6.1.5.3 Mitigation

Bear Head LNG is committed to ensuring that adverse environmental impacts from the Project are avoided or minimized wherever practicable. Construction hours will vary but, during certain phases of the Project, work will take place on site twenty-four hours a day, seven days a week. The nature of the noise generated will also vary through construction and operation. Based on the results of the acoustic modelling, consideration will be given during the FEED process on how best to incorporate practices and mitigation measures into the design and operation of the facility to minimize annoyance from noise and to ensure that all regulatory requirements with respect to noise levels are met at a minimum.

During the design and selection of equipment, for example, noise ratings shall be taken into consideration to meet noise assessment criteria. Enclosures, piping insulation and silencers may be employed, and the feasibility of low noise designs will be explored. The EPP will incorporate the mitigation measures and protocols necessary to address noise related matters and will also identify the appropriate numbers that can be used to register noise related complaints.

6.1.5.4 Potential Residual Effects

Potential residual effects are summarized below in Table 6-19. Significant impacts to the acoustic environment are not expected to occur during construction, operation, as a result of accidents and malfunctions, or during decommissioning assuming proper monitoring and mitigation are employed.

6.1.5.5 Monitoring and Follow-Up

Follow-up monitoring will be performed during construction activities, in particular during pile driving to determine whether sensitive receptors (residences across the Strait) are being negatively impacted. If noise levels exceed assessment criteria, mitigation measures will be implemented.

Monitoring will also be performed during operation to ensure that sensitive receptors do not experience noise that exceeds noise assessment criteria and to establish baseline noise levels for reference in case of future developments.

If noise related complaints are received during construction or operation, additional noise monitoring will be undertaken to verify these claims and to aid in meeting noise assessment criteria.

Table 6-19: Potential Environmental Effects Assessment Matrix for the Acoustic Environment

Activity	Potential Effects	Mitigation	Significance Criteria					Residual Effects Significance
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Eco/Socio Context	
Construction and Commissioning								
Site preparation (blasting, clearing, grading, est.) and construction of onshore facilities and marine terminal	• Increased noise levels. Modelling predicts values below assessment criteria with the exception of pile driving	• Appropriate noise muffling equipment used • Equipment maintenance • Possible acoustic shroud, or other mitigation measures for pile driving will be evaluated if required	Low (mitigation measures will reduce noise from pile driving to below guidelines)	1-10 km	To the end of construction, approximately 3 years. Construction will take place 24 hours a day, seven days a week	Reversible	Noise impacts mainly occur in a developed area zoned for industrial use	Not significant (noise levels experienced at sensitive receptors are below guidelines, with the exception of annoyance related to pile driving. Mitigation measures will reduce this impact)
Operation and Maintenance								
Plant operation	• Increased noise levels. Modelling predicts values below assessment criteria at the nearest sensitive receptor	• Noise will be considered in equipment selection • Enclosure of equipment	Low	Onsite	Life of the Project (approximately 25 years). Plant operation will be around the clock	Reversible	Noise impacts occur in a developed area zoned for industrial use	Not significant (noise levels experienced at sensitive receptors are below guidelines)
Accidents and Malfunctions								
Flaring and Venting	• Increased noise levels over short durations. Noise levels expected to be high during these times	• No mitigation proposed. Flaring and venting not expected during regular operations	Low	1-10 km	Intermittent over the life of the Project	Reversible	Noise impacts occur in a developed area zoned for industrial use	Not significant
Decommissioning								
Activities similar to construction	• Increased noise levels similar to those experienced during construction • Pile driving will not be required	• - Plan will be developed prior to any works being undertaken	Low	1-10 km	Noise will be limited to the duration of decommissioning	Reversible	Noise impacts occur in a developed area zoned for industrial use	Not significant

6.2 Ecological Environment

6.2.1 Terrestrial Habitat

The terrestrial habitats on site consist mostly of mixed and coniferous forests and wetlands that support plant and wildlife species typical of the area. Initial clearing and site preparation was completed on the site in 2007, replacing the natural upland environments with a finished base pad in preparation for the installation of LNG plant facilities. Two wetlands were modified in part and one was infilled during site preparation; all necessary permits were attained from NSE and conditions adhered to. The only additional displacement of natural habitat will involve a small intrusion into forest stands in the south western corner of the site for a gas metering station and also on the south east corner of the site for a future lay down area.

Wetlands are an important feature of the terrestrial environment, performing biological, hydrological, social, cultural and economic functions. Wetlands support various species of plants and animals that depend on wetland functionality for survival. Bear Head LNG does not anticipate further alteration of any wetlands on site.

6.2.1.1 Boundaries and Threshold

Spatial Boundaries

The spatial boundary for the assessment of the terrestrial habitat is the Project site boundary as depicted in Figure 1-1.

Temporal Boundaries

Terrestrial habitats including wetlands, forested areas and other vegetation communities are present on the property site. There is, therefore, the potential for the Project to interact with the terrestrial habitat on a continuous, year-round basis.

Wetlands are most sensitive during spring and early summer when they are wet and easily physically disturbed. During this time, birds and herptiles use wetlands as breeding habitat and are also susceptible to disturbance. Other wildlife, particularly birds, may be more susceptible to construction activities in the spring and early fall when larger numbers of migrating birds feed and rest in productive areas. Wetlands will be least sensitive to construction activities during the winter.

Administrative Boundaries

Terrestrial habitats such as wetlands are regulated by the Activities Designation Regulation under Section 105(a) and 110(d) of the Nova Scotia *Environment Act*. As of 2011, the *Environment Act*

required that an approval be attained for any activities that may impact a wetland. These activities are referred to as wetland alterations and may include filling, draining, flooding or excavating (NSE, 2013). Vegetation species that are provincially or federally protected are listed under the Nova Scotia *Endangered Species Act* or under SARA.

Technical Boundaries

Information on terrestrial habitat including wetlands and vegetation was derived from the previously accepted environmental assessment (JWEL, 2004a) and by site visits completed in 2014 to verify the status of significant biological resources in the vicinity of the site, specifically to determine if conditions had changed since prior site activity.

Threshold

Evaluation criteria were used to determine whether a potential residual environmental effect on terrestrial habitats was significant, not significant or positive. The following is a summary of the criteria for each:

- A **significant adverse effect** would occur when there is a net loss of wetland or other terrestrial habitat functions of significant value. Furthermore, a significant adverse effect occurs when a population of a species is sufficiently affected causing a decline in abundance and/or change in distribution beyond which natural recruitment would not return to the population to its former level within several growing seasons.
- An **adverse effect** that does not exceed the above criteria is evaluated as not significant.
- A **positive effect** may enhance the quality, increase the species population/diversity, or increase the area of wetland.

A relative magnitude rating was established for terrestrial habitats. The following criteria are considered when determining the significance of an effect:

High: An environmental effect affecting a whole stock, population or definable group, or where a specific parameter is outside the range of natural variability determined through research and local knowledge over many seasons.

Medium: An environmental effect affecting a portion of population or one or two generations, or with rapid and unpredictable changes in a specific parameter so that it is temporarily outside the range of natural variability determined from local knowledge over many seasons.

Low: An environmental effect affecting a specific group of individuals in a population in a localized area, one generation or less, or where rapid and unpredictable changes in a specific parameter occur so that it is temporarily outside the range of natural variability determined through research and local knowledge over many seasons.

6.2.1.2 Interactions and Potential Effects

Construction and Commissioning

Terrestrial habitats may be lost as a result of the physical works associated with construction activity. Minimal clearing, grubbing and grading of the site, as well as the installation of facility equipment, may cause habitat loss as a consequence of tree removal, or possible erosion causing sedimentation of wetlands, which could potentially alter their hydrology.

Clearing and grubbing will result in disturbed soil surfaces leaving them without cover or vegetation. Exposed soil is susceptible to erosion from precipitation events and construction activities; erosion can result in sedimentation of terrestrial habitats and wetlands. Construction activities, including increased transportation near the site, also have the potential to generate dust. The deposition of dust on vegetation in the area may affect photosynthesis, respiration and transpiration. The resulting effects are potential decreased growth rates and reduced productivity of vegetation (Farmer, 1993).

During the construction phase, extensions to the existing security fencing will be installed along the property boundary to augment security. This fencing will be located along the property line and will likely pass through wetlands 2 and 6 and be located in close proximity to wetland 4. Its installation may cause some physical disturbance to these wetlands; however, it will provide increased security, inhibit unauthorized trespassing and keep large mammals away from the facility.

Operation and Maintenance

Everyday operation of the LNG facility has the potential to generate sediment and dust from increased usage of the roads. Increased sedimentation and dust can affect wetlands and other water bodies by altering their hydrology which, in turn, could affect surrounding vegetation and associated habitats. The orientation and layout of the infrastructure on site may alter local wind patterns which could cause minor damage to vegetation and possible tree blow-downs.

Accidents and Malfunctions

Accidents and malfunctions may occur at any time and could affect the terrestrial habitats on-site. Sedimentation and erosion can upset the regular hydrology of wetlands which may affect vegetation and local habitats. Spills or leaks of hazardous materials may result in contamination of local habitats, including wetlands. The eastern sedimentation pond is currently used to retain stormwater and surface water runoff from the facility. This pond is designed to allow for treatment through settling prior to manual discharge to Wetland 1. If a spill or leak occurs, the sedimentation pond is designed to catch the runoff; depending on the circumstances, contaminated runoff may be discharged to Wetland 1. A fire or explosion, should such an unlikely event occur, has the potential not only to damage terrestrial habitats within the property boundary, but may also spread to adjacent properties.

Decommissioning

Decommissioning activities are expected to present the same risks to terrestrial habitat as the construction and commissioning phases. Decommissioning could result in habitat loss or alteration of forested and vegetated areas as well as soil erosion and the sedimentation of wetlands. Potential effects to terrestrial habitat as a result of decommissioning will be considered and addressed in a decommissioning plan which would be developed when the facility nears the end of its life; this plan will incorporate relevant standards and regulations.

6.2.1.3 Mitigation

The Bear Head LNG Project site was carefully selected and developed to minimize interactions with sensitive ecological features and terrestrial habitats, particularly wetlands. In most cases there is a buffer area of approximately 30 m between the wetlands and the developed areas of the site. Recently, the orientation of the gas metering station was changed due to a concern that it had the potential to impact a small 0.06ha treed Black Spruce and Sphagnum slope/basin swamp discovered during a site visit in December 2014. Bear Head LNG does not anticipate any further wetland alteration on site. Minimal additional clearing and grubbing is required to complete construction.

During the installation of the perimeter fencing that may interact with wetlands 2, 4 and 6, the fence will not be buried (keyed in), thereby minimizing disturbance to the wetland. Construction will take place in winter, and vehicles will avoid the wetlands; small tracked vehicles may be used if conditions are acceptable. Any heavy equipment will skirt around the wetland only where feasible during installation. Clearing of vegetation along the fence line where it passes through the wetland habitat will be kept to a minimum (JWEL, 2004b).

Mitigation measures to protect terrestrial habitat, specifically wetlands will be detailed in the EPP. The EPP will include detailed procedures and provide information pertaining to erosion and sedimentation control, surface water control, and spill and leak management.

During construction and operation, erosion control methods will be applied wherever there is potential for surface water runoff, from rainfall and running water, to protect steep slopes and erodible soils. The amount and duration of exposed soil shall be kept to a minimum to prevent erosion at the source; this will reduce the amount of sediment to be managed. Sedimentation ponds will be established to capture runoff from the site and allow for settling of solid particles. Whenever possible, sediment controls will prevent sediment from leaving the site. The prudent maintenance of vegetation cover on site throughout the operational phase of the Project will help to minimize the effects of erosion and potential sedimentation of sensitive habitats.

The current design of the Bear Head facility incorporates secondary containment berms to restrict the distribution of chemicals and harmful liquids in the case of an accidental spill or leak. These have been

included in the design to minimize impacts on the terrestrial ecosystems on-site and adjacent to the site.

Construction activities and associated vehicle traffic will result in the generation of dust emissions which could have an effect on terrestrial habitat and vegetation. Mitigation measures will include the application of water or dust suppressants, the stabilization of exposed ground and will include speed limits to reduce the overall displacement of dust.

Care shall be taken to minimize the potential introduction of invasive plant species into the wetlands and other vegetated parts of the site. All equipment should be cleaned prior to being transported to the site to reduce the potential transfer of invasive species. Cleared areas should be re-vegetated with native species following construction activities.

6.2.1.4 Potential Residual Effects

Provided that the recommended mitigation measures are implemented throughout the life of the Project, no significant adverse residual environmental effects on the terrestrial habitat are likely to occur. Table 6-20 provides a summary of the potential residual environmental effects and recommended mitigation measures to be adhered to for terrestrial habitat protection.

6.2.1.5 Monitoring and Follow-up

Throughout the construction and operational phases of the Project, walk through assessments will be undertaken to observe and assess the general health of the terrestrial habitat as part of the environmental management program.

6.2.2 Terrestrial Fauna

Due to concern with biodiversity, ecological importance and regulatory protection for species at risk, terrestrial fauna have been identified as a VEC. This encompasses mammals (including bats), herptiles (amphibians and reptiles) and birds (both land and sea).

Table 6-20: Potential Environmental Effects Assessment Matrix for Terrestrial Habitat

Activity	Potential Effect	Mitigation	Significance Criteria					Residual Effect Significance
			Magnitude	**Geographic Extent**	**Duration/Frequency**	**Reversibility**	**Eco/Socio Context**	
Construction and Commissioning								
Clearing, grubbing and grading (majority of which is complete) Increased Road Traffic Construction and installation of equipment, infrastructure buildings and piping Onsite assembly of the liquefaction modules and construction of the LNG storage tanks Installation of Security Fencing along property boundary	• Habitat Loss or alteration* • Soil Erosion • Introduction of invasive plant species • Habitat alteration • Sedimentation of wetlands • Alteration of wetland hydrology • Dust generation • Direct mortality (associated with sensitive flora)	• Development and Implementation of EPP in general • Erosion and sedimentation controls as specified in EPP • Stormwater is to be retained in two sedimentation ponds and treated prior to discharge • Avoid wetland and terrestrial habitats whenever practical • Use of invasive non-native species for reclamation will be avoided • Use of water and dust suppressants as well as management practices outlined in the EPP to reduce dust generation	Low	Onsite (within property boundary)	To the end of construction, approximately 3 years. Construction hours will take place 24 hours a day, seven days a week	Reversible	The site has been affected by human activity and is located within an industrial park	Not significant
Operation and Maintenance								
Operation of LNG liquefaction trains, supporting infrastructure and LNG storage Increased Road Traffic Facility orientation can effect wind patterns	• Sedimentation of wetlands • Noise • Tree Blow Down	• Stormwater Management Plan • Erosion and sedimentation controls as specified in EPP • Surface water management as specified in EPP	Low	Onsite (within property boundary)	Life of the Project (approximately 25 years)	Reversible	The site has been affected by human activity and is located within an industrial park	Not significant
Accidents and Malfunctions								
Sedimentation or erosion, particularly during construction. Eastern sedimentation pond will receive runoff which is directed to Wetland 1 Spills or accidents. If required, the eastern sedimentation pond could receive contaminated runoff which is directed to Wetland 1 Accidental release of LNG, fires or explosions	• Sedimentation of wetlands • Alteration of wetland hydrology • Habitat loss or alteration* • Direct mortality (associated with sensitive flora)	• Stormwater is retained in sedimentation ponds and treated to government standards prior to discharge (through settling) • Emergency response and contingency plan as specified in the EPP • Spill management plan as specified in the EPP • Erosion and sedimentation controls as specified by EPP • Secondary containment walls	Low	Mostly onsite with the potential to spread to habitats nearby in the case of a fire, leak or sedimentation	Potential for accidents and malfunctions exists through construction, operation and decommissioning of the Project	Reversible	The site has been affected by human activity and is located within an industrial park	Not significant
Decommissioning								
Effects expected to be similar to construction. Activities would include: decommissioning of equipment, piping and buildings and restoration of terrestrial habitats. Impacts to be determined with development of a decommissioning plan	• Habitat Loss or alteration* • Soil Erosion • Introduction of invasive plant species • Habitat alteration • Sedimentation of wetlands • Alteration of wetland hydrology • Dust generation • Direct mortality (associated with sensitive flora)	• Mitigation measures similar to construction will be employed • Decommissioning Plan would be developed prior to decommissioning activities • Ensure cleared areas are re-vegetated where appropriate • Use of invasive non-native species for reclamation will be avoided	Low	Onsite (within property boundary)	Decommissioning strategy and duration to be determined prior to decommissioning	Reversible	The site has been affected by human activity and is located within an industrial park	Not significant

*Wetland alteration is not anticipated.

6.2.2.1 Boundaries and Threshold

Spatial Boundaries

The spatial boundary for the assessment of terrestrial fauna includes the Project area as shown in Figure 1-1. Both the developed and undeveloped portions of the site provide suitable habitat for a variety of mammals and herptiles. Bird species could frequent any location within the property boundary as well as associated marine areas.

Areas on the site may be critical to specific bird species. Birds are sensitive to disturbance around their nest sites. Some aquatic birds may gather in large numbers during their migration in feeding and resting areas. This assessment considers the potential effects on bird species within two distinct areas, i.e., the facility footprint and marine terminal, and the coastal waters along the approach route to the terminal site.

Temporal Boundaries

Most of the terrestrial fauna identified on site would be present in the area year-round. Some species would be particularly sensitive to disturbance during certain times of the year depending on migratory patterns, seasonal movement/hibernation or mating/breeding seasons.

Herptile species may be most sensitive to disturbance when they mate and lay eggs in wetland habitats during the spring and summer (April through July). Mammals are mostly non-migratory and may be present within the Project area year round, but some species may be more sensitive during harsh winter conditions or hibernation periods. Migratory birds may occupy habitats in the vicinity of the Project area during critical points in their life cycle, while others are residents of the site year-round. The breeding season, typically April to August for most species, can be the most critical period for bird species that are sensitive to habitat destruction and general disturbance (JWEL, 2004a).

Though temporal boundaries will vary for some species, this assessment will consider the potential effects of the Project on terrestrial fauna on a year-round basis.

Administrative Boundaries

In general, the Nova Scotia *Endangered Species Act* and the federal SARA offer legal protection to those species that are considered endangered, threatened, and vulnerable or of special concern.

All mammal species which are not designated as game animals or harvestable wildlife under the provincial *Wildlife Act* and Regulations are protected at all times of the year. Herptiles which are hunted for food are protected from hunting outside of defined seasons. Other herptiles have no legislative protection unless they are considered a species at risk or are found in a protected area. The NS provincial *Wildlife Act* and Regulations protect all non-game bird species that are not considered pests

(JWEL, 2004a). Migratory bird species are protected under the *Migratory Birds Convention Act*, 1994 which was most recently amended in 2010.

Technical Boundaries

Information regarding terrestrial fauna at or near the Bear Head LNG facility site was derived from the previously accepted environmental assessment, the knowledge of the consulting team, the ACCDC data base (ACCDC, 2014) and the Maritime Breeding Birds Atlas database (MBBA, 2013).

Data received from ACCDC identifies rare and/or endangered flora and fauna within both a 5km buffer area surrounding the Project site and a 100km buffer area. It also identifies whether any location sensitive species are known within 5km of the site.

Data from the Maritimes Breeding Bird Atlas database identifies bird species with the potential to breed in the vicinity of the Project site based on presence of suitable habitat. Bird species associated with both water habitats and terrestrial settings are presented in the data. Data was obtained for the 10 x 10 km survey area that encompasses the Project site.

Threshold

Evaluation criteria were used to determine whether a potential residual environmental effect on terrestrial fauna was significant, not significant or positive. The following is a summary of the criteria for each:

- A **significant adverse effect** occurs when the population of a species is sufficiently affected to cause a decline in abundance and/or a change in their distribution beyond which natural recruitment (such as reproduction and immigration) would not return the population to its former level within several generations. A significant adverse effect on sensitive/critical wildlife habitat is defined as any adverse environmental effect that results in a net loss of habitat function.
- An adverse effect that does not exceed the above criteria is evaluated as **not significant**.
- A **positive effect** occurs when Project activities help increase species populations and/or diversity or enhance habitat.

A relative magnitude rating was established for terrestrial fauna. The following criteria are considered when determining the significance of an effect:

High: An environmental effect affecting a whole stock, population or where a specific parameter is outside the range of natural variability determined by research and measurement based on local knowledge over several seasons.

Medium: An environmental effect affecting a portion of a population, or the environmental effect may be where there are rapid and unpredictable changes in a specific parameter so that it is temporarily

outside the range of natural variability determined by research and measurement based on local knowledge over several seasons.

Low: An environmental effect affecting a specific group in a population in a localized area, or where there are distinguishable changes in a specific parameter, but that parameter is within the range of natural variability determined by research and measurement and local knowledge over several seasons.

6.2.2.2 Interactions and Potential Effects

Construction and Commissioning

During the construction and commissioning phase, clearing and grubbing may result in habitat removal and fragmentation for various species of terrestrial fauna.

Herptiles and amphibians may be affected by the potential diminution of general function of wetlands and riparian areas as a result of clearing and grubbing, erosion and dust generation causing sedimentation and changes in hydrology. This may affect the general suitability of some wetlands as breeding habitats on the site.

Mammals may be adversely affected by the fragmentation and habitat loss due to clearing and grubbing and disturbance by human activity. The extension of the security fence around the Project site may inhibit the movement of larger mammals. It is likely that some mammal species will migrate to similar habitats nearby, away from the Project site.

Land birds may be impacted by the loss of nesting and foraging habitats due to clearing and grubbing activities. To avoid harming nesting birds, any additional clearing will be conducted prior to the breeding season (May 1st to August 31st).

In addition to habitat loss, temporary effects from the generation of construction noise may affect terrestrial fauna, especially birds and mammals. Construction noise can interfere with normal bird behavior such as feeding, breeding and migrating. Noise may create stressful nesting and living environments for wildlife which may result in species displacement, whereby individuals leave the Project area and settle in less favourable habitats.

Increased vehicle traffic associated with the construction of the LNG facility could adversely affect terrestrial fauna as a result of collisions with vehicles. It is expected that collisions would involve small mammals, various land bird and herptile species. Amphibians would be most sensitive to road kill during the spring when they migrate to nesting sites, whereas some reptile species, such as snakes, would be susceptible during early spring and late fall when they bask on roads to increase body temperature (JWEL, 2004a).

Operation and Maintenance

The operation of the facility will generate noise and related disturbance which may affect terrestrial fauna on or near the site. The degree of impact will differ between species; most will likely continue to occupy adjacent habitat.

The LNG facility will be equipped with lighting for safety and security purposes and flares will be installed for specific operational purposes. The facility, for example, will be equipped with two process flares, a warm flare and a cold flare in the northern portion of the site. A third totally enclosed ground flare will be installed at the marine terminal. These flares are not required under normal operating conditions, but are designed to dispose of streams released during start-up, shutdown and plant upsets or emergency conditions. Structures, flares and lighting all pose a risk of attraction and possible collision to aggregations of birds, particularly to migrating birds. Birds can be attracted to lights and can die either directly or from exhaustion when circling them for an extended period.

Since the flares will only be operational in specific circumstances and detailed flare management procedures will be in place, they are unlikely to have a significant adverse effect on migrating birds and bats.

Accidents and Malfunctions

Accidents and malfunctions during either the construction or operational phases could affect terrestrial fauna; accidents may include erosion and sedimentation, fires and explosions, and leaks or spills.

Erosion resulting in sedimentation is most likely to occur during the construction and commissioning phases of the Project due to increased ground disturbance. The site has been designed with two sedimentation ponds for stormwater and surface water runoff control during rain events or increased activity on the site. In the event that these controls fail or are not working properly, it is likely that nearby wetlands, which are home to various species of herptiles and sources of food for other terrestrial fauna, could be affected.

A fire or an explosion, should such an unlikely event occur, could result in terrestrial and wetland habitat loss or alteration and direct mortality of mammals, birds and herptiles.

A spill or leak of hazardous materials could also occur on or near the Bear Head LNG facility as chemicals used in the liquefaction process are transported, stored and used on site. A spill or leak could cause the pollution of terrestrial habitats, including wetlands.

Decommissioning

Decommissioning activities are expected to present the same risks to terrestrial fauna as during the construction and commissioning phase. Decommissioning could result in habitat loss or alteration, specifically of forested and vegetated areas, as well as soil erosion and sedimentation of wetlands; in

turn, this would adversely impact terrestrial fauna. Noise associated with the decommissioning of the LNG facility could also disturb terrestrial fauna. The potential effects to terrestrial fauna during decommissioning will be considered and addressed in a decommissioning plan which would be developed as the facility nears the end of its life. This plan would include references to the standards and procedures in place at the time. Depending on the future use of the site, the removal of the security fence and re-vegetation of the site could allow for the re-introduction and possible re-population of species that may then consider the site a suitable habitat, or may have inhabited the site prior to development.

6.2.2.3 Mitigation

During construction it is important to limit the extent of the Project footprint and temporary work areas as much as possible and to restrict clearing and grubbing to the necessary areas.

Dust prevention and abatement measures will be detailed in an EPP. Construction and operations staff will maintain proper housekeeping practices and ensure that food and garbage items are properly disposed of in a designated location to avoid attracting predators that may disturb or cause injury to wildlife and birds.

The enhanced security fence planned for installation around the perimeter of the property will be chain link; it will not be buried which will facilitate easy passage for small mammals. Although the fence may restrict access for medium to large sized mammals, there will be areas that will allow passage along the shoreline where the fence meets the water.

Vegetation clearing and grubbing must be avoided during the nesting season (May 1 to August 31). Buffer zones will be placed around nests that are found, and clearing will only take place outside these buffer zones. All construction equipment should contain noise-muffling devices to minimize noise disturbance. Noise and light disturbance will be minimized and restricted to those areas where it is necessary. The highest risk periods for migrating birds are from May 1 to mid-June and from mid-August to mid-October, the periods of peak spring and fall migration. Birds would be most at risk during foggy nights during these periods.

As part of an EPP and Stormwater Management Plan, specific methods will be discussed on how best to manage erosion and sedimentation during construction and operation of the facility. Frequent inspection of surface water runoff controls will be made to ensure that they function efficiently. Inspections will take place before and after heavy precipitation events to identify whether erosion and sedimentation control measures have failed; if failure occurs, repairs will be immediately undertaken. Details regarding ongoing maintenance, inspections and repair of erosion and sedimentation controls will be specified in the EPP. It is unlikely that a failure of erosion and sedimentation control measures would cause a significant effect on terrestrial fauna. Strict adherence to the procedures specified in the EPP and frequent inspections will inhibit the likely occurrence of a serious incident.

The current design of the Bear Head facility incorporates secondary containment berms to restrict the distribution of chemicals and harmful liquids in the case of an accidental spill or leak. These have been included in the design to minimize impacts on terrestrial fauna onsite.

An emergency response and contingency plan will be developed to address the unlikely event of a hazardous spill, fire or explosion. The plan will detail procedures to respond to incidents and to restrict the dispersion of fire fighting chemicals and any other spilled substances that may adversely affect terrestrial fauna.

Vehicle traffic associated with the operation of the facility is not expected to be high, and it is therefore unlikely that wildlife populations will be significantly affected by mortality as a result of collisions. The incidence, however, can be reduced by maintaining low speed limits on all roads.

Lighting at the facility during its operation will be on an as required basis to ensure for safe and effective operations. The facility will be lit during night hours to ensure proper usage of the security cameras and the general health and safety of personnel. Low intensity lighting will be used wherever possible, and mounted lighting will be kept at low heights to the extent possible to reduce interference with migratory birds and bats.

As discussed, there will be two land flares associated with the liquefaction trains; these flares will only be used under specific circumstances during plant operation or shut-down. A flare management plan will be developed as part of the EPP to reduce the overall effects that flares may have on terrestrial fauna, specifically birds and bats. This plan will include detailed procedures on overall flare operations and management, especially during adverse weather conditions. It will include detail on operating times (during daylight hours/night hours). It is not likely that the flare will have serious effects on birds and bats assuming mitigation measures are followed.

6.2.2.4 Potential Residual Effects

Provided that the recommended mitigation measures are implemented throughout the life of the Project, no significant adverse residual environmental effects on terrestrial fauna are likely to occur. Table 6-21 provides a summary of the potential residual environmental effects and recommended mitigation measures that will be adopted to protect terrestrial fauna.

6.2.2.5 Monitoring and Follow-up

As discussed, the EPP will include a specific flare management plan to mitigate the potential effects of flares on birds. In addition, a monitoring program may be developed to determine the overall residual effects of the flare on local bird and bat populations. Monitoring programs will be developed in consultation with NSE, NSDNR and the Canadian Wildlife Service.

Throughout the construction and operational phases of the Project, walk through assessments will be

completed to observe and assess the general health of terrestrial fauna located on site as part of the environmental management program.

Furthermore, any incident involving wildlife found on-site that appears to be in distress or agitated will be reported to NSDNR in order to ensure that the animal receives proper care. The interaction of construction and operations activities and staff with terrestrial fauna and their respective habitats will be kept to a minimum to decrease the likelihood of potential habituation.

6.2.3 Freshwater Fish and Fish Habitat

Freshwaters (lakes, ponds, and streams and open water wetlands) have the potential to support fish and other organisms which are important both ecologically and have social significance in supporting commercial, recreational and Mi'Kmaq fisheries. Although there are several streams in the vicinity of the Project site, they are all small, first order watercourses and for the most part not fish-bearing. The streams do not at present, or are not likely to support significant numbers of fish, and are not likely to support recreational, commercial or Mi'Kmaq fisheries. Overall, the probability of freshwater fish and fish habitat, as well as their fisheries, being affected by the Project is low, and possible impacts of the Project, although negative, are minor. Construction of the base pad was completed on the site in 2005-2006; its construction did not remove or impact the streams on site. Current and future indirect effects would be due to contributions from managed surface runoff into freshwater ditches and detention ponds, affecting the magnitude of flows and water.

6.2.3.1 Boundaries and Threshold

Spatial Boundaries

The spatial boundaries for the assessment of freshwater fish and fish habitat include the Project site indicated on Figure 1-1 and those portions of the streams that flow between the site and the Strait of Canso.

Temporal Boundaries

Fish habitat is nearly always present in streams. There is therefore always the potential that Project activities could impact both fish and fish habitat. Streams and associated fish habitat are most sensitive to contamination during low flow periods (July-August) and to physical damage from extreme flows in the spring summer and fall.

Table 6-21: Potential Environmental Effects Assessment Matrix for Terrestrial Fauna

Activity	Potential Effect	Mitigation	Significance Criteria					Residual Effect Significance
			Magnitude	**Geographic Extent**	**Duration/Frequency**	**Reversibility**	**Eco/Socio Context**	
Clearing, grubbing and grading (majority of which is complete) Increased vehicle traffic Construction and installation of equipment, infrastructure buildings and piping: Generation of noise, dust and light Onsite assembly of the liquefaction modules and construction of the LNG storage tanks: Generation of noise, dust and light Installation of Security Fencing along property boundary	• Habitat Loss • Fragmentation • Disturbance • Noise • Dust • Mortality • Erosion and Sedimentation of Wetlands (effecting herptiles) • Light (if required for construction activities)	• Implementation of EPP in general • Minimize area and ground disturbance and maintain connectivity between similar habitats where possible • Clearing and grubbing to be completed outside of breeding season • Avoid wetland habitats where practical • Erosion and sedimentation controls as specified by EPP • Minimize duration of noise disturbance. Use noise muffling devices on construction equipment where possible • Minimize use of lighting to greatest extent possible. Use low intensity lighting and install at low heights to avoid bird migratory paths	Low	Onsite (within property boundary)	To the end of construction, approximately 3 years Construction will take place twenty four hours a day, seven days a week	Reversible	The site has been affected by human activity and is located within an industrial park	Not significant
Operation and Maintenance								
Operation of LNG liquefaction trains, supporting infrastructure and LNG storage leading to increased personnel on site Increased vehicle traffic Increased security lighting and potential use of flares	• Disturbance of terrestrial fauna • Noise • Light causing disorientation for birds	• Implementation of EPP in general • Stormwater Management Plan • Ensure cleared areas are re-vegetated where appropriate • Flare Management Plan as part of EPP • Use noise muffling devices on equipment where possible • Minimize use of lighting to greatest extent possible. Use low intensity lighting and install at low heights to avoid bird migratory paths	Low	Onsite (within property boundary)	Life of the Project (approximately 25 years)	Reversible	The site has been affected by human activity and is located within an industrial park	Not significant
Accidents and Malfunctions								
Sedimentation or erosion, particularly during construction Spill, Leak or accident Accidental release of LNG, fires or explosions	• Sedimentation of wetland • Alteration of wetland hydrology • Habitat Loss • Direct Mortality	• Implementation of EPP including the following plans: • Emergency Response and Contingency Planning • Stormwater Management Plan • Spill Management Plan • Secondary containment walls	Low	Mostly onsite with the potential to effect fauna off the site in the case of a fire, leak or sedimentation spreading	Potential for accidents and malfunctions exists through construction, operation and decommissioning of the Project	Reversible	The site has been affected by human activity and is located within an industrial park	Not significant
Decommissioning								
Effects expected to be similar to construction. Impacts to be determined with development of a decommissioning plan	• Habitat Loss • Fragmentation • Disturbance • Noise • Dust • Mortality • Erosion and Sedimentation of Wetlands (effecting herptiles)	• Mitigation measures similar to construction will be employed • Decommissioning Plan would be developed prior to decommissioning activities • Ensure cleared areas are re-vegetated where appropriate • Use of invasive non-native species for reclamation will be avoided	Low	Onsite (within property boundary)	Decommissioning strategy and duration to be determined prior to decommissioning	Reversible	The site has been affected by human activity and is located within an industrial park	Not significant

Administrative Boundaries

Surface waters containing fish which are the object of aboriginal, commercial, and recreational fisheries may not be disturbed without authorization from DFO; Watercourse Alteration Approvals are required from NSE for any work undertaken in streams. A Coastal Approval may be required from NSDNR for activities undertaken in streams below the High Water Mark. If there were fish species at risk in the streams, approvals would be required under the Nova Scotia *Endangered Species Act* or SARA.

Technical Boundaries

Information on freshwater fish and fish habitat and recreational, commercial and Mi'Kmaq use was derived from the consultants' knowledge, recent site visits completed to verify the status of significant biological resources in the vicinity of the site and to assess water chemistry; and the environmental assessment undertaken in 2004 (JWEL, 2004a).

Threshold

Evaluation criteria were used to determine whether a potential environmental effect on freshwater fish and fish habitat was **significant**, **not significant** or **positive**. The following is a summary of the criteria for each:

A significant adverse effect would occur when there is a permanent net loss of freshwater habitat, or a release of a deleterious substance into a watercourse in sufficient quantity to kill fish or reduce the ability of the fish population to reproduce for one year or to induce a decline in abundance and/or change in distribution beyond which natural recruitment would not return to the population to its former level within several growing seasons.

High: A high effect would be one that removes all the fish from a site.

Medium: A medium effect one that induces a change (decline) of more than 2 standard deviations of the normal average abundance of a particular species.

Low: A low effect one that has demonstrable effects on fish and fish habitat, such as loss of fish, reduced condition, and removal of fish habitat, but does not meet the criterion for medium and high effects.

An **adverse effect** that does not exceed the above criteria is evaluated as not significant.

A **positive effect** may enhance the quality, increase the species population/diversity, or increase the area of freshwater fish habitat at the site, such as causing changes in the substrate or flow which make the environment more suitable for fish.

6.2.3.2 Interactions and Potential Effects

Construction and Commissioning

The pad for the facility has been prepared. Further physical activity at the site will involve above ground construction and the mechanical assembly of the proposed facilities. Some additional forest clearing may be required adjacent to the existing pad, but the impacts will be mitigated. Negligible impacts on water quality and existing watercourses in the vicinity of the site are expected.

Clearing and Grubbing

Most of the onsite work of this type is complete; therefore any additional areas of the watershed affected by new construction, e.g., construction of additional pads for buildings, or laydown areas, will have only a minor, if any, impact on the streams at the site. Any effects will be mitigated by appropriate runoff management and sedimentation controls. The degree of impact of these activities on fish and fish habitat etc. with mitigation applied is low, and any effects while highly localized will be short-term in nature.

Construction and Installation of Equipment, Buildings and Piping

Impacts from dust and air emissions generated by construction activities may be experienced in the streams at the site. Similarly, the additional clearing and grubbing that is necessary will have minor, if any, impact, on fish, fish habitat, and associated fisheries in the two intermittent streams on site. Mitigation will be in place, and the impacts of these activities on fish, fish habitat and fisheries is likely to be negligible.

Assembly of Liquefaction Modules and Construction of Storage Tanks

Impacts from dust and air emissions generated by construction activities may be experienced in the streams on site. Similarly the additional clearing and grubbing that is necessary will have minor, if any, impact on fish, fish habitat, and associated fisheries. Mitigation will be in place, and the impacts of these activities on fish, fish habitat and fisheries is likely to be negligible.

Operation and Maintenance

The site will be operated to minimize dust from the use of roads, contaminant releases into runoff, and air emissions. Contaminant releases may include oil and grease from equipment and vehicle operations, salt from de-icing in winter, and reject and backwash from the demineralisation system. Freshwater fish habitat will not be affected by activities related to the marine terminal and shipping.

Routine activities include the operation of the LNG liquefaction trains, supporting infrastructure and LNG storage. The principal impacts from these activities will be changes to the runoff regime and consequent flows (peak and minimum flows) in the streams; these will be moderated by the execution

of a runoff management system and the monitoring of changes in the chemical characteristics of the runoff. Any impacts from the residual contamination of runoff from site operations on fish are likely to be minor. The site will not be available for use by locals for recreational purposes or for Mi'Kmaq use; the site, however, was not a prime area for these uses in the past. Operations may result in air emissions which could in turn lead to the contamination of waters, but the effects, if any, are expected to be minor. Impacts from dust and air emissions generated by construction activities may be experienced in watercourses at the site. Mitigation will be in place for these types of activities and the overall effect will be minor.

Use of deicing chemicals such as road salt can potentially enter surface waters and change conditions. The overall amounts that might be used cannot be predicted; however, the areas of open surface are relatively small in relation to the area of the Project site and it is expected that any de-icing chemicals used will be diluted significantly before entering the two small freshwater streams.

Accidents and Malfunctions

Accidents and malfunctions that may occur during construction or the operation of the LNG facility could affect fish habitats and freshwater fish at the site. Accidental releases of hydrocarbons and fires, and the emergency responses to them can generate contaminants in water and fluid flows which may enter the runoff management system and potentially contaminate the streams.

Sedimentation or Erosion

Failure due to erosion of developed surfaces at the site, or structural failure of stormwater management ponds under extreme flows, can damage streams exiting the site. The pad has been designed and built such that failure is unlikely during exposure to extreme runoff events. Normal use of settling ponds and prompt use of remediation measures to repair damage to erodible surfaces will reduce the potential for sedimentation effects on streams and fish habitat.

Spills or Accident

Of the two freshwater streams at the site, the one located to the southeast drains most of the pad and will be most seriously impacted in the event of any liquid spills and water used in cleanup of accidental spills.

Accidental Releases of LNG, Fires or Explosion

The structural failure of LNG storage tanks and the responses to such an eventuality could overwhelm the capacity of adjacent riparian areas to channel flow, and could disrupt the stream structure for varying periods of time. The LNG itself will vapourize in the containment basin and will not reach the streams and fish habitat. Accidental releases, fires, etc. and fluids used in emergency responses can

generate contaminants and water and fluid flows which may enter the runoff management system and contaminate the streams at the site.

Decommissioning

Decommissioning activities are expected to present the same risks to freshwater fish and fish habitat as during the construction and commissioning phase. Impacts from dust and air emissions generated by decommissioning activities may be experienced in watercourses at the site. Mitigation will be in place for these types of activities and the overall effect will be minor.

6.2.3.3 Mitigation

The Bear Head LNG Project site and facility components have been carefully sited to minimize interactions with freshwater fish and fish habitat and to avoid the two small first order water courses. Both the present, and proposed, configuration of the site includes measures to minimise suspended sediments and consequential changes to flow regimes in the streams. Further construction and commissioning of the Project will not change the existing environmental protocols, which have been in place and appear to have been working successfully to mitigate adverse effects on the streams. Further mitigation measures for impacts on the freshwater fish and fish habitat will be detailed in the updated EPP. This plan will include detailed procedures and information pertaining to erosion and sedimentation control, surface water control and spill and leak management procedures.

The current design of the Bear Head LNG facility incorporates secondary containment berms for restricting the distribution of chemicals and harmful liquids in the case of an accidental spill or leak. These have been included in the design to minimize impacts on marine ecosystems including freshwater fish and fish habitat on site and adjacent to the property.

6.2.3.4 Potential Residual Effects

Provided that the recommended mitigation measures are implemented throughout the life of the, no significant adverse environmental effects on the freshwater fish and fish habitat are expected. Table 6-22 provides a summary of the potential environmental effects and recommended mitigation measures to be taken for the protection of freshwater fish and fish habitat, and recreational, commercial and Mi'Kmaq fisheries.

6.2.3.5 Monitoring and Follow-up

Effluent, storm water and surface water monitoring will take place in accordance with the EPP to ensure that TSS concentrations meet regulatory standards.

Table 6-22: Potential Environmental Effects Assessment Matrix for Freshwater Fish and Fish Habitat

Activity	Effect	Mitigation	Significance Criteria					Significance
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Eco/Socio Context	
Construction and Commissioning								
Clearing, grubbing and grading (majority of which is complete) Road Traffic Construction and installation of equipment, infrastructure buildings and piping Onsite assembly of the liquefaction modules and construction of the LNG storage tanks Installation of Security Fencing along property boundary	• Habitat Loss or alteration • Habitat alteration of streams; washout during extreme flows. • Sedimentation of streams • Alteration of stream hydrology	• EPP • Spill Management Plan • Stormwater is retained in two sedimentation ponds and treated prior to discharge • Dust management	Low	Onsite	1/2	Reversible	Developed Area	Not significant
Operation and Maintenance								
Operation of LNG liquefaction trains, supporting infrastructure and LNG storage Road Traffic Facility structures can effect wind patterns	• Sedimentation of streams from dust & erosion • Washout during extreme flows • Change in hydrologic regime	• Stormwater Management Plan • Erosion and sediment controls as specified in EPP • Surface water management as specified in EPP	Low	Onsite	1/25	Reversible	Developed Area	Not significant
Accidents and Malfunctions								
Spills or accidents. Potential of contaminants to enter streams Accidental release of LNG, fires or explosions	• Incidences of severe erosion causing sedimentation and structural changes to streams • Failure of stormwater management structures • Fluid losses; • Contaminants from fires and firefighting contaminate streams	• Stormwater is retained in sedimentation ponds and treated prior to discharge (through settling) • Emergency response and contingency plan as specified in the EPP • Spill management plan as specified in the EPP • Erosion and sedimentation controls as specified by EPP • Secondary containment walls	High	Onsite	1/100	Reversible	Developed Area	Not significant
Decommissioning								
Effects expected to be similar to construction. Activities would include: decommissioning of equipment, piping and buildings and restoration of terrestrial habitats. Impacts to be determined with development of a decommissioning plan	• Habitat Loss or alteration • Habitat alteration of streams; washout during extreme flows. • Sedimentation of streams • Alteration of stream hydrology	• Decommissioning Plan • EPP • Spill Management Plan • Stormwater is retained in two sedimentation ponds and treated prior to discharge • Avoid streams • Dust management	Low	Onsite	1/2	Reversible	Developed Area	Not significant

6.2.4 Species at Risk

Information on SAR that may inhabit the Project site is detailed in Section 4.3. Terrestrial SAR which have been recorded within 5 km of the site include 2 rare plants, 6 species of birds and the wood turtle; the latter is not likely to be found on the Bear Head site. There are 6 additional avian species at risk that are found in the near shore areas of the Scotian Shelf, but none are known to breed in Chedabucto Bay. With the exception of the Ipswich Sparrow, they may occur in the Project area from time to time. Marine SAR includes cetaceans, sea turtles and various species of marine fish. The following sections focus on the terrestrial SAR, particularly the two plant species on site.

6.2.4.1 Boundaries and Thresholds

Spatial Boundaries

The spatial boundary for the assessment of SAR, particularly the Southern Twayblade and Northern Comandra, is the Project area (Figure 1-1). Bird species considered at risk could frequent both the Project site and the lands and waters at some distance from the Project site.

Temporal Boundaries

The two identified plant species are present on site year round. Other species of concern may or may not be present. The bird species are considered migratory and may occupy habitats in the vicinity of the Project site during critical points in their life cycle, while others may be residents of the site, or adjoining lands, year-round. The breeding season, typically April to August, can be the most critical period for bird species which are sensitive to habitat destruction and general disturbance (JWEL, 2004a).

Though temporal boundaries will vary by species, this assessment will consider the potential effects of the Project on SAR on a year-round basis.

Administrative Boundaries

The Nova Scotia *Endangered Species Act* and the federal SARA offer legal protection to species that are considered endangered, threatened, and vulnerable or of special concern. Birds which are hunted for food are protected from hunting outside of defined seasons while others, not considered species at risk, have no legislative protection unless found in a protected area. The NS provincial *Wildlife Act* and Regulations protect all non-game bird species that are not considered pests (JWEL, 2004a). Migratory bird species are protected under the *Migratory Birds Convention Act.*

Information regarding SAR at or near the Bear Head LNG facility site was derived from the previously accepted environmental assessment, knowledge of the consulting team, a review of the ACCDC data

base (ACCDC, 2014). Specific information on the distribution and abundance of birds has been obtained through the Maritime Breeding Birds Atlas database (MBBA, 2013). ACCDC identifies confirmed occurrences of rare and/or endangered flora and fauna in Nova Scotia, and a report is provided which shows occurrences within a requested radius of a site, typically 5 km or 100 km.

The Maritimes Breeding Bird Atlas database identifies bird species with the potential to breed in the vicinity of the Project site based on observations by birders in the area. Bird species associated with both water habitats and terrestrial settings were presented in the data. Data was obtained for the 10 x 10 km survey area that includes the Project site.

Threshold

Evaluation criteria were used to determine whether a potential residual environmental effect on SAR was significant, not significant or positive. The following is a summary of criteria for each:

A **significant adverse effect** occurs when the population of a species is sufficiently affected to cause a decline in abundance and/or change in distribution beyond which natural recruitment (such as reproduction and immigration) would not return the population to its former level within several generations. A significant adverse effect on sensitive/critical wildlife habitat is defined as any adverse environmental effect that results in a net loss of habitat function.

An adverse effect that does not exceed the above criteria is evaluated as **not significant**.

A **positive effect** occurs when Project activities help increase species populations and/or diversity or enhance habitat.

A relative magnitude rating was also established for Species at Risk. The following criteria are considered when determining the significance of an effect:

High: An environmental effect affecting a whole stock, population or definable group of organisms, or where a specific parameter is outside the range of natural variability determined from local knowledge over many seasons.

Medium: An environmental effect affecting a portion of population or one or two generations, or the environmental effect may be where there are rapid and unpredictable changes in a specific parameter so that it is temporarily outside the range of natural variability determined from local knowledge over many seasons.

Low: An environmental effect on: a specific group of individuals in a population in a localized area; one generation or less; or where there are distinguishable changes in a specific parameter but the parameter is within the range of natural variability determined from local knowledge over many seasons.

6.2.4.2 Interactions and Potential Effects

Construction and Commissioning

During construction and commissioning, further clearing and grubbing of vegetation could result in habitat loss and potential fragmentation of habitat for species of terrestrial flora that are considered at risk or sensitive in the area.

The potential for sedimentation of wetlands is greater during this phase because larger areas of soil will be exposed and physically disturbed. Sensitive species and SAR include Northern Comandra and Southern Twayblade; these species may be affected by any increase flow of sedimentation to wetlands from project works. Appropriate sediment control measures and the maintenance of a forested buffer around both adjoining wetlands and the identified plant communities will prevent impacts to these species.

Potential habitat for the Four-toed Salamander, a species at risk, exists in one of the wetlands though the salamander has not been seen in the Project area. Should Project activities adversely impact the wetland during construction, this could reduce the likelihood of finding this species on site.

Woodland birds, including those at risk or of concern, may be impacted by the loss of nesting and foraging habitats due to additional clearing and grubbing activities. Measures prescribed by Environment Canada (Canadian Wildlife Service), such as clearing outside breeding season (May 1st to August 31st) will be employed throughout further construction in undisturbed environments to avoid disturbing nesting birds.

In addition to habitat loss, temporary effects from the generation of construction noise may also affect SAR, especially listed birds. Construction noise can interfere with normal bird behavior such as feeding, breeding and migration.

Operation and Maintenance

An important concern during the operation of the facility is the potential impact to SAR birds as a result of noise, lights and flares. Birds that are at risk could also be affected by increased vehicle traffic and by the sedimentation of wetlands or physical disturbance associated with normal operating activities.

The LNG facility will be equipped with lighting for safety and security purposes. Security cameras require lighting to view the facility operations at night. The facility lighting may attract migratory birds;

and cause disorienting effects which may cause collisions leading to mortality. Facility lighting and noise generated from operation may also disturb foraging routines for any bats in the area.

Three flares will be located on the Bear Head LNG site; two will be located within the terrestrial developed footprint and the third, an enclosed ground flare, will be located near the marine terminal. Flares have similar effects to lights in relation to migratory birds; they can also cause mortality to birds and bats that are attracted to them. Bats aren't necessarily attracted to the lights and flares, but could be impacted if they accidentally stray into the flare along their flight path. The flares are not required under normal operating conditions, but are designed to dispose of streams released during start-up, shutdown, and plant upsets or emergency conditions. The land flares may attract migratory birds and bat species which may be considered at risk; although enclosed, the marine flare on site may still attract sensitive or at risk seabirds and coastal waterfowl.

Avian species at risk using the coastal waters at or in proximity to the Project site, or further out into the waters of Chedabucto Bay, are unlikely to interact significantly with the marine facilities associated with the Project.

Accidents and Malfunctions

Accidents and malfunctions resulting from the construction or operational phases of the LNG facility that could affect identified SAR are likely to involve erosion and sedimentation, fires and explosions, or leaks or spills.

Erosion leading to sedimentation would most likely occur during the construction and commissioning phase due to increased ground disturbance. The site has been designed with two sedimentation ponds for stormwater and surface water; these accommodate runoff control during rain events or increased activity on the site. In the case that these controls fail or are not working properly, it is likely that nearby wetlands and streams, and associated habitat for the two listed species of plants, could be affected.

There is potential for fires and explosions associated with accidental releases of LNG while the facility is in operation. Fire or an explosion could result in terrestrial habitat loss, or in the direct destruction of sensitive habitat and plant groupings.

A spill or leak of hazardous materials could also occur on or near the Project site as chemicals used throughout the liquefaction process will be transported and stored on site. Comparable to the effects of fires and explosions, spills and leaks could cause pollution of terrestrial habitats, including wetlands, which support the identified SAR flora.

Decommissioning

Decommissioning activities are expected to present the same risk to SAR as the construction and

commissioning phase. Decommissioning could result in habitat loss or alteration of forested and vegetated areas, and cause soil erosion and sedimentation of wetlands which could adversely impact the identified flora at risk. Noise associated with decommissioning could disturb birds at risk if they are present in adjacent forest and wetland areas. A decommissioning plan will be developed when the facility nears the end of its life; this plan would include references to the standards and procedures in place at the time. Depending on the future use of the site, a buffer area may be required around the flora at risk to ensure their protection from physical disturbance.

6.2.4.3 Mitigation

Mitigation measures will be similar to those proposed for terrestrial habitat and terrestrial fauna. During construction it is important to reduce the project footprint and temporary work areas as much as possible and restrict clearing and grubbing to areas absolutely necessary to carry out the Project. Physical disturbance to wetland and terrestrial habitats will be minimized where possible. A forested buffer area approximately 30 m wide will be maintained around the Southern Twayblade and Northern Comandra populations and construction or operational activities should not be undertaken within this area.

Vegetation clearing and grubbing must be avoided during the nesting season (May 1 to August 31) to protect all birds including those at risk. Buffer zones will be placed around any nests that are found, and clearing will only occur outside of this zone. All construction equipment should contain noise-muffling devices to minimize noise disturbance. Noise and light disturbance is to be minimized and restricted to areas only where it is necessary.

As part of an EPP and Stormwater Management Plan, specific methods will be adopted to manage erosion and sedimentation during both construction and operation of the facility. Frequent inspection of surface water runoff controls will be made to ensure their efficient functioning. Inspections will occur before and after any heavy precipitation events to identify whether erosion and sedimentation control measures have failed, and repairs will be immediately undertaken if required. Details regarding ongoing maintenance, inspections and repair of erosion and sedimentation controls will be specified in the EPP. It is unlikely that a failure of erosion and sedimentation control measures would cause a significant effect on SAR identified species; strict adherence to the procedures specified in the EPP and frequent inspections will inhibit the likely occurrence of a serious incident.

The current design of the Bear Head facility incorporates secondary containment berms to restrict the distribution of chemicals and harmful liquids in the case of an accidental spill or leak. These have been included in the design to minimize impacts on the terrestrial and marine ecosystems on-site and adjacent to the property, including SAR.

An emergency response and contingency plan will be developed to address the unlikely event of a hazardous spill, fire or explosion. This plan will detail procedures to respond to these incidents and to

restrict the dispersion of fire fighting chemicals and any other spilled substances that may adversely affect the identified SAR.

Operational lighting at the facility will be on an as required basis. The facility will be lit during night hours to ensure proper usage of security cameras and to ensure the general health and safety of personnel. Low intensity lighting should be used wherever possible, and mounted lighting should be kept low to reduce interference with migratory birds, including those of special concern.

There will be two land flares associated with the liquefaction trains and one flare associated with the marine terminal. These flares will only be in use under specific operational circumstances. A flare management plan will be developed as part of the EPP to reduce the overall effects that that flares may have on various species including SAR. It is not likely that the flare will have serious effects on SAR if identified mitigation measures are followed. The flares will be operational throughout the life of the Project so minimal residual effects could result.

6.2.4.4 Potential Residual Effects

Provided that the recommended mitigation measures are implemented throughout the life of the Project, no significant adverse residual environmental effects on SAR are likely to occur. Table 6-23 provides a summary of the potential residual environmental effects and recommended mitigation measures to be taken for protection of at risk and sensitive species on the Project site.

The marine operations associated with the Bear Head LNG Project, including the transport of LNG through coastal waters, will be conducted to high environmental standards; no harmful interactions with marine life or marine SAR are expected.

6.2.4.5 Monitoring and Follow Up

An annual inspection of the site by an appropriately qualified ecologist will be undertaken to observe the general abundance and health of the Southern Twayblade and Northern Comandra in their respective wetland habitats. It will be pertinent to determine whether significant population changes occur, and whether or not these changes could be related to Project activities. Similar studies may be undertaken to observe and record bird species in and around the site to determine whether the variety of species has changed and if any new SAR are encountered.

The EPP will include a specific flare management plan to help mitigate the potential effects that the flare may have on birds, particularly SAR. Appropriate monitoring programs will be developed in consultation with NSE, NSDNR and the Canadian Wildlife Service.

Table 6-23: Potential Environmental Effects Assessment Matrix for Species at Risk

Activity	Potential Effect	Mitigation	Significance Criteria					Residual Effect Significance
			Magnitude	**Geographic Extent**	**Duration/Frequency**	**Reversibility**	**Eco/Socio Context**	
Construction and Commissioning								
Clearing, grubbing and grading (majority of which is complete) Increased vehicle traffic Construction and installation of equipment, infrastructure buildings and piping: Generation of noise, dust and light Onsite assembly of the liquefaction modules and construction of the LNG storage tanks: Generation of noise, dust and light Installation of Security Fencing along property boundary	• Habitat Loss • Fragmentation • Disturbance • Noise • Dust • Mortality • Erosion and Sedimentation of Wetlands (effecting herptiles) • Light (if required for construction activities)	• Implementation of EPP in general • Minimize area and ground disturbance and maintain connectivity between similar habitats where possible • Ensure buffer area is established surrounding Southern Twayblade populations • Clearing and grubbing to be completed outside of breeding season • Avoid wetland habitats where practical • Erosion and sedimentation controls as specified by EPP • Minimize duration of noise disturbance. Use noise muffling devices on construction equipment where possible • Minimize use of lighting to greatest extent possible. Use low intensity lighting and install at low heights to avoid bird migratory paths	Low	Onsite (within property boundary)	To the end of construction, approximately 3 years Construction hours will take place 24 hours a day, seven days a week	Reversible	The site has been affected by human activity and is located within an industrial park	Not significant
Operation and Maintenance								
Operation of LNG liquefaction trains, supporting infrastructure and LNG storage leading to increased personnel on site Increased vehicle traffic Increased security lighting and potential use of flares	• Disturbance of terrestrial fauna • Noise • Light causing disorientation for birds	• Implementation of EPP in general • Stormwater Management Plan • Ensure cleared areas are re-vegetated where appropriate • Flare Management Plan as part of EPP • Use noise muffling devices on equipment where possible • Minimize use of lighting to greatest extent possible. Use low intensity lighting and install at low heights to avoid bird migratory paths	Low	Onsite (within property boundary)	Life of the Project (approximately 25 years)	Reversible	The site has been affected by human activity and is located within an industrial park	Not significant
Accidents and Malfunctions								
Sedimentation or erosion, particularly during construction Spill, Leak or accident Accidental release of LNG, fires or explosions	• Sedimentation of wetland • Alteration of wetland hydrology • Habitat Loss • Direct Mortality	• Implementation of EPP including the following plans: • Emergency Response and Contingency Planning • Stormwater Management Plan • Spill Management Plan • Secondary containment walls	Low	Onsite (within property boundary)	Potential for accidents and malfunctions exists through construction, operation and decommissioning of the Project	Reversible	The site has been affected by human activity and is located within an industrial park	Not significant
Decommissioning								
Effects expected to be similar to construction. Impacts to be determined with development of a decommissioning plan	• Habitat Loss • Fragmentation • Disturbance • Noise • Dust • Mortality • Erosion and Sedimentation of Wetlands (effecting herptiles)	• Mitigation measures similar to construction will be employed • Decommissioning Plan would be developed prior to decommissioning activities • Ensure cleared areas are re-vegetated where appropriate • Use of invasive non-native species for reclamation will be avoided	Low	Onsite (within property boundary)	Decommissioning strategy and duration to be determined prior to decommissioning	Reversible	The site has been affected by human activity and is located within an industrial park	Not significant

6.3 Ecological Environment: Marine

A wide range of marine and estuarine animals and plants utilize marine waters and the seabed, both in the immediate Project area and in the waters of the Strait of Canso and Chedabucto Bay. Not only does the environmental assessment undertaken in 2004 recognize the importance of this marine regime, but Bare Head LNG, as indicated in Sections 4.6-4.10 has updated the marine biological data base. The marine environment, however, is not the primary focus of this registration to NSE. As indicated in Section 1.9, the proponent has met with the Canadian Environmental Assessment Agency, with DFO, with Transport Canada and with others, has provided information on the parameters of the revised Project and a determination has been made that CEAA no longer applies and that all approvals and authorizations pertaining to the marine environment are either in place or are in the process of being updated.

In the course of reviewing both the previously approved environmental assessment and the updated data compiled through the latter half of 2014 and early 2015, the following marine VECs were identified: marine habitat and marine life. These were subject to analysis, and Tables 6-24 and 6-25 provide the results. There will be no significant impact from the proposed Project on the marine environment. The considerable work done to update the marine data bases, however, remains of relevance as it will provide an invaluable reference in the preparation of subsequent documentation including the marine terminal EPP.

6.4 Socio-Economic Environment

The socio-economic environment encompasses the communities, the residents and businesses that will accommodate and support the Bear Head LNG facility. The Municipality of the County of Richmond in collaboration with others, including the Province of Nova Scotia, has already designated the lands at Point Tupper for industrial development. The proposed use is appropriate to the land use designation. The consequences of the Project's further construction, commissioning and operation will have consequences for the surrounding communities, the Province and beyond. The more significant of these are referenced in the sections that follow. Table 6-26 provides an overview of the socio economic consequences of the proposed Project at the end of the section.

Table 6-24: Potential Environmental Effects Assessment Matrix for Marine Habitat

Activity	Effect	Mitigation	Significance Criteria					Significance
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Eco/Socio Context	
Construction and Commissioning								
Construction of Marine Terminal including vessel berth and trestles Installation of dolphins and associated pile driving Construction of marine equipment and vessels	• Habitat loss or alteration • Sedimentation and seabed erosion • Sediment and water contamination • Underwater Noise	• EPP • Spill Management Plan	Medium	Onsite	Short-term	Reversible	Undeveloped Area	Not significant
Operation and Maintenance								
Increased marine traffic with operation of terminal including tankers and support vessels Marine Flare operation LNG Pipeline Operation	• Sediment and water contamination • Lights and Flare	• EPP • Spill Management Plan • Marine Safety Plan	Low	Onsite	Duration of Project	Reversible	Undeveloped Area	Not significant
Accidents and Malfunctions								
Spill or Leak – from tankers and vessels Accidental release of LNG, fires or explosions	• Sediment and water contamination • Habitat alteration	• EPP • Spill Management Plan • Marine Safety Plan • Secondary containment walls (land based portion of facility)	Low	Onsite	1/100	Reversible	Undeveloped Area	Not significant
Decommissioning								
Effects expected to be similar to construction. Activities would include: decommissioning of equipment, piping and buildings and restoration of disturbed coastline and marine habitat if possible. Impacts to be determined with development of a decommissioning plan	• Habitat loss or alteration • Sedimentation and seabed erosion • Sediment and water contamination	• EPP • Spill Management Plan	Low	Onsite	Short-term	Reversible	Undeveloped Area	Not significant

Table 6-25: Potential Environmental Effects Assessment Matrix for Marine Life

Activity	Effect	Mitigation	Significance Criteria					Significance
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Eco/Socio Context	
Construction and Commissioning								
Construction of Marine Terminal including vessel berth and trestles Installation of dolphins and associated pile driving Construction of marine equipment and vessels	• Underwater Noise • Collisions and Entanglement • Hydrocarbon & Contaminant Spills	• EPP • Spill Management Plan • Marine Mammal / Sea Turtle Monitoring	Low	On-site	Short-term	Reversible	Undeveloped Area	Not significant
Operation and Maintenance								
Increased marine traffic with operation of terminal including tankers and support vessels Marine Flare operation LNG Pipeline Operation	• Lights and Flare attract / harm seabirds • Collisions of Tankers with Whales & Sea Turtles	• EPP • Spill Management Plan • Marine Mammal / Sea Turtle Monitoring	Low	1-10 km	Duration of Project	Reversible	Undeveloped Area	Not significant
Accidents and Malfunctions								
Spill or Leak – from tankers and vessels Accidental release of LNG, fires or explosions	• Oiling of coastal birds. • Spill response effects	• EPP • Spill Management Plan • Secondary containment walls (land based portion of facility) • Emergency Response Plan for coastal colonies	Low	1-10 km	1/100	Reversible	Undeveloped Area	Not significant
Decommissioning								
Effects expected to be similar to construction. Activities would include: decommissioning of equipment, piping and buildings and restoration of disturbed coastline and marine habitat if possible. Impacts to be determined with development of a decommissioning plan	• Habitat loss or alteration • Sedimentation and seabed erosion • Sediment and water contamination	• EPP • Spill Management Plan • Marine Mammal / Sea Turtle Monitoring	Low	On-site	Short-term	Reversible	Undeveloped Area	Not significant

6.4.1 Key Settlements, Land Use, Community Services and Infrastructure

A description of key settlements, land use, community services and infrastructure in the Point Tupper, Port Hawkesbury and Richmond County areas is provided in Section 4.10.1. To facilitate the analysis land use, community services, traffic demands, medical and emergency facilities, accommodations, entertainment, and related infrastructure have been grouped and considered together; these components are relevant and important to the communities, whose services and infrastructure contribute to the successful accommodation of a new industry and future socio-economic growth in the Strait region. Although the Bear Head LNG site has been partially developed and is located within an industrial park zoned for heavy industrial use, its further construction and subsequent operation will have an effect on many facets of the community and its infrastructure and services.

6.4.1.1 Boundaries and Threshold

The spatial boundaries of potential impact include the Project site as shown in Figure 1-1, the communities surrounding the Strait of Canso and the Municipality of the County of Richmond. Indeed, the construction and operation of the Project will impose demands on the services and facilities provided in these areas, but at the same time the Project will also support the further economic well being of these areas both directly and indirectly. The Project dimensions that may have impact on these factors include, but are not limited to, the development and operation of the facility itself, project labour, the direct and indirect spending power of that labour and their need for services; the proponent's need for services and goods locally and beyond; and travel patterns associated with the Project through both construction and operation.

Work started at the site in 2004. The Project site has been cleared and a large portion of the site work completed. Construction of the plant and associated marine terminal is predicted to take place over the next 3 years and the operation of the facility is predicted to continue for at least 20 years. The demands on land use, services and infrastructure by Bear Head LNG will change over time, but there will be demands throughout construction, plant operation and ultimate decommissioning that will have consequences for the regional area.

The Project site is located in the Point Tupper Industrial Park in the Municipality of the County of Richmond. Port Hawkesbury is the nearest large town and will be the community that provides many of the services and accommodates a large percentage of the labour force during the plant's construction and its subsequent operation.

The following factors need to be taken into account to determine whether or not a significant effect on this group of considerations could occur:

- Whether or not the proposed facility poses an inordinate demand on the social infrastructure of the surrounding communities with respect to schooling, medical services, municipal services

etc.;

- Whether or not there is excessive demand on the local emergency response capacity and health care system;
- Whether or not there is an excessive demand on local accommodations, entertainment and food establishments;
- Whether the road networks and other transportation systems can accommodate the increased demands being placed upon them;
- Whether or not there is a demand for new accommodations that put stress on local property markets; and
- Whether demands for potable and process water can be accommodated without posing a threat to supplies to neighbouring areas, particularly the Town of Port Hawkesbury that draws its water from Landrie Lake.

If a demand on a service can be accommodated without undue pressure on the supplying or responsible agency, it is not considered to be **significant**.

A **positive effect** is one that:

- Increases the potential for economic growth in the study area and Nova Scotia;
- Improves community infrastructure (including medical and health care services, food and entertainment, roads, and municipal infrastructure); and
- Elicits broad social support.

6.4.1.2 Interactions and Potential Effects

Construction

The Project site is zoned for industrial use in the Point Tupper Industrial Park and is located some distance from the nearest residence and from other industrial facilities with a significant daily labour force. The nearest industrial activities include a wind farm and the NSPI ash dump. Construction activity is therefore unlikely to cause disturbance to the abutting land uses. The LNG facility will be developed in accordance with all municipal land use planning requirements. Construction traffic will certainly add to the volumes that currently use Industrial Park Road from Trunk 4, but as detailed in section 4.10.1.7, the traffic volumes using these roads have fallen over the past decade; there is therefore capacity within the system to accommodate the construction traffic that is anticipated without posing an unwarranted burden on the road authority.

As indicated in Section 2.9, it is anticipated that up to 700 jobs will be generated through construction.

This labour force will be drawn from a wide catchment and many employees will drive to the site individually or in car pools; some may seek accommodation locally. Point Tupper and the neighbouring communities have accommodated construction labour forces of the same or greater numbers in the past, e.g., for the construction of the mill and of fractionation plant; they will be able to do so again. This labour force will place demands on local services, i.e., everything from food outlets, to grocery stores and gas stations, but overall the impacts for the local community will be positive. At the same, time there could be an increased demand on emergency and health care services in the area; again the services exist in the local area and will adjust to the demands that arise. The likely increase of population and activity in the area will increase demand on all services and may take up some of the slack resulting from fluctuations in the local economy.

Operations and Maintenance

The principal aspects of the operation and maintenance of the Bear Head LNG facility that will have an impact on the regional settlements, land use, community services and infrastructure include the Project's proximity to the settlements of the Strait region and its location within the Municipality of the County of Richmond; the appropriateness of its development within an industrial park; the demands that the labour force will place on the region's services plus the direct and indirect spending that both labour and Bear Head LNG will incur locally, regionally, nationally and internationally; and the demands that the plant and its employees will make on infrastructure such as the roads, marine services, electricity and other utilities.

As detailed, the Project is appropriately sited in an industrial area and is likely to strengthen the dynamics and linkages that already exist both within the immediate area and in the Strait region as a whole. The marine terminal will add an important dimension to the traffic that already uses the existing Port and will generate more business to those who provide services and goods to the vessels. The development and expansion of the commercial linkages that exist in an industrial area are essential to its success and further expansion. After several years of disappointing economic activity around the commercial waters in the Strait of Canso, the development of this facility could be an important catalyst for further investment. Its development will be positive not only for the Municipality of the County of Richmond, but Port Hawkesbury, Mulgrave and communities further afield.

The demands of community services and infrastructure will again change when the plant is commissioned and in full operation. There will be fewer people employed directly, but the additional largely technical and professional workforce will augment and complement the labour force that exists in the region. Over time, it is likely that important lineages will be established with the NSCC, with Cape Breton University and with other institutions of higher learning in the region and beyond. Bear Head LNG have made commitments to work with representative labour groups, in the region, with First Nations and with other stakeholders to ensure the success of their Project and to facilitate growth and maximize benefits to the communities of which they have become part.

Accidents and Malfunctions

As with all heavy industrial operations, there is potential for the accidental release of contaminants (POL and chemicals) from equipment and vehicles, an increased potential for personal injuries and the unlikely potential for a serious accidental event, such as fire or explosion at any time through the life of the Project. This will place an increased demand on local first responders and services including fire, police, emergency and medical services. As referenced in Section 4.10.1, the services in the area respond to the needs of the Point Tupper Industrial Park. Bear Head LNG will also work collaboratively throughout the life of the Project with representatives of all pertinent services to ensure that the appropriate protocols are in place at the plant and in the broader area to ensure the safety of their employees and others working and living in the immediate area.

Decommissioning

The potential effects of decommissioning process are expected to be comparable to those described in for the construction and commissioning phase of the Project with the difference that mechanisms and advisory services may be required to support those who would inevitably lose their employment.

6.4.1.3 Mitigation

As stated in previous sections, Bear Head LNG will develop their own contingency plans and will initiate the necessary communications with local service providers to develop the response protocols for the facility. These will be detailed in an Emergency Response and Contingency Plan. Bear Head LNG has articulated its intent to be a responsible corporate citizen and to work collaboratively with the representatives of the local communities and key organizations. These initiatives will be instigated and will evolve over time.

Environmental management and contingency systems will be put in place to ensure the safe operation of the Bear Head LNG facility and marine terminal. The proponent, and particularly the employees, will forge a place for themselves in the communities of the region. The mitigation of any adverse impact associated with the operation of the facility, or additional pressure, if any, on services, will be countered by the contributions that a skilled labour force and their families will make to the communities in which they live. This will include people who already live in the area and who will find employment at the plant; it will also include those who come to the area for employment and who contribute to associations and sporting events for the first time.

6.4.1.4 Potential Residual Effects

The development and operation of the proposed LNG facility and associated marine terminal will strengthen the industrial fabric of the Strait region, will generate substantive employment and will directly and indirectly contribute positively to the economy of the region. Although there will

undoubtedly be some pressures exerted on services in response to specific demands, some totally unforeseen, it is anticipated that these will be addressed through responsible collaboration between the parties involved. The Point Tupper Industrial Park was designated and developed to accommodate this type of development and investment, and the benefits will occur locally, regionally and provincially.

6.4.1.5 Monitoring and Follow-Up

The follow-up that is required is the maintenance and expansion of the dialogue that is taking place between the proponent, the municipalities in the area, the service providers and other stakeholders. This will evolve and develop over the next three years as the plant is constructed. Existing collaborative relationships will be strengthened and new ones will be established that will ensure that the plant is successfully commissioned and becomes a contributing industry in the Strait region.

6.4.2 Economic Development

Economic development is essential to the future well being not only of the Strait of Canso, but to the Province. The need to generate new employment opportunities and to retain a greater percentage of the provinces graduates has been well documented. Economic development is therefore seen as a factor in this assessment.

6.4.2.1 Boundaries and Threshold

The Bear Head LNG Project will generate benefits to the economy of the Municipality of the County of Richmond, Port Hawkesbury, other communities in the Strait Region and beyond, and the Province as a whole. Indeed benefits will extend beyond the Province to Canada and elsewhere through the distribution of direct and indirect spending and tax regimes.

Temporal boundaries encompass the construction period, i.e., approximately 3 years, the period of operation, i.e., at least 20 years, and a shorter period associated with decommissioning.

The technical boundaries in many respects overlay the administrative boundaries with respect to the regimes that influence the distribution of project expenditures including taxes. It is also true that the development of this Project will have an economic impact not only beyond the boundaries of the Strait region, but internationally. During construction, for example, highly specialized facility components will be purchased in the US or elsewhere; this will also be true, but likely to a lesser extent, during the plant's operation.

A **significant adverse effect** on economic development is one that negatively impacts one of the following economic factors:

- Regional employment and income levels;
- Regional economic activity;

- Existing commercial and industrial activity; and/or
- Regional labour supply.

A **positive effect** is one that enhances the above-mentioned criteria.

6.4.2.2 Interactions and Potential Effects

It is estimated that through construction some $3.312 billion in gross product and 36,263 person-years of employment will be generated overall (Perryman Group, 2015). As indicated in Section 2.9, this likely to translate into a construction workforce of up to 700. It is through local expenditures on labour, goods and services, and on municipal and other taxes that the benefits will accrue locally, regionally, provincially and nationally.

Construction

The Bear Head LNG Project is expected to have a positive impact on regional employment, income and local economic activity throughout the construction period. During the peak construction period, approximately 600 to 700 jobs will be created. It is predicted that construction and preoperational spending will likely generate a gain in business activity of about $2.415 billion in gross product and 24,302 person-years of employment.

Operations and Maintenance

Although the economic benefits associated with the operation of the facility will differ from those experienced through the construction period, the operation of the Project will continue to have positive impact on regional employment, incomes and gross economic activity. The operations and maintenance phase will create between 45 and 70 permanent direct jobs for a period of 20 years and upwards of 175 indirect jobs. In addition, Bear Head LNG will pay taxes to all levels of government and continue to purchase goods and services within the local community and beyond.

Accidents and Malfunctions

Not applicable.

Decommissioning

The economic consequences of decommissioning are two fold: a change in the manpower requirements both in the short and long term and a demand for a different range of services and equipment during the process. The long term consequences of loss of employment, related expenditures and taxes would be significant particularly to the local municipalities.

6.4.2.3 Mitigation

As a premise of being a good corporate citizen in the Strait region, Bear Head LNG has developed a dialogue with the key business groups including those that represent businesses throughout Cape Breton to ensure firstly that they are made aware of the services and skills that exist within the region, and secondly to ensure that local providers are aware of the opportunities presented by the proposed Project. Bear Head LNG are also in the process of developing a Benefits Plan with First Nations in recognition of the skills and attributes that they can bring to the successful execution and operation of the project. This outreach will continue as it is in the best interests not only of Bear Head LNG, but the communities involved.

6.4.2.4 Potential Residual Effects

See section 6.4.1.4.

6.4.2.5 Monitoring and Follow-Up

See section 6.4.1.5.

6.4.3 Marine Navigation

Section 4.10.3 describes marine navigation and traffic, current procedures, and the ways that marine traffic associated with the Bear Head LNG facility will be accommodated and handled within Chedabucto Bay and the Strait of Canso waters. Marine traffic and infrastructure are important for the following reasons:

- Will have an impact on existing patterns of marine transportation;
- May have an impact on navigation safety; and
- Changes in traffic may impact traffic of existing industries.

6.4.3.1 Boundaries and Threshold

Spatial boundaries relate to the waters of the Strait of Canso and Chedabucto Bay. The Harbour Limit, as shown on Figure 4-35, stretches between Red Head and Janvrin Island. The Pilotage Limit stretches between Red Head and Crichton Island Light. All anchorages are shown on Figure 4-35, including the six east of the vessel track and the nine in the Inhabitants Bay and Lennox Passage area. The proposed wharf facility is located approximately 1,260 m northwest of the Bear Head Light and will extend into the Strait of Canso to a charted water depth of approximately 20 m.

There will likely be some vessel movements associated with the development of the wharf facilities, but LNG tankers are associated with the operation of the facility. Vessel movement will be a year round

activity. It is expected that Bear Head LNG activities will result in 80 to 130 LNG vessels per year servicing the needs of the facility. This represents the arrival of a vessel approximately every 2-3 days. These LNG vessels reach an average sea speed of 19.5 knots, but will reduce to 15 knots before reaching the Pilot Boarding Station.

The following acts, regulations, and guidelines will apply to the LNG vessel movements:

- *Canada Shipping Act* and Regulations, Transport Canada, 2001, c.26
  - Vessel movement;
  - Promote well-being of individuals and crews who participate in marine transportation;
  - Promote safety and protect environment from damage;
  - Promote efficient vessel movements and harmonization of marine practices; and
  - Regulations, inspection, and enforcement program, including *Regulations for the Prevention of Pollution from Ships and Dangerous Chemicals*
- *Oceans Act* and Regulations, 1996, c.31
  - Vessel movement;
  - Coast guard services;
  - Navigation aids, marine communications and traffic management; and
  - Channel maintenance (including ice breaking).
- *Canadian Marine Act*, 1998, c.10
  - Vessel movement;
  - Implementation of policies for, and management of, marine transportation and infrastructure; and
  - Promote success and growth in Canadian economy and trade;
- *Pilotage Act* and Regulations, 1985, C.P-14
  - Vessel movement;
  - Establish, operate, maintain, and administer the interests of safety and efficient pilotage service; and
  - Responsible for compulsory pilotage and other activities.
- *Navigable Waters Protection Act*, 1985, c.N-22
  - Construction of the terminal and other marine infrastructure.
- International Maritime Dangerous Goods (IMDG) Code;

- Classification of dangerous goods.

♦ International Maritime Organization (IMO) and Safety of Life at Sea (SOLAS)

With respect to marine navigation, the Canadian Coast Guard, the Atlantic Pilotage Authority and Transport Canada all have jurisdiction over activity within the Strait of Canso and Chedabucto Bay areas. Table 6-26 describes the roles of each of these authorities. The routing of vessels is monitored by the Vessel Traffic Services (VTS), assisted by Pilots and permitted by Customs and Port Authorities.

Transport Canada Marine Services (TCMS) will form a technical review committee (TRC) to review the TERMPOL document presented by Bear Head LNG. The scope of review will be defined by the Bear Head LNG team, proponent agents, and the TRC.

Table 6-26: Roles of Marine Authorities within the Strait of Canso

Authority	Duties and Responsibilities
Canadian Coast Guard	• Verification that Aids to Navigation meets National Levels of Service Standards for all Canadian Waters, including buoys and lights. • MCTS services (ECAREG and Canso Traffic) • Communication between vessels and authorities • Emergency Preparedness and Response • CSA Response Organization and Oil Handling Facilities Regulations (Point Tupper Marine Services, PTMS)
Atlantic Pilotage Authority	• Pilotage in Canso Area • Pilotage Act and Regulations • Vessels LOA > 225.5 m can embark pilot at Compulsory Pilotage area D (Fox Island and Green Island) with outer pilotage station at 4524N 6101W • Vessels LOA < 225.5 m can embark pilot at Compulsory Pilotage area C (Red Head and Crichton Island Light) with inner pilotage station at 4529N 6111W

Transport Canada	• Canadian Marine Act and Regulations
	• Responsible for safety of operations in Port Hawkesbury Public Harbour and the seabed within the area (construction of terminal)
	• Harbour Limits:
	  ○ Southern: Red Head and Janvrin Island
	  ○ Northern: Canso Causeway and Pirate Harbour
	• Harbour Master designates vessel movements, anchorages, and safety of operations

A **significant adverse effect** on marine navigation would arise if:

♦ An increase in cost results to the regulating bodies for marine navigation in the area, including costs associated with accidents and spills; and

♦ A reduction in safety or service for the increase vessel traffic for the Strait of Canso and

Chedabucto Bay areas, leading to non-compliance with the Acts and Regulations discussed in the Administrative Boundaries section.

6.4.3.2 Interactions and Potential Effects

Construction

During the construction phase of the Project, there may be an increase in marine vessel traffic to the area to deliver materials to the Project site. The potential effects are possible disruption to existing marine traffic and the release of chemicals or POL from equipment, spills or accidents.

Operations and Maintenance

Operations of the Bear Head LNG facility will run 24 hours each day, and, as referenced above, there is the possibility that a vessel may dock once approximately every 2-3 days. The potential effects arising from this traffic are obstruction and interference with existing traffic and the release of chemical or POL from equipment, spills or accidents.

Accidents and Malfunctions

The potential effects from accidents and malfunctions that could arise from LNG shipping activities include potential spills of contaminants (POL and chemicals) from equipment and vessels, marine vessel accidents, and potential equipment malfunction onboard the vessel leading to an explosion or release of gas.

Decommissioning

Decommissioning would involve the cessation of LNG vessels entering the Strait at the Bear Head LNG terminal.

6.4.3.3 Mitigation

To mitigate the potential negative effects from additional marine traffic during the construction, all vessels will comply with the *Canada Shipping Act* and the *Oceans Act*. All vessel movements will also be managed by the MCTS, which can inform the other users of the harbour and infrastructure of the upcoming movement. Any spills from equipment will be addressed by the Risk Assessment Plan and EPP. Spill kits will be available on site and defined cleanup procedures will be followed.

To mitigate the potential negative effects from additional marine traffic during the operations phase of the Project, the following measures will be taken:

- All crew on LNG vessels will be qualified to a minimum set of standards as prescribed by the

IMO (including training and certifications);

- All LNG vessels will meet the required standards for vessels carrying hazardous materials;
- ECAREG will issue Notices to Shipping;
- An area-designated Pilot will take all LNG vessels to berth;
- Inspections will be carried out by Transport Canada Marine Safety Inspectors;
- Tugs will be used for berthing; and
- Terminal will be constructed in accordance with the *Navigation Protection Act* and will include all prescribed marine navigational aids.

To mitigate the potential negative effects of accidents and malfunctions at the marine terminal and on LNG vessels, spill cleanup procedures will be followed and cleanup kits will be on hand. The implementation of the EPP, including emergency response, contingency and spill management planning will support effective mitigation.

6.4.3.4 Potential Residual Effects

Because the terminal is being built on a relatively small portion of the Strait of Canso, and by implementing the advocated mitigation measures, of the Project on marine navigation will be negligible. It is possible that Project activities may have an overall positive effect as the increase in marine traffic may allow for opportunities to enhance safety zones and navigational aids.

6.4.3.5 Monitoring and Follow-Up

As referenced in Section 1.8, TERMPOL documentation is being updated and the review process is underway. Through this process, Transport Canada, Bear Head LNG and the TRC will ensure that all navigation and safety protocols and associated regulations are addressed during the planning process. This review process will encompass necessary monitoring to address the anticipated increase in marine traffic in the Strait of Canso and Chedabucto Bay areas.

6.4.4 Fisheries, Aquaculture and Marine Harvesting

Fisheries, aquaculture and marine harvesting have both an economical and cultural significance to maritime communities, and have been selected as a VEC.

6.4.4.1 Boundaries and Threshold

The assessment of commercial fisheries takes into account all fisheries within DFO Unit Area 4Wd, encompassing the Strait of Canso (east of the Causeway) and Chedabucto Bay. The assessment considers recreational fishing that takes place within the Strait of Canso and those aquaculture

commercial operations and foreshore lease holdings within the Strait of Canso and Chedabucto Bay.

Temporal boundaries will include the construction and operation phases of the Project.

DFO assumes responsibility for management of the fish stocks within DFO Unit Area 4Wd.

Effects will be considered **significant** if Project activities result in a reduction in the incomes or profitability of commercial fisherman within a particular fishery or community. To be significant the change would need to be measurable at the community or fishery level and outside of the normal variability of the fishery. This could occur from effects on target marine fish populations, damage to fishing vessels or gear or loss of access to fishing grounds.

A reduction in incomes or profitability of commercial aquaculture operations would also be considered **significant** if it was outside of the natural variability of the operation and can shown to be a direct result of Project activities. This could occur from loss of lease areas, effects on farmed species or equipment damage.

If the Project enhances profitability of commercial aquaculture or fisheries operations or increases catch levels of recreational fisherman than this would be deemed a positive effect.

6.4.4.2 Interactions and Potential Effects

Construction

The construction of marine works will restrict both commercial and recreational fisheries, but activities in the immediate area are not intensive. Construction activities will attempt to avoid peak fishing periods and minimize the degree of interference. There may be a loss to existing fishing grounds (from construction activities and related increases in vessel traffic), but adjustments in fishing locations should prevent loss of income in most instances. Effects to the marine environment could have potential to impact fisheries, and loss of gear or vessel damage related to Project activities could occur.

Interaction with commercial aquaculture activities is not expected as these activities do not take place in the vicinity of the Project site. The distances between the two are large enough that effects are not expected.

Operation

Operation of the marine terminal and the associated increases in marine traffic could result in a loss of existing fishing grounds in the immediate vicinity of the wharf. Increased marine traffic may also affect the distribution and migration patterns of marine species such as mackerel. These impacts could decrease catches or increase fuel costs. Loss of gear or vessel damage related to Project activities could also occur.

Interaction with commercial aquaculture activities is not expected as these activities do not take place in the vicinity of the Project site. Separation distances between the two are large enough that effects are not expected.

Accidents and Malfunctions

Accidents and malfunctions involving spills of contaminants (POL and chemicals) from equipment and vessels, marine vessel accidents, and potential equipment malfunction onboard vessels causing an explosion or release of gas could impact fisheries and aquaculture.

Decommissioning

Decommissioning would involve the cessation of LNG vessels entering the Strait at the Bear Head LNG terminal and would negate any possibility of impact with the fisheries or with aquaculture.

6.4.4.3 Mitigation

Construction

Mitigation measures employed during construction will include:

- Communication and dialogue will be established with the fishing industry to limit impacts to fishing grounds;
- Effort will be made to time construction activities around those periods when fishing efforts are limited;
- All necessary navigation safety procedures will be followed; and
- A program to minimize the impact of gear loss or vessel damage sustained by fishers due to Project related activities will be determined through discussion with local fishers.

Operation

Mitigation measures to be employed during operation include:

- Following necessary navigation safety procedures;
- Use of pilots and established shipping lanes;
- Notices to Mariners will be issued regarding the location and scheduling of activities and other potential hazards;
- Participation in the TERMPOL process; and
- Discussion with local fishers to identify further measures to minimize impacts on fisheries in the local area.

Accidents and Malfunction

To mitigate the potential negative effects from accidents and malfunctions at the marine terminal and on LNG vessels, spill cleanup procedures will be followed and cleanup kits will be on hand. The implementation of the EPP, including emergency response, contingency, and spill management planning will assist in mitigation. Also, all crew on LNG vessels will be certified to the minimum standards as prescribed by the IMO, or by other more stringent applicable requirements. Ensuring that necessary safety procedures are implemented, use of pilots and participation in the TERMPOL process will aid in limiting the possibility and severity of accidents.

Decommissioning

Mitigation measures employed during decommissioning will be developed along with the future decommissioning plan.

6.4.4.4 Potential Residual Effects

Assuming recommended mitigation measures are implemented, residual effects on the fishery and aquaculture are not predicted. The physical area impacted by the marine terminal is small compared to the 4Wd fishing area; commercial aquaculture activities do not take place in the vicinity of the Project site.

The impact on lobster fishers is limited to a small number of individual fishers who can compensate by adjusting their fishing patterns to minimize impact. The amount of catch from the wharf area is small in comparison to the overall fishing area even of an individual fisher, so the impact on incomes is not considered to be significant.

6.4.4.5 Monitoring and Follow-Up

Communications will be established with local fishers prior to construction and will be maintained with the local fisheries industry, particularly with those individual fishers who have leases in the vicinity of the proposed wharf. These communications will be maintained as circumstances warrant through the life of the Project.

6.4.5 First Nations Land and Resource Use

6.4.5.1 Boundaries and Threshold

The MEKS considered a 5 km radius surrounding the proposed area of development; it was determined that Mi'kmaq land and resource use had occurred in this area within living memory. Because of the nature of the site, it was deemed unlikely that long-term occupation had occurred. The Project site and

surrounding area would, however, have formed an important travel route between the mainland and Cape Breton (Unama'kik) as Mi'kmaq use and occupation of the area east of Bear Head is known to have occurred.

The Mi'kmaq have interests in the lands and waters in the vicinity of Bear Head that extend through all phases of the Project's development, operation and decommissioning.

A **significant** adverse impact of First Nations Land and Resource Use would occur if they relied substantially on the lands and waters of the Project site for their livelihood, or if these lands and waters had a special historical meaning to them, and they were denied access.

A **positive** impact would occur if First Nations people, particularly First Nations youth, were able to benefit directly or indirectly in the realisation of their goals as a consequence of the development and operation of the Project.

6.4.5.2 Interactions and Potential Effects

From the work done to date through the MEKS undertaken in 2004, the current updated MEK (2015) (Appendix I) and through discussion with representatives of KMKNO, there is no resource use actively undertaken by the Mi'kmaq on the Project site at this time. There seems little likelihood that this area, because of its exposure, was of central importance to the Mi'kmaq. The archaeological work that has been undertaken on the site and beyond appears to confirm this conclusion.

In parallel to the work that has been done on site, representatives of Bear Head LNG, as referenced in Section 3.2, have met with the Benefits Committee of KMKNO. A MOU is being negotiated. This is an important step towards the preparation of a Benefits Agreement between Bear Head LNG and KMKNO. A contract has been signed with the Waycobah First Nation to provide security services to the site.

6.4.5.3 Mitigation

Bear Head LNG has taken important steps to establish dialogue with First Nations and through the establishment of a benefits Agreement with KMKNO is optimistic that First Nations will not only contribute to the success of the Project, but will use their involvement in this enterprise as a catalyst both for sustaining and strengthening their culture and way of life, and for creating new economic and educational opportunities for their youth.

6.4.5.4 Potential Residual Effects

The finalisation of the Benefits Plan will enable First Nations to be actively involved and benefit from the Project through not only construction, but the operating life of the Project. The potential residual effects of this involvement could be great.

6.4.5.5 Monitoring and Follow-Up

Bear Head LNG is committed to working collaboratively with First Nations. The signing of the MOU and the agreement with the Waycobah First Nation are the first commitments in a relationship and dialogue which will evolve and develop through the development and operation of the Project.

6.4.6 Archaeology

Research and field investigations undertaken in 2004 indicated that there were no sites of archaeological worth within the Project footprint. Work was instigated and the greater part of the lands necessary for the proposed facility cleared with no finds discovered. Nevertheless, there is always a possibility that future construction activities will unearth something unexpected. It is also a subject of great importance to First Nations. For these reasons, archaeology is considered a matter worthy of consideration.

6.4.6.1 Boundaries and Threshold

The area of interest is the Project footprint at Bear Head, very specifically those areas that will be disturbed and developed for the LNG facility and associated marine terminal. Should site activities unearth artefacts or finds that went unrecorded, there is potential for an adverse effect on archaeology, i.e., on attaining a full understanding of the history of the Project site.

6.4.6.2 Interactions and Potential Effects

Since no intrusive field investigations were undertaken in 2004, it is conceivable that further disturbance of the site, no matter how small, could reveal something worthy of recording. That this did not happen through the clearing and construction that has taken place to date would appear to confirm the findings of the earlier research. Nevertheless, those responsible for further construction should be made aware through the EPP of the procedures that should be instigated in the unlikely event of something being found. It would be highly unlikely that there would be an archaeological find of interest when the facility is operational.

6.4.6.3 Mitigation

In the unlikely circumstance that something is found during the further period of construction, Bear Head LNG will report the find to the Nova Scotia Museum.

6.4.6.4 Potential Residual Effects

Given the work that has been completed and the fact that nothing has been found during the construction that has taken place, the likelihood of potential residual effects is negligible.

6.4.6.5 Monitoring and Follow-up

Apart from reporting any find, which is highly unlikely, there is no need for monitoring, or any other follow-up.

6.5 Cumulative Effects

6.5.1 Cumulative Interactions and Potential Effects on VECs

The following sections discuss the potential environmental and socioeconomic cumulative interactions and effects of the Bear Head LNG Project with other identified projects and activities.

Air Quality

The Maher Melford Terminal and the H-Energy LNG Project are anticipated to include dust and vehicle emissions during construction and operation. These emissions could interact cumulatively with emissions from the Bear Head LNG Project to increase the levels of suspended particulate matter within the airshed. Suspended particulate levels are regulated for all facilities, as would be described in the facilities' Industrial (Division V) Approvals, and Bear Head LNG will conduct air monitoring at the request of NSE to ensure compliance. Maher Melford Terminal's provincial environmental assessment approval requires an air quality and dust management plan and this will likely be a requirement for the H-Energy LNG and the Bear Head LNG Projects.

Construction of the tie-ins and rights-of-way may also interact cumulatively with the Project and result in increased dust and vehicle emissions should there be temporal overlap between the construction phases. These emissions would be temporary, localized and reversible; therefore significant cumulative environmental effects are not likely.

The mitigation measures described in sections 6.1.3.4 and 6.1.4.4 are also important in the context of cumulative environmental effects. Bear Head LNG will contribute to the management of cumulative regional air quality effects by participating in future regional airshed monitoring and management programs at NSE's request. Existing regional levels of suspended particulates, NO_x and SO_x are within federal and provincial regulatory limits, and the Projects are not anticipated to cumulatively exceed regulated thresholds.

Table 6-27: Overview of Socio-economic Consequences of Bear Head LNG Project

Activity	Observations & mitigation	Significance Criteria				Significance
		Magnitude	Geographic Extent	Duration/ Frequency	Reversibility	
Key Settlements, Land Use, Community Services & Infrastructure						
• Demand on services and infrastructure from labour and from facility, e.g., on roads, marine support services, social infrastructure, community infrastructure including accommodation and food services • Increased potential for personal injuries and demand on first responders and services: police, fire and medical • Demands for skills training etc.	• Strengthen the commercial linkages that exist in the region • Likely to strengthen linkages with NSCC, Cape Breton University and other institutions of higher learning • Communicate labour and material requirements to labour unions and local suppliers in advance of tenders • Establish and maintain dialogue with service providers and responders • Develop Emergency Response & Contingency Plan	Medium	Primarily Strait region, Particularly Port Hawkesbury, Mulgrave and the Municipality of the County of Richmond	• Will vary through different phases of the Project, but will exist throughout • Intermittent in response to specific events i.e., if and when they happen	Closure would have negative ramifications for the region, but things would not revert to a current status quo	Positive Impact
Economic Development						
• Direct and indirect employment • Direct and indirect spending • Contribution to local, provincial & national tax regimes	• Maintain and strengthen dialogue with all levels of government • Maintain dialogue with labour representative organizations, including First Nations	High during construction Medium through Project operation	Regional, Provincial and national	• Will vary through different phases of the Project, but will exist throughout	Closure would have irreversible negative ramifications	Positive impact
Marine Navigation						
• Increased vessel movements, i.e., one every 2 -3 days • Demands on pilotage and related marine services	• All vessels entering the area need to comply with the *Canada Shipping Act* and the *Oceans Act* • Vessel movements controlled from the Sydney MCTS and through TERMPOL	medium	Strait of Canso and approaches through Chedabucto Bay	Demand will be less through construction and decommissioning, but greater and more constant for the duration of Project operation	Shipping to site would cease	Positive Impact
Fisheries, Aquaculture & Marine Harvesting						
• Potential loss of access to fishing licenses in the vicinity of the marine terminal	• Communication and dialogue with fisher associations • Area of the marine terminal is small relative to available fishing area within 4Wd	low	Within 1000 m of the marine terminal	Life of the Project	Reversible	Not significant
First Nations Land & Resource Use						
• General access to Project site for resource use not available	• Confirmation through MEKS and engagement that Project site not regularly accessed • More favourable areas for resource use in region	Low	Project Footprint	Duration of Project	Reversible	Not significant
Archaeology						
• Remote possibility of finding artifacts of value	• Most clearing has been undertaken • Notification procedure	Low	Project Footprint	Duration of Project	Reversible	Not significant

Climate

Increased GHG emissions from the Bear Head LNG Project will interact cumulatively with emissions from other fossil fuel-burning projects in the province, Canada and abroad, overlapping both spatially and temporally, with similar environmental effects.

The Bear Head LNG Project will represent approximately 10.3% of Nova Scotia's and 0.3% of Canada's GHG emissions. The contribution on a national or global scale is not considered to be significant, but at a provincial scale the contribution is considered to be an adverse environmental effect.

When operational, the Maher Melford Terminal is estimated to contribute approximately 93,000 tonnes CO_2 eq annually, or 0.39 percent of the total provincial GHG emissions (AMEC 2008). The Goldboro LNG Project is estimated to contribute approximately 3,778 kt of CO_2 annually, which would result in an increase in CO_2 emissions of approximately 15% to Provincial levels and 0.5% to Canadian levels (AMEC 2013). Estimated emissions from the H-Energy LNG Project are not available, but at full capacity of 13.5 mtpa, it can be assumed that emissions will exceed those of the 10 mtpa Goldboro LNG Project.

The defined mitigation measures are also pertinent for decreasing cumulative environmental effects and minimizing GHG-related climate change. The efficiency of the OSMR® technology employed for the Bear Head LNG Project inherently mitigates Project-related effects to air quality and climate by minimizing the Project's relative contribution to GHG emissions in comparison with most other LNG export Projects. Although the Project will contribute to an increase in provincial GHG emissions, the OSMR® technology results in a reduction of GHG emissions of approximately 16% relative to most other proposed or operational LNG facilities.

Bear Head LNG is working actively with NSE's Climate Change Directorate to develop a GHG Management Plan to ensure adherence to applicable provincial and federal GHG regulations and policies throughout the Project lifecycle. The plan will:

- Include an accounting of anticipated GHG emissions;
- Explain how the Bear Head LNG Project is employing the best-available technology for GHG mitigation;
- Demonstrate how the Project's carbon intensity is aligned with best-in-class;
- Provide details on GHG emissions monitoring and reporting; and
- Describe ongoing GHG management and abatement practices.

Bear Head LNG is endeavouring to comply with the Province's new GHG policies for the LNG industry (currently in development) within the framework of the 2007 *Environmental Goals and Sustainable Prosperity Act*. Bear Head LNG understands that other LNG proponents are also working with NSE to minimize GHG emissions and decrease carbon intensities.

Terrestrial Habitat, Freshwater Fish and Fish Habitat

Construction of the pipeline, water and electrical tie-ins and rights-of-way may interact cumulatively with the Bear Head LNG Project to result in potential effects on terrestrial habitat and freshwater fish and fish habitat. The LNG facility was sited with consideration for avoidance of wetlands and freshwater habitats, and no wetlands or streams are anticipated to be affected by Project construction. An updated EPP and Stormwater Management Plan are being developed to control potential sedimentation of, and discharge to, freshwater habitats on the site. Mitigation measures for potential accidental events such as spills will also be detailed in the EPP.

It is anticipated that routing, siting and construction of any facilities in the vicinity of the proposed Project will adhere to environmental standards, planning and mitigation measures that are similar to the Project, including careful design and management of watercourse crossings, identification of any particularly sensitive habitats, determination of any special mitigation measures in consultation with the applicable regulators, and potential wetland compensation where avoidance may not be possible.

Given the preference to route and site to avoid wetlands, the proven effectiveness of erosion and sediment controls for watercourse crossings, and the attention to spill prevention and contingency planning, cumulative effects on wetlands and freshwater fish and fish habitat are not predicted to be significant.

Terrestrial Fauna

Cumulative effects to seabirds may result from the Project-related increase in vessel traffic in combination with other marine-based projects in the Strait. Increased vessel traffic may cause disturbance and changes in foraging behaviour and habitat, and increase the risk of oil spills due to potential vessel collisions. Potential cumulative interactions and mitigation measures related to navigation are discussed in the Marine Navigation and Marine Life sections.

Construction of the Strait pipeline crossing, if it coincides with marine construction at the LNG Terminal, could present a minor incremental risk (insignificant) to seabirds from disturbance and spills. This Project would be limited in duration and subject to regulatory approvals and environmental management processes.

It is assumed that the other marine projects will adhere to similar mitigation measures. Significant cumulative effects to seabirds are not anticipated.

The primary Project-related issue of concern for terrestrial fauna is the potential for direct mortality of birds and possibly bats from operation of the flare stack. Canaport LNG has been charged under the federal Migratory Birds Convention Act and the Species at Risk Act after an estimated 7,500 songbirds flew into the gas flare at the Saint John, NB import facility during a foggy and overcast night in September 2013. The environmental assessment approval for the Goldboro LNG Project (2014) includes

the following condition related to flaring:

"The Approval Holder must monitor and undertake research on the impacts of gas flaring on birds and bats through radar and onsite monitoring. Methodologies and the approach to research, and monitoring for assaying the impacts on birds and bats must be developed in consultation with NSE, NSDNR and CWS. Based on the results of the monitoring program, the Approval Holder must make necessary modifications to mitigation plans and/or operations to prevent any unacceptable environmental effects, to the satisfaction of NSE."

Bear Head LNG is actively coordinating efforts with regional radar and weather monitoring sources, and developing a program to further mitigate flaring at sensitive times, such as during known migrations and when additional risk factors are anticipated to align (e.g., suitable weather conditions at night). With regards to flaring-related cumulative effects, H-Energy LNG Project plans are not known at this time, however it can be assumed that flaring will also be a component of that project. The potential cumulative effect of multiple flares in the area is unknown, however diligent planning, monitoring and adaptive mitigation for each project will help minimize the likelihood of significant cumulative adverse environmental effects.

Marine Navigation

The Bear Head LNG Project and the Maher Melford Terminal are anticipated to result in an increase in vessel traffic in the Strait of up to approximately 28 percent and 40 percent, respectively, for a cumulative increase in vessel traffic of almost 70 percent. Vessel numbers are not known for the H-Energy Project, but given the similarity of the projects, could be estimated to be in the order of Bear Head LNG vessel traffic, for an additional 30 percent increase. Increased traffic has the potential to increase the risk of vessel collisions.

As per Canada *Shipping Act* requirements, the Transportation Safety Board of Canada (TSB) maintains records of specific accidents and incidents occurring in Canadian waters. Their records indicate that in the area covered by CHS chart, LC 4335, there were 31 accidents and reportable incidents over the past 10 years, none of which resulted in a pollution incident (JWEL, 2004a). Given the low incidence of accidents involving LNG vessels, the number of accidents and reportable incidents in the Strait of Canso is unlikely to increase.

Should the construction of the marine pipeline crossing overlap temporally with the marine aspects of the Bear Head LNG Project, a minor cumulative increase in vessel traffic is predicted. This additional traffic could increase the cumulative risk of vessel collisions, though this cumulative increase is not anticipated to be significant.

Marine Habitat

The temporary wharf and work surface required for the Bear Head LNG Project will result in a loss of

fish habitat. This habitat loss has been previously compensated for, as detailed in the Fish Habitat Compensation Plan associated with the Project's existing Fisheries Act authorization. The minimal benthic footprint of the piles associated with the permanent wharf is offset by the piles themselves, as they provide vertical fish habitat. Their hard surfaces are ideal for colonization and will eventually provide a reef effect, perhaps even significantly increasing the biodiversity in the immediate area.

Mitigation measures specific to the LNG Project include development and implementation of an EPP and Stormwater Management Plan, silt curtains and debris booms (as required), temporary tenting and confinement to catch sand blasting debris and paint-over spray, and adherence to applicable regulations, guidelines and conditions of permits.

The Maher Melford Terminal will also result in a loss of fish habitat, and a Habitat Compensation Plan was previously developed for the Project, thereby mitigating this effect. It is likely that the H-Energy Project will result in benthic habitat loss. However, it is anticipated that the Project will be subject to similar environmental standards, with possible offsetting of impacts to Commercial, Recreational and Aboriginal fisheries productivity.

The location for a potential pipeline crossing the Strait is likely to be within the current pipeline corridor, but it is assumed at this time that spatial overlap with the Project's small marine footprint is unlikely. The overall cumulative effect on marine habitat is predicted to be not significant.

Marine Life

Temporal overlap of marine construction-related activities of the Bear Head LNG Project, Maher Melford Terminal and H-Energy Project is possible. It is uncertain if there will be a temporal overlap of marine construction activities involving the pipeline crossing.

Minimal, localized increases in turbidity are predicted during marine construction activities for each of the marine-based projects (Bear Head LNG Project, pipeline crossing, Maher Melford Terminal and H-Energy Project), and there may be temporal overlap between these activities. However, the spatial separation of the Projects reduces the likelihood of turbidity-related cumulative effects on marine life.

Underwater noise can result in noise-related adverse effects on marine mammals such as avoidance, changes in migration, changes in feeding and reproductive behavior, and possibly communication marking (interference in communication between marine mammals). Of particular concern is the noise associated with pile driving, and it is likely that all three Projects will include this activity. Bear Head LNG is committed to conduct pile driving in late fall and winter in order to avoid sensitive periods, complete pile driving within a 60 day window, and halt pile driving when a whale is sighted within 500 m of the area, resuming pile driving only once the whale has left the area.

The Maher Melford Terminal identified ramped warning signals and bubble curtains (noise masking) as possible mitigation measures during construction (AMEC, 2008). It is anticipated that the H-Energy

Project will adhere to similar mitigation measures as the other projects. With each Project employing applicable mitigation measures, and in consideration of the temporary and localized nature of Project activities and separation distance between the Projects, significant cumulative effects on marine mammals due to pile driving are not anticipated.

The projected cumulative increase in operation-related vessel traffic associated with the Bear Head LNG Project, Maher Melford Terminal and H-Energy Project also has the potential to cumulatively affect sensitive marine mammals through increased noise disturbance, possible vessel collisions and marine spills. However, given the established standard vessel operation procedures to be followed for all Projects, including slow vessel speeds and avoidance of marine mammals, and the high probability that marine mammals will avoid the area during marine construction, significant cumulative effects on marine mammals are not anticipated.

A potential increase in vessel traffic may lead to an increase in the number of vessel collisions with whales; however, collisions tend to be of particular concern where shipping lanes intersect with known concentrations of whales, such as in the Bay of Fundy. No information has been located on historic numbers of vessel collisions with whales in the Strait of Canso, however the Strait is not known as an area with high concentrations of whales on a seasonal basis. Whales are only occasional visitors to the Strait, and rarely does a whale with conservation status appear in the Strait. Furthermore, vessel collisions with whales are less likely when vessels travel at slower speeds, as required in the Strait. Therefore, the cumulative increase in vessel traffic is not anticipated to result in a commensurate increase in vessel collisions with whales.

Species at Risk

Any Project-related or cumulative adverse effect on a species at risk is, by definition, significant; therefore, consideration of likelihood is particularly important for assessing significance on species at risk.

Rare plant populations found in the Bear Head LNG Project site have the potential to be adversely affected, if the utility corridors are constructed within or in close proximity to these populations. As the locations of these species are now known and avoided by the Project, these locations are expected to be factored into the regulatory approval of the tie-ins and final corridor routes.

Previously unknown populations of rare plants could be affected by clearing of the corridors, however it is expected that rare plant surveys will be a requirement of the associated regulatory approval processes. It is also expected that mitigation measures will be developed for the corridors, to minimize adverse effects on any rare plant populations that may be encountered. Given these factors and mitigation measures, no cumulative effects on terrestrial species at risk are anticipated.

The area is absent of rare mammals and sensitive mammal habitat. The Bear Head LNG Project is not anticipated to further affect wetlands, and the utility corridors will likely avoid these to the extent

possible, therefore cumulative adverse effects are not anticipated on wetland species such as the four-toed salamander.

As discussed in the Terrestrial Fauna section, flares associated with the Bear Head LNG Project and, presumably the H-Energy Project, have the potential to adversely affect birds and bats. Mitigation measures described in the Terrestrial Fauna section will also decrease the likelihood of cumulative adverse effects to bird and bat species at risk.

Potential effects on marine fauna are addressed in the Marine Life and Marine Navigation sections, and these mitigation measures will also decrease the likelihood of cumulative adverse effects to marine species at risk.

Community Services and Infrastructure

Temporal overlap between the construction and operation of all the identified Projects is possible, and the anticipated Project sizes and the locations of the Projects could result in a cumulative burden on local roads, emergency response services and on-going support services. However, the Strait area has successfully accommodated other large scale construction Projects, and with proper communications and planning with local emergency response and other service providers, a significant cumulative adverse effect on community services and infrastructure is not anticipated.

Economic Development

The identified major Projects have the potential to result in positive cumulative effects on economic activity in the immediate area, Nova Scotia and Canada. Should the Projects be constructed simultaneous, it is possible there could be competition for labour and equipment; however with proper planning and communication with local labour organizations and equipment operators, these cumulative adverse effects are not expected to be significant.

Fisheries and Aquaculture

The increase in overall vessel traffic from the marine-based Projects has the potential to result in cumulative adverse effects on fisheries within the Strait. It is possible that fishing activities may be limited by the increased vessel traffic, and that incidents of loss of fishing gear may increase.

Bear Head LNG consulted with the fishing industry prior to Project initiation in the mid-2000s, and has reinitiated consultation for this phase of the Project. A Fisheries Compensation Plan is being developed to establish compensation available should Project activities result in damage to fishing gear or vessels. The Maher Melford Terminal has developed a similar mechanism for compensation, and it is expected that H-Energy would also be subject to this requirement. With each Project compensating for any potential associated losses, cumulative effects on fisheries and aquaculture are not anticipated.

6.6 Effects of the Environment on the Project

It is important to not only consider impacts of the Project on the environment, but also those of the environment on the Project. Instances of extreme weather, sea ice, climate change, sea level rise and seismic activity can all adversely affect the Project and need to be considered in Project design. Examples of adverse effects could include damage to Project infrastructure, stoppages or delays in construction, stoppages in production and operation or dangerous conditions for workers. Effects of the environment on the Project and how they will be addressed is discussed further in this section.

6.6.1 Extreme Weather

A study by Beaumont et al., 2011 examined the impact of climate change on some of the world's most exceptional ecoregions. It determined that of the 132 terrestrial and 53 freshwater ecoregions examined, 86% of terrestrial and 83% of freshwater ecosystems will be exposed to climactic conditions considered extreme in 1961 – 1990 (greater than 2 standard deviations in average monthly temperature). Extreme weather events have also shown increases in Nova Scotia, with greater increases predicted. This includes a warmer and wetter future climate with increased storm activity (Richards and Daigle, 2011). Extreme weather includes cases of extreme temperatures, precipitation, winds and storm events. Due to the potential impacts coupled with the fact that instances of extreme weather are expected to increase, it is important to consider the related effects on the Project.

Historical temperatures recorded at Eddy Point vary from 33.3 °C to -25.6 °C. Typical of Nova Scotia coastal regions, this temperature range is wide but not extreme. Average yearly precipitation is 1349.3 mm, with an extreme daily rainfall of 78.6 mm and an extreme daily snowfall of 63 cm. Model results from Richards and Daigle, 2011 predict increases in temperature for the climate station in Deming (with the magnitude of temperature increases increasing with time). They also show increases in precipitation, indicating a warmer and wetter climate with time. Annual average temperatures are predicted to increase by 0.9°C from 1980 values by 2020, 2 °C by 2050, and 3.1 °C by 2080. Annual precipitation is expected to increase by 27 mm from 1980 values by 2020, 35.5 mm by 2050, and 71.6 mm by 2080.

Although wind speeds in the 54 – 72 km/h range have been recorded at Eddy Point, this is not considered normal. Average wind speeds are around 20 km/h during summer months and between 12-15 km/h during winter, with wind direction being predominantly from the west and northwest during winter and from the south and south west in warmer months. Extreme winds can produce high waves, stormy seas, blowing sea spray/foam and cause reduced visibility. Frozen sea spray which can cause unsafe working conditions is also an issue during colder months, with February being the worst for ice build up on vessels. Storm surge accompanying strong storms can increase water levels, potentially causing issues with loading and unloading procedures. Strong currents can impact vessel navigation and docking.

The Project is located in an area that will be susceptible to increases in storm events (Forbes et al., 1997). Hurricane Juan is an example of a hurricane that hit the Maritimes in 2003 causing massive damage to local infrastructure. The possibility of damage due to more frequent and severe storms is a possibility given the Project location in a coastal region.

Reduced visibility can occur throughout the year due to fog; however it is most likely to occur in late spring and early fall when the greatest difference between the coastal water and air temperature exists. Reduced visibility can cause marine navigation issues and increase the risk of accidents.

The Project will be designed to withstand instances of extreme weather as described above. Wind loads, harshest recorded conditions, and predictions of future conditions will all be taken into account during the FEED process. The facilities will be designed with a safety factor that accounts for variability. Policies and procedures will also be in place to protect against extreme weather. For example, vessels typically do not dock in winds that exceed a set speed (usually 25 knots). Weather forecasts will be monitored on a daily basis. Project activities will be suitably adjusted when extreme weather is expected and the work area secured to the extent possible in advance of predicted extreme weather events. It is not expected that extreme weather will have a significant impact on the Project.

6.6.2 Sea Ice

The Strait of Canso is an extremely deep and ice free harbour, however this was not always the case. Prior to the construction of the Canso Causeway in 1955, sea ice was prevalent. Ice cover was heavy enough that planes were able to use it as a runway, ice flows frequently put ferries between Mulgrave and Port Hawkesebury miles off course and vessels would break away from wharves due to the strong currents. Since construction of the Canso Causeway created a barrier between ice packs on the north side the characteristics of the Strait have been altered, and the south side remains ice free year round (Strait of Canso Superport Corporation, n.d.). As a result, sea ice is not expected to impact Project construction or operations.

6.6.3 Climate Change and Sea Level Rise

It is predicted that sea level rise due to climate change in the Guysborough County, Canso Harbour area will be in the magnitude of 0.16 m +/- 0.03 m by 2025, 0.45 m +/- 0.15 m by 2055, and 0.86 m +/- 0.36 m by 2085. Extreme estimates put these values at 2.96 m +/- 0.23 m by 2025, 3.25 m +/- 0.35 m by 2055, and 3.66 m +/- 0.56 m by 2085 (Richards and Daigle, 2011). This rise in sea level has the potential to impact the Project, particularly the Marine terminal and associated works.

The Project will consider sea level rise due to global warming. This will involve consideration of sea level rise and incorporating safety factors during Project design at the FEED stage to ensure impacts are avoided. Sea level rise is not expected to negatively impact the Project given proper consideration.

6.6.4 Seismic Activity

Seismic activity is limited on the East Coast of Canada, with no important historical earthquakes listed in Nova Scotia (Natural Resources Canada, 2013c). The closest two important earthquakes listed include a magnitude 5.7 earthquake in New Brunswick in 1982 and a 7.2 magnitude earthquake in the Grand Banks in 1929 (Natural Resources Canada, 2013d). No major damage was caused by the 1982 earthquake in New Brunswick, although many people were woken up, it was felt outdoors and small and unstable objects were overturned or moved (Bashman et al., 1984). The Grand Banks earthquake occurred approximately 250 km south of Newfoundland. It was felt as far away as New York and Montreal and generated a tsunami that resulted in 28 deaths in Newfoundland. Vibrations were felt in Cape Breton that caused minor landslides and knocked down or cracked chimneys (Natural Resources Canada, 2013d). Historically, most seismic shocks recorded in Atlantic Canada are below magnitude 5, with the exception of those mentioned above (Rast et al., 1979).

Project design will take into account seismic activity. All buildings will be constructed to the National Building Code of Canada and LNG storage tanks will be designed for the regions seismic rating under CSA Z276-11.

6.6.5 Security

However unlikely, the possibility of a terrorist attack on the facility would be extremely hazardous and should be addressed. The site will have a security team in place and surveillance equipment. The perimeter of the site will be fenced and access to the site will be through a security gatehouse.

Design of the facility will comply with the *Marine Transport Security Regulations* (MTSR). The MTSR outlines operator and personnel roles and responsibilities in developing and implementing security plans, provides a process to conduct security assessments establishes security protocols, proper documentation and reporting procedures and allows TC to oversee compliance of marine transportation security systems. Discussions have already been held with TC officials regarding the MTSR and its application to the Project.