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8.0 ENVIRONMENTAL EFFECTS ASSESSMENT

8.1 Valued Environmental Components

8.1.1 Groundwater

Groundwater Resources is a VEC because of its importance in the hydrologic cycle and ecological function (*e.g.*, surface water discharge), as well as importance as a water supply, particularly to rural users. Groundwater originates from percolation of rain, snowmelt, or surface water into the ground. This infiltrating water fills voids between individual grains in unconsolidated materials and fills fractures developed in consolidated materials. The upper surface of the saturated zone is called the water table. The water table intersects the surface at springs, lakes and streams where interaction between the groundwater and the surface water environment can occur. Groundwater flows through soil and bedrock from areas of high elevation (recharge areas) to areas of low elevation (discharge areas) where it exits the sub-surface as springs, streams, and lakes.

Groundwater yield to dug or drilled wells can vary greatly, depending on the hydraulic properties of overburden or bedrock aquifers. An aquifer is a formation or group of formations that can store or yield useable volumes of groundwater to wells or springs. Natural groundwater quality is directly influenced by the geochemical composition of the aquifer materials though which it passes, and the time the water resides within that material.

A description of existing conditions for groundwater within the study area is presented in Section 6.1.1.

8.1.1.1 Boundaries

Spatial Boundaries

Spatial boundaries for the assessment of groundwater resources are based on a combination of aquifer hydraulic properties, expected groundwater flow directions, and the distance between the future developed portion of the subject property and wells and ecological receptors (*e.g.*, streams) that may be affected by Project activities. For example, the area of influence or capture area of a typical low yield domestic water well is usually less than about 100 m, and generally in a direction hydraulically up-gradient of the well. Project-related contamination (*i.e.*, petroleum hydrocarbon spills) within this capture area could potentially affect well water quality. Vibration damage to a drilled or dug well is generally a function of distance between the energy source and the well, and seismic properties of the aquifer materials. With respect to rock type, risk is greater for wells completed in fractured crystalline bedrock than for wells completed in soft bedrock such as sandstone and shale. Based on experience, the risk of damage from blasting or major excavation is considered to be greatest within 50 m, moderate from 50 to 200 m, and is expected to be minimal beyond about 200 m from a well.

To be conservative, blasting effects are considered for drilled wells within 500 m on all sides of the future development portion of the site, and the potential effects of accidental spills are considered for the proposed LNG site and all areas down-gradient (*i.e.*, southwest) of the site to the Strait of Canso. The actual extent of the area potentially affected depends on surface drainage and surficial geology and would likely be less than the conservative area considered in this study.

Temporal Boundaries

With respect to temporal boundaries, most physical effects on groundwater resources during construction are likely to be temporary. Chemical effects from spills of materials could occur at any time during the lifespan of the project including the construction phase. Depending on various factors (*i.e.*, the type of substance spilled, the quantity of material, the length of time the spill goes undetected, *etc*.), a spill can have long lasting effects on groundwater which may take years to remediate and/or naturally return to the pre-impacted state.

Administrative Boundaries

The guideline, Atlantic PIRI (Partnership in RBCA (Risk-Based Corrective Action) Implementation) Reference Documentation for Petroleum Impacted Sites in Atlantic Canada, Version 2.0 (October 2003), is applicable for comparison of analytical results of any spills of petroleum hydrocarbons which may occur on the property. The Canadian Environmental Quality Guidelines published by Canadian Council of Ministers of the Environment (CCME) are also applicable. However, they only apply for drinking water as it emerges from a tap (CCME Guidelines for Canadian Drinking Water Quality) or as groundwater enters aquatic systems (CCME Canadian Water Quality Guidelines for the Protection of Aquatic Life). They are not directly applicable to groundwater collected directly from the water table unless it is immediately entering an aquatic environment or is being used untreated as a drinking water source.

Technical Boundaries

A technical limitation for this assessment is that a well water inventory was not undertaken for this study. However, this preliminary assessment identifies that there are likely no active water wells within the study area.

8.1.1.2 Residual Environmental Effects Evaluation Criteria

A **significant adverse effect** is defined as one in which the Project causes one or more of the following:

- petroleum hydrocarbons impact the groundwater on the site above the PIRI criteria; and/or

- the aquifer is physically or chemically altered to the extent that interaction with local surface water results in stream flow or chemistry changes that adversely affect aquatic life.

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

A **positive effect** is defined as one on which the aquifer or spring water is improved as a result of Project activities.

8.1.1.3 Potential Interactions, Issues and Concerns

A review of water well records, aerial photos and the field reconnaissance indicates that there are no domestic water supply wells, surface water reservoirs or municipal supply wells located within 500 m of the proposed project area. Water will be supplied to the facility through the local municipal water department, and no groundwater withdrawals will be required for the construction, operation or maintenance of the Project. The main issues are related to accidental releases of petroleum hydrocarbons (diesel, fuel oil, etc.) or other chemicals either during construction or through the life span of the Project.

The severity of these impacts is a function of type, quantity and location of the petroleum hydrocarbon/chemical spilled, the overburden thickness between spill and the water table, the hydraulic properties of both the overburden and the bedrock and the distance to a potential receptor.

Due to the physical properties of LNG (*i.e.*, becomes vapour at -160^{o} C), the opportunity for spilled LNG to enter the groundwater table is remote.

8.1.1.4 Analysis, Mitigation and Residual Environmental Effects Prediction

Construction

Construction activities are not expected to adversely affect groundwater at the site barring an accidental spill of petroleum hydrocarbons (diesel, fuel oil) or chemicals (covered in Section 8.3).

Operation and Maintenance

Operation activities are not expected to adversely affect groundwater at the site barring an accidental spill of petroleum hydrocarbons (diesel, fuel oil) or chemicals (covered in Section 8.3).

8.1.1.5 Follow-up and Monitoring

If bulk storage of petroleum hydrocarbons other than LNG (or diesel fuel for back up generators) or other chemicals, are to be stored on the site then a groundwater monitoring program for the particular chemical of concern should be undertaken.

8.1.1.6 Summary of Residual Environmental Effects Assessment

Provided the recommended mitigative measures are implemented, no significant adverse residual environmental effects on groundwater resources are likely to occur. Table 8.1 provides a summary of the residual environmental effects and recommended mitigative action for groundwater resources.

Table 8.1 Residual Environmental Effects Assessment Matrix: Groundwater

Project Activity	Potential Positive (P) or Adverse (A) Environmental Effect	Mitigation	Significance Criteria for Environmental Effects					Residual Environmental Effect	Level of Confidence
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/ Social-cultural and Economic Context		
CONSTRUCTION									
General construction activities	Hydrocarbon or chemical spills from construction equipment (A) (see Section 8.3)	• See Section 8.3	1	1	2 / 1	R	2	N	2
OPERATION AND MAINTENANCE									
Site operations	Hydrocarbon or chemical spills from equipment (A) (see Section 8.3)	• See Section 8.3	1	1	2 / 1	R	2	N	2

KEY

Magnitude: 1 = Low (*e.g.*, within the normal variability of baseline conditions; 2 = Medium (*e.g.*, increase/decrease with regard to baseline but within standards and objectives; 3 = High (*e.g.*, singly or as a significant contribution in combination with other sources causing exceedances or impingement upon standards and objectives beyond the property line of the project
Geographic Extent: 1=<500 m^2; 2=500 m^2 – 1 km^2; 3=1-10 km^2; 4=11-100 km^2; 5=101-1000 km^2; 6=>1000km^2
Duration: 1=<1month; 2=1-12 months; 3=13-36 months; 4=37-72 months; 5=>72 months
Frequency: 1=<11 events/year; 2=11-50 events/year; 3=51-100 events/year; 4=101-200 events/year; 5=>200 events/year; 6=continuous
Reversibility: R=Reversible; I=Irreversible
Ecological/Socio-cultural and Economic Context: 1=Pristine area 2= Area affected by human activity; 3=Evidence of adverse effects
Residual Environmental Effect Rating: S=Significant Adverse Environmental Effect; N=Nonsignificant Adverse Environmental Effect; P=Positive Environmental Effect
Confidence: 1=Low level of confidence; 2=Medium level of confidence; 3=High level of confidence

8.1.2 Air Quality

Air quality is a VEC because it is one of the most important components of the environment, supporting the health and well being of human and other ecosystem components. Emissions to the atmosphere have the potential to adversely affect these components. The Project will discharge several gaseous and particulate emissions considered in the relevant legislation, and commonly associated with industrial projects. Effects upon the atmospheric environment are conventionally expressed in terms of these contaminants, and changes in their concentration due to project activities.

A description of existing conditions for air quality within the study area is presented in Section 6.1.4.

Nitrogen Oxides

Nitrogen oxides are produced in most combustion processes, and are almost entirely made up of nitric oxide (NO) and nitrogen dioxide (NO_2). Together, they are often referred to as NO_x. NO_2 is an orange to reddish gas that is corrosive and irritating. Most NO_2 in the atmosphere is formed by the oxidation of NO, which is emitted directly by combustion processes, particularly those at high temperature and pressure, such as diesel engines. NO is a colourless gas with no direct effects on health or vegetation at ambient levels; however NO_2 is an irritant that is harmful to vegetation and animals. NO_2 is the regulated form of NO_x. The levels of NO and NO_2, and the ratio of the two gases, together with the presence of hydrocarbons and sunlight are the most important factors in the formation of ground-level ozone and other oxidants. Further oxidation, and combination with water in the atmosphere forms part of "acid rain".

For this Project, NO_x will be produced by the backup HTF heaters, internal combustion engines on ships, haulage vehicles and handling vehicles at the LNG plant site.

Sulphur Dioxide

Sulphur dioxide (SO_2) is a colourless gas with a distinctive pungent sulphur odour. It is produced in combustion processes by the oxidation of sulphur in the fuel. SO_2 can, at high enough concentrations, cause damage to vegetation and health effects to animals through the respiratory system. SO_2 can also be further oxidized and combines with water to form the sulphuric acid component of "acid rain."

There will be negligible emissions of SO_2 in this project. Fuel regulations in Canada limit the sulphur content of diesel fuel. Heavy oil fuels with a higher sulphur content may be used on some ships, but these emissions will be limited to the time the LNG vessel is at or near the dock and is transferring cargo. The natural gas used in the backup HTF heaters have negligible sulphur content.

Total Suspended Particulate Matter

Total suspended particulate matter (TSP) is a measure of the particles in the atmosphere that are too small to settle out quickly, but remain suspended for significant periods of time (generally, particles with an aerodynamic diameter of less than 44 µm). TSP is produced by mechanical processes, such as the abrasion of vehicle tires on unpaved roads, and by combustion processes. Most particulate matter formed by combustion is either mineral ash from the fuel, or hydrocarbons formed by incomplete combustion.

This Project will result in construction-related emissions of particulate matter for the onshore facilities (*e.g.*, dust, vehicle exhaust); these emissions will be similar in type and scale to those created by other medium to large sized construction projects.

Fine and Respirable Particulate Matter

Although TSP is an excellent measure of the loading of particulate matter in the air, it does not necessarily reflect the health risks of the particulate matter. Large aerodynamic particles are trapped by the upper airways, and do not enter the lungs. Smaller diameter particles make their way to the lungs, and may become lodged there. Over the past few years, greater concern with regard to these fine particles has led to research resulting in new sampling methods and criteria. In June, 2000, the CCME adopted in principle Canada Wide Standards for particulate matter. Although these standards are not yet applicable, they will be relevant in the future. These standards provide for a proposed $PM_{2.5}$ standard of 30 µg/m^3 for the fine (<2.5 µm) particulate fraction, with the current objective of meeting the standard by 2010. The particulate matter from this Project is assessed as $PM_{2.5}$.

$PM_{2.5}$ will be produced primarily by internal combustion engines operating at or near the LNG plant. Most construction dust is of a greater particle size. The natural gas in the backup HTF heaters produces negligible particulate matter.

Carbon Monoxide

Carbon monoxide is a colourless, odourless gas that can be toxic to humans. It is a result of incomplete combustion, and is associated with all combustion processes, including internal combustion engines. Generally, ambient levels of carbon monoxide seldom exceed acceptable concentrations except in relatively congested traffic areas. In this project, some carbon monoxide will be emitted from the site activity, from the vehicles travelling to the plant, and by internal combustion engines on the ships.

Ozone

Ozone is a colourless gas with a sharp odour that acts as an oxidant, with the potential to cause damage to humans, vegetation and animals. It is a photochemical pollutant, formed as a secondary pollutant by the action of sunlight on the precursor pollutants, nitrogen oxides and hydrocarbons. Much of the ozone in this region is formed as a result of long-range transport of precursors from the US and central Canada.

For this Project, there will be emissions of nitrogen oxides and hydrocarbons resulting in some contribution to the potential for ozone formation.

Hydrogen Sulphide

Hydrogen sulphide (H_2S), is one of the pollutants regulated by the Province, but is not anticipated to result from any activities of the Project.

Greenhouse Gases

Methane is released by fugitive emissions, and as a trace residual as a result of incomplete combustion in flaring. Methane is an important greenhouse gas, being 21 times more effective than carbon dioxide (CO_2) on a weight to weight basis; 1 unit of methane is equivalent to 21 units of CO_2. There will also be CO_2 released from flaring, engine combustion, and other processing; this also represents a contribution to greenhouse gases.

8.1.2.1 Boundaries

Temporal Boundaries

Temporal boundaries for the assessment of air quality have been developed in consideration of those time periods during which Project air emissions have the potential to degrade ambient air quality. Construction of the Project will take a period of approximately 32 months. Within this period, there will be two to three months of site clearing and preparatory work, and a similar period of construction activity at the wharf. The active site clearing, and truck delivery period defines the critical period during which particulate matter emissions (*i.e.*, dust) are at their highest.

Process emissions will occur throughout the operational life of the Project. The routine testing of backup diesel engines for the fire pump and electrical power will occur for 30 minutes each week. There are no significant seasonal boundaries.

Spatial Boundaries

The spatial boundary for the assessment of air quality is the approximate zone of influence of a proposed LNG plant on regional air quality (*i.e.*, the distance over which project related emissions might match or exceed background levels). Based on dispersion modelling this distance is conservatively estimated as less than 5 km. There is also a corridor along which the cargo vessels travel to and from the terminal. This corridor is already in use and emissions occur regularly from vessels transiting the corridor; the additional traffic will not add significantly to these emissions. The focus of this analysis is the operations within the terminal.

Administrative Boundaries

Ambient air quality in Canada is regulated by the provincial government. The federal government has set objectives for air quality which are taken into account by federal agencies in project review. These objectives form the basis for the air quality regulations of several provinces, including Nova Scotia. The Nova Scotia regulated limits correspond to the upper limit of the Maximum Acceptable category of air quality, which are set under the *Canadian Environmental Protection Act* (*CEPA*). These guidelines may also be used as reference by provincial or federal regulators. The air quality guidelines of tolerable, acceptable, and desirable, as defined under *CEPA*, will be used in the evaluation of significance. The maximum tolerable level denotes a concentration beyond which appropriate action is required to protect the health of the general population. The maximum acceptable level is intended to provide protection against effects on soil, water, vegetation, visibility, and human well being. The maximum desirable level is the long-term goal for air quality. Additional guidelines are under development by the Canadian Council of Ministers of the Environment (CCME), and ultimately this body will develop Canada Wide Standards (CWS) that harmonize the regulations in all jurisdictions. The federal ambient air quality objectives and the Nova Scotia *Air Quality Regulations* are shown in Table 8.2.

Table 8.2 Nova Scotia Air Quality Regulations *(Environment Act)* and *Canadian Environmental Protection Act* Ambient Air Quality Objectives

Pollutant and units (alternative units in brackets)	Averaging Time Period	Nova Scotia	Canada			
		Maximum Permissible Ground Level Concentration	Canada Wide Standards (pending)	Ambient Air Quality Objectives		
				Maximum Desirable	Maximum Acceptable	Maximum Tolerable
Nitrogen dioxide µg/m^3 (ppb)	1 hour	400 (213)	-	-	400 (213)	1000 (532)
	24 hour	-	-	-	200 (106)	300 (160)
	Annual	100 (53)	-	60 (32)	100 (53)	-
Sulphur dioxide µg/m^3 (ppb)	1 hour	900 (344)	-	450 (172)	900 (344)	-
	24 hour	300 (115)	-	150 (57)	300 (115)	800 (306)
	Annual	60 (23)	-	30 (11)	60 (23)	-
Total Suspended Particulate Matter (TSP) µg/m^3	24 hour	120	-	-	120	400
	Annual	70	-	60	70	-

Table 8.2 Nova Scotia Air Quality Regulations *(Environment Act)* and *Canadian Environmental Protection Act* Ambient Air Quality Objectives						
Pollutant and units (alternative units in brackets)	**Averaging Time Period**	**Nova Scotia**	**Canada**			
		Maximum Permissible Ground Level Concentration	**Canada Wide Standards (pending)**	**Ambient Air Quality Objectives**		
				Maximum Desirable	**Maximum Acceptable**	**Maximum Tolerable**
PM2.5 $\mu g/m^3$	24 hour, 98th percentile over 3 consecutive years	-	30 (by 2010)	-	-	-
PM10-2.5 $\mu g/m^3$		-	Recommended in 2003	-	-	-
Carbon Monoxide mg/m^3 (ppm)	1 hour	35 (31)	-	15 (13)	35 (31)	-
	8 hour	15 (13)	-	6 (5)	15 (13)	20 (17)
Oxidants – ozone $\mu g/m^3$ (ppb)	1	160 (82)	-	100 (51)	160 (82)	300 (153)
	8 hour, based on 4th highest annual value, averaged over 3 consecutive years	-	128 {by 2010} (65)	-	-	-
	24 hour	-	-	30 (15)	50 (25)	-
	Annual	-	-	-	30 (15)	-
Hydrogen sulphide $\mu g/m^3$ (ppb)	1 hour	42 (30)	-	-	-	-
	24 hour	8 (6)	-	-	-	-

Mobile source (*e.g.*, ships, vehicular traffic) emissions are regulated at the federal level by Transport Canada and Environment Canada. On-road vehicles are subject to federal new-vehicle emission limits. Several provinces have comprehensive limits for in-use vehicles; Nova Scotia does not.

For the purposes of this study, the term "standards" refers to the Nova Scotia Maximum Permissible Ground Level Concentration as specified under the Nova Scotia Air Quality Regulations under the Nova Scotia *Environment Act*.

Technical Boundaries

The assessment approach taken in this study is based on a dispersion modelling approach. This approach involves the prediction of the increased concentration of the contaminants in the atmosphere within the zone of influence of the facility. The predictions are based on computerized mathematical dispersion models. Such models require the specification of emission rates, the physical geometry of the sources of the contaminants, the spatial relationship of the sources and the receptors, and the meteorological elements that are directly relevant to the movement of the air contaminants in the atmosphere. These approaches are well developed, and are accepted by the regulatory agencies involved in this assessment.

The dispersion model used here is the Industrial Source Complex model version 3, or ISC3, which was developed by the US EPA for applications similar to this Project. The model is applicable for distances up to about 35 km, well beyond the zone of interest in this study. More advanced models are available for use; ISC3 is considered to be conservative (err on the safe side – overpredicting), but the very low level of effect from this plant is adequately considered by ISC3. The meteorological data were taken from the Eddy Point meteorological station for the years 1979-1983. These data are observations of weather elements, and there has been no significant change in those elements since the period of observation. The Eddy Point station was discontinued in 1985. This station provides good representation of the study area, and the data series is sufficiently long to provide a stable basis for estimating the maximum impacts. Source information was predicted using the latest version (online) of the US EPA Compilation of Emission Factors for Stationary Sources (AP-42).

8.1.2.2 Residual Environmental Effects Evaluation Criteria

A **significant adverse effect** is a change in the air quality that would result in a exceedance of the regulated limits of the Nova Scotia Department of Environment and Labour on a repeated or sustained basis at any location outside the property boundaries of the project.

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

A **positive effect** is a net reduction in air pollutants at any location influenced by the construction of this undertaking.

8.1.2.3 Potential Interactions, Issues and Concerns

During construction activities, particulate matter may be emitted from site excavation, grading, aggregate handling, and vehicle movement on unpaved access roads. Emissions from mobile sources, such as ships and vehicular traffic along with flaring and fugitive emissions are the most likely contaminants to be found during operation of an LNG plant.

Emissions of the major sources (*e.g.*, ship) are of a short-term nature, relatively low frequency, and with potential impacts in the order of several hundred metres. Emissions from freight vehicles may be more frequent and sustained over the life of the project, but with a smaller zone of influence and concentration of contaminants.

Processing emissions will comprise combustion products primarily NO_x and CO_2. NO_x is regulated because of potential health effects. CO_2 is a greenhouse gas. Emergency or test depressurization flaring is a concern because it is a source of CO_2 and NO_2. Flares are not perfectly efficient and will result in emission of residual amounts of methane, which is of significant interest as a greenhouse gas.

The continuing increase in greenhouse gas emissions is expected to result in a changing and/or more varied climate. Some experts maintain that this is already happening, and a greater frequency of weather extremes is now imposing additional stress on natural ecosystems and social systems.

As temperatures warm, oceans will expand, causing sea levels to rise. Canadian research suggests that sea levels on the Atlantic coast of Nova Scotia could rise by 70 cm by 2100 (Environment Canada 1997). The majority of the Atlantic coast of Nova Scotia is highly sensitive to rising sea levels. Therefore, projects in coastal zones are sensitive to climate change. The most sensitive areas are low-lying salt marshes, barrier beaches, and lagoons. Higher sea levels will cause increased erosion, smaller or disappearing beaches, and flooding of coastal freshwater marshes. They will also affect coastal infrastructure, such as bridges, wharves, breakwaters, and roads. Effects of the environment on the Project are discussed in Section 8.5.

The availability of more natural gas on the energy market provides a basis for repowering and fuel switching by the potential users. Significant reductions in emissions of particulate matter, sulphur dioxide, and other pollutants are likely to result where this fuel substitution is achieved.

8.1.2.4 Analysis, Mitigation and Residual Environmental Effects Prediction

Construction

During construction, the site preparation work and intensive use of heavy construction vehicles at the plant site will result in the emission of particulate matter. Dry weather conditions will increase emissions by such vehicles; wet weather will reduce the emissions as will the application of water, calcium chloride, or other agents to reduce road dust. As the site is sufficiently isolated by distance from residents of the area, the particulate emissions will not result in significant impacts off the plant site. It is understood, however, that in the interest of industrial hygiene, and to reduce the aesthetic impacts of dust generation, a responsible degree of particulate control will be undertaken.

Specific attention must be paid to the route that construction vehicles use from concrete plants, work yards, and supplier facilities to the plant site. There should be a tire washdown area available at the worksite to avoid tracking soil onto the public roadways. In view of the importance of traffic control to the minimization of impacts to air quality, noise, and public safety, a traffic management plan will be completed for the construction phase (Section 8.2.6).

As part of the plant commissioning, there will be testing of all operating equipment. This testing program is not anticipated to result in any significant emission. There will be a need to cool down the entire plant to the operating temperatures. This has been done in some plants using vented LNG to effect the cooling. Liquid nitrogen may also be used to cool down the system prior to the introduction of LNG. The proponent will consider this option and render a decision based on environmental and

technical issues during more detailed engineering design. From an environmental perspective, the discharge of nitrogen gas to the atmosphere is negligible, as the atmosphere is composed of 78% nitrogen. The discharge of methane represents a one-time release of a greenhouse gas of 6,500 tonnes, equivalent to 137 kilotonne of carbon dioxide.

Operation and Maintenance

Dispersion modelling was conducted to determine the maximum ground-level impacts of the emission sources of the plant. Refer to Section 2.4.1 for anticipated operational air emissions.

The sources considered in this analysis included:

- backup HTF heaters;
- flare pilot burners and purge, or sweep gas;
- backup diesel generator;
- backup diesel driven fire water pumps; and
- ship hotelling emissions (*i.e.*, when LNG vessel is at dock).

Nitrogen oxides

The maximum predicted nitrogen oxide concentration (NO_x) is 179 $\mu g/m^3$, resulting from the emissions of the test diesel engines (assuming continuous operation during test period). As diesel engines emit approximately 90% of the NO_x in the form of NO, and about 10% as NO_2, this corresponds to about 18 $\mu g/m^3$ NO_2. This represents about 4.5% of the one hour criterion, which, in combination with existing source contributions, would still be well within the criterion.

The emissions from the backup HTF heater and the flare produce a maximum one-hour ground-level concentration of NO_x of 13.9 $\mu g/m^3$. Assuming a NO_2/NO_x ratio of 0.10, this would represent a negligible concentration of about 0.3% of the standard.

Particulate matter and PM-2.5

The particulate emissions from the backup diesel engines are predicted to produce a maximum off-site, 10-hour ground-level concentration of 4.3 $\mu g/m^3$. The ship emissions will result in 1.3 $\mu g/m^3$. The backup HTF heaters will contribute 3.5 $\mu g/m^3$. These are all well below the current limit of 120$\mu g/m^3$ for total particulate and the future 30 $\mu g/m^3$ limit for $PM_{2.5}$. As these particulate emissions are all combustion products, it can be assumed that the majority of the emission is in the fine respirable fraction. As the results compare favourably with the standards, the analysis does not go beyond the worst-case assumption that all of the emissions are in the $PM_{2.5}$ range. In combination with existing levels, the particulate matter in all size ranges would be within criteria levels.

Carbon Monoxide

The regulated limit for carbon monoxide is relatively high, at 35 mg/m^3 for a one-hour average. The maximum computed ground-level concentration, including all sources in normal operating mode, is 0.04 mg/m^3, about 0.1% of the standard, a negligible increase to existing concentrations.

Sulphur Dioxide

The sulphur dioxide results from the sulphur content of the diesel fuel used in the backup diesel engines, which are used only 30 minutes per week in testing, and from the ship hotelling emissions. The maximum hourly concentration of sulphur dioxide is predicted to be 39 $\mu g/m^3$, or about 2.3% of the relevant standard. This increment will not significantly increase the existing concentrations of sulphur dioxide, especially in consideration of the very low frequency of operation of backup diesel engines.

Carbon Dioxide

If the HTF heaters are used for three weeks per year while the waste heat from the power plant is not available, the carbon dioxide emissions from the shore based facilities and ship hotelling will be 36.2 kilotonnes. Fugitive emissions of methane add an additional 0.6 tonnes of carbon dioxide equivalent (CO_2e). If the HTF heaters must be used full time, the emissions would be 596.5 kilotonnes CO_2 plus 0.8 kilotonnes CO_2e, to give 597.3 kilotonnes. The use of waste heat to reduce the greenhouse gas emissions from the Project would be a preferred approach.

In comparison, the greenhouse gas inventory for Nova Scotia, for the latest available tabulation year, 2000, was a total of 21,500 kilotonnes. Energy emissions accounted for 19,800 kilotonnes. If the planned mitigation design, using waste thermal power plant heat, cannot be implemented, the Project will emit 2.8% of the provincial total. If the waste heat option is achieved, the project will emit 0.17% of the provincial total.

These systems will cause no significant impact. There have been impact mitigation components incorporated into the design of this plant. In particular, it is planned at the present time to use waste heated water from the nearby thermal power plant as the source of energy for regasification of the LNG. It is necessary to provide backup energy for this, hence the incorporation of backup HTF heaters into the system. When in operation, these heaters represent the largest single source, in terms of energy use. It is anticipated that they may operate for a period of approximately three weeks each year while the power plant is undergoing annual maintenance.

There will be a flare to handle process upsets and emergency conditions. Two pilot burners will be installed, and a gas supply will purge, or sweep the main burners. The flare is designed to exhaust at a physical height of 61 m, as this provides sufficient separation from the ground for thermal radiation emissions during full operations. During normal conditions, when only the pilot and purge gas is

combusted and exhausted at the flare, the height of the flare, and the heat released by the combusting gases are more than sufficient to prevent significant ground-level concentrations of exhaust products. As natural gas is the only fuel with negligible sulphur or other contaminants, the only contaminant produced in the exhaust is the group of nitrogen oxides.

8.1.2.5 Follow-up and Monitoring

NSDEL have identified the industrial Strait region as one where an airshed management approach will be taken. ANEI has agreed to participate in the cooperative monitoring programs that are a part of this concept.

ANEI will also conduct independent testing at the Project site. High-volume samplers will be used, if required, during the construction phase to monitor particulate emissions from the site. Equipment will be tested on commissioning using combustion analyzers. This will include the diesel engines as well as the backup heaters. During normal operation, utilizing waste heated water for regasification, the plant will operate with minimal emissions to the atmosphere. Continuous monitoring is not deemed to be necessary unless there are significant changes in the design concepts.

8.1.2.6 Summary of Residual Environmental Effects Assessment

During construction, there is potential for excessive particulate generation on-site and on the approach roads. Vigilant attention to standard dust control practices, industrial hygiene, and traffic control can minimize these effects on air quality.

During normal operation, the plant will have few sources of emissions, and will have no significant impacts. In emergency situations, the diesel backup equipment will cause increased, but not significant emissions.

Flaring is an essential safety provision. The flare will not cause any significant local deterioration in air quality.

Provided the recommended mitigative measures are implemented, no significant adverse residual environmental effects on air quality are likely to occur. Table 8.3 provides a summary of the residual environmental effects and recommended mitigative action for air quality.

Table 8.3 Residual Environmental Effects Assessment Matrix: Air Quality

Project Activity	Potential Positive (P) or Adverse (A) Environmental Effect	Mitigation	Significance Criteria for Environmental Effects					Residual Environmental Effect	Level of Confidence
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/ Social-cultural and Economic Context		
CONSTRUCTION									
Site clearing	Particulate matter (A)	• Dust control program	1	2	3	R	2	N	2
Heavy truck traffic	Particulate matter (A)	• Dust control program	1	2	3	R	2	N	2
Cool down	Venting methane (A)	• Use liquid nitrogen if found feasible	1	1	1	R	2	N	3
		• No mitigation of LNG venting	2	6	1	R	2	N	2
OPERATION AND MAINTENANCE									
HTF Heaters	Emissions (A)	• None required for criteria contaminants, significant GHG reductions potential through utilization of waste heat from Point Tupper generating station	1	6	5	R	2	N	3

KEY

Magnitude: 1 =Low: (*e.g.*, within normal variability of baseline conditions); 2 = Medium: (*e.g.*, increase/decrease with regard to baseline but within standard objectives); 3 =High: (e.g., singly or as a significant contribution in combination with other sources, causing exceedances or impingement upon standards and objectives).
Geographic Extent: 1= <500 m²; 2 = 500 m² -1 km²; 3 = 1-10 km²; 4 = 11-100 km²; 5 =101-1000 km²; 6 = >1000 km².
Duration: 1 = < 1 month; 2 = 1-12 months; 3 = 13-36 months; 4 = 37-72 months; 5 = > 72 months.
Frequency: 1 = < 11 events/year; 2 = 11-50 events/year; 3 = 51-100 events/year; 4 = 101-200 events/year; 5 = >200 events/year; 6 = continuous.
Reversibility: R = Reversible; I = Irreversible.
Ecological/Socio-cultural and Economic Context: 1 = Pristine area; 2= Area affected by human activity; 3 = Evidence of adverse effects.
Residual Environmental Effect Rating: S = Significant Adverse Environmental Effect; N = Non-significant Adverse Environmental Effect; P = Positive Environmental Effect.
Confidence: 1 = Low; 2 = Medium; 3 = High.

8.1.3 Acoustic Environment

The acoustic environment is a VEC due to concern with potential Project noise emissions and sensitive receptors. Noise is defined as unwanted sound. Noise is measured in the same way as any sound, as a sound pressure level, or SPL, in units of decibels. To reflect the sensitivity of the human ear across the audio spectrum, the SPL readings are given in what is termed the "A-scale" and are denoted as dBA. Ambient noise readings in an area remote from most development (*e.g.*, Bear Head) may include direct wind-induced effects, such as the rustling of leaves, or indirect effects, such as waves crashing along the shore.

Humans live in a broad range of sound pressure levels. A level of 0 dBA is the least perceptible sound by a human. A change of 3 dBA represents a physical doubling of the sound pressure levels, but is barely perceptible as a change, whereas most persons clearly notice a change of 5 dBA and perceive a change of 10 dBA as a doubling of the sound level. Typically, conversation occurs in the range of 50 to 60 dBA. Loud equipment, trucks passing by on a busy road, are responsible for noise levels of about 85 dBA, the threshold for which hearing protection may be required in the workplace. Very quiet environments, such as a still night in a remote environment may fall below 40 dBA, but only below 30 dBA in exceptionally quiet environments.

The acoustic environment can be degraded by the presence of unwanted sound. For the most part, noise is a nuisance that detracts from the enjoyment of a quiet acoustic environment. In severe cases, noise can cause sleep disturbance, anxiety, and consequent health effects. It can damage the natural environment by alarming wildlife, inhibiting reproduction, and spoiling habitat.

The potential for underwater noise and effects on marine mammals is discussed in Section 8.1.6.

A description of existing conditions for the acoustic environment within the study area is presented in Section 6.1.5.

8.1.3.1 Boundaries

Temporal Boundaries

Temporal boundaries for the assessment of the acoustic environment have been developed in consideration of the period of Project construction activities and the Project operation. The plant will be constructed over a period of about 32 months. Greatest activity by heavy vehicles is likely to occur in late 2005. The noisiest activity, the pile driving phase of jetty construction, will take place over an estimated six month period.

The significance of noise impacts are dependent upon the time of occurrence. Generally, assessments consider three time frames:

- Day 07:00 – 19:00;
- Evening 19:00 – 23:00; and
- Night 23:00 – 07:00.

These periods are listed in order of increasing sensitivity and, in most jurisdictions, in order of lowering limits.

Spatial Boundaries

Spatial boundaries for the assessment of acoustic environment have been developed in consideration of the alternation characteristics of sound emissions and the distances to potentially affected sensitive receptors. The nearest residences to the plant site are the houses across the Strait, approximately 2 km from the proposed plant. The land on the east side of the Strait is zoned industrial, and there are no receptors within 2 km of the plant. Any future development in the industrial park will likely not be considered a sensitive receptor and the plant property will provide substantial buffers.

Administrative Boundaries

NSDEL has established the following criteria for the provincial Guideline for Environmental Noise Measurement and Assessment (NSDEL Guidelines) (NSDOE 1989) with respect to sensitive receptors (*e.g.*, residential areas, schools, *etc.*):

- An L_{eq} of 65 dBA between 0700 to 1800 hours;
- An L_{eq} of 60 dBA between 1900 to 2300 hours; and
- An L_{eq} of 55 dBA between 2300 to 0700 hours.

The Equivalent Sound Level (L_{eq}) is a logarithmic average of noise levels due to all sources of noise in a given area over a stated period of time.

Technical Boundaries

Noise transmission in the atmosphere can be complicated by the presence of thermal inversion layers such as occur along coastlines due to the strong temperature difference between land and water. Transmission loss estimates are considered sufficiently accurate for the purposes of this assessment.

8.1.3.2 Residual Environmental Effects Evaluation Criteria

The NSDEL Guidelines are useful screening guidelines to determine if further investigation is warranted. They are the primary criteria for the assessment. In addition, an increase of 10 dBA above existing noise levels is considered significant because it represents a perceived doubling of the noise.

A **significant adverse effect** occurs where the project increases the noise levels at a residential area beyond the NSDEL guidelines, or more than 10 dBA above pre-Project levels.

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

A **positive effect** occurs where the project results in a decrease of ambient noise levels.

8.1.3.3 Potential Interactions, Issues and Concerns

Onshore noise will be produced in the construction phase and in the operational phase of this Project. During the construction phase, the noise will be similar to common construction projects involving large machinery. Table 8.4 lists the typical noise outputs of commonly used construction machinery including pile drivers (May 1978). Construction equipment generally has outputs ranging from 68-105 dBA. The level of noise will vary according to the type and level of construction activity.

Table 8.4 Typical Construction Equipment Noise

Equipment Powered By Internal Combustion Engines	Noise Level dBA (at 4.5 m)
Earth Moving	
Compactors (Rollers)	72 – 75
Front Loaders	72 - 85
Backhoes	72 - 94
Tractors	76 - 96
Scrapers, Graders	80 - 94
Materials Handling	
Cranes (Moveable)	75 - 86
Cranes (Derrick)	86 - 88
Stationary	
Pumps	68 - 72
Generators	72 - 82
Compressors	75 - 86
Impact Equipment	
Jack Hammers and Rock Drills	82 - 98
Impact Pile Drivers	95 - 105
Source: May 1978	

Pile drivers though intermittent are of concern for several reasons. When used for jetty construction (as planned for the ANEI facility), a large noise emission may be transmitted. They also emit more noise than any other anticipated equipment item and the noise from a pile driver is an intermittent impulse

noise, rather than a continuous one. Those affected by continuous noise sources may become accustomed, and less sensitive to the noise. Intermittent noises are more difficult to ignore, and sustained operation of such devices is much more likely to cause annoyance than a continuous noise source even though each activity might have the same noise output on average.

During the operational phase, noise sources will include:

- process equipment at the plant site, such as motors, pumps, compressors and vents;
- routine testing of emergency diesel generators, and fire pump engines;
- vehicles used for property maintenance, employee travel; and
- tanker and tugs assisting in berthing.

Standard operations of onshore facilities are not anticipated to generate audible noise off facility property.

There are no known issues with respect to current levels of ambient noise in the area. This results from the very low background noise and the apparent absence of any specific identifiable source (refer to Section 6.1.5).

Potential effects of underwater noise on marine mammals is discussed in Section 8.1.6.

8.1.3.4 Analysis, Mitigation and Residual Environmental Effects Prediction

Construction

During Project construction, site activity is likely to be intense, and it is probable that noise levels onsite will be in the range of 80 to 90 dBA. Although the areas adjacent to the site are not highly sensitive to noise, it is good practice to maintain reasonable controls on excessive noise activities. Noise reduction is generally compatible with good industrial hygiene practice as well as reducing disturbance to wildlife.

The noisiest activity is likely to be the pile driving during jetty construction. Sound pressure levels of 100 dBA may occur at about 10 m. Without mitigation, the noise may attenuate across the Strait to about 50 dBA, sufficient to be audible and distinguishable from other sources. If the impulse noise peaks cannot be limited to 50 dBA or less at the nearest residence, as identified through monitoring of the noisiest activities (*e.g.*, pile driving), specific mitigation measures will be implemented (as noted above and/or imposition of a shorter work week). It is possible to provide some mitigation by placing noise absorbing barrier material between the impact head of the pile driver and the receptors. Heavy acoustic blanketing material is available for this purpose and is capable of reducing the noise by a further 5 to 10 dBA. Vibratory pile driving equipment is much less noisy than the drop hammer type and should be investigated for cost effectiveness. Other measures include limiting the time when pile

driving occurs. If mitigation can reduce the noise below the specified targets, the time limitations are not necessary.

Other equipment used in construction is likely to be 10 to 15 dBA less noisy than pile driving, and will likely not be noticeable except on an occasional basis, and not likely to an extent that would be annoying. No restrictions in the work week are necessary. The routing of the truck traffic, especially concrete trucks during the maximum period of activity, must be controlled to avoid excessive noise effects in residential areas. If these areas can be avoided, scheduling restrictions need not be applied.

Assuming effective mitigation, significant residual effects on the acoustic environment from Project construction are not likely.

Operation and Maintenance

The Project will be typical of many LNG facilities operating in numerous locations. The design engineers have provided information on a similar facility that had proceeded through final engineering design, and for which a detailed inventory was available for noise producing machinery. The results of noise modelling for that facility were that the plant noise would attenuate to about 55 dBA within about 300 m from the centre of the Project site (see Figure 12, Appendix D).

Additional noise from the operation of ship traffic during operations, will be similar to the noise experienced currently from ship traffic in the Strait. No additional mitigation is considered necessary.

No significant residual affects on the acoustic environment from Project operation are likely.

8.1.3.5 Follow-up and Monitoring

Follow-up monitoring is required during the construction period to ensure that the pile-driving and other construction activities do not disturb the tranquil nature of the residential properties on the west side of the Strait. Specific mitigative measures will be implemented if noise levels at the nearest residences exceed threshold levels. Monitoring should be conducted if complaints arise due to truck traffic through the towns during the construction period, and acceptable routing may be evaluated and enforced.

During operation, a round of noise monitoring is advisable to establish baseline levels due to plant operation prior to any other future nearby development. This should include characterization of ship noise, emergency equipment (*e.g.*, emergency generators and firewater pumps), and normal operating modes. This information will provide evidence on behalf of the plant in the event that further development triggers complaints.

8.1.3.6 Summary of Residual Environmental Effects Assessment

It is likely that construction activity will result in the detection and identification of certain noise outside of the plant construction area. Pile driving is of specific concern and the noise will be monitored with mitigation applied if necessary.

Other noise generating activity at the site is likely to yield little or no impact beyond the site. Truck traffic during the construction phase can be controlled provided that routing provisions are enforced.

Provided the recommended mitigative measures are implemented, no significant adverse residual environmental effects on the acoustic environment are likely to occur. Table 8.5 provides a summary of the residual environmental effects and recommended mitigative action for the acoustic environment.

Table 8.5 Residual Environmental Effects Assessment Matrix: Acoustic Environment

Project Activity	Potential Positive (P) or Adverse (A) Environmental Effect	Mitigation	Significance Criteria for Environmental Effects					Residual Environmental Effect	Level of Confidence
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/ Social-cultural and Economic Context		
CONSTRUCTION									
Jetty construction	Noise from pile driving (A)	• Implementation of measures (*e.g.*, acoustic blankets, vibratory pile drivers, shortened work time) if noise exceeds threshold levels.	2	3	2 / 3	R	2	N	2
Clearing, grading, terminal construction	Noise from construction equipment (A)	• No mitigation recommended.	1	2	3 / 4	R	2	N	3
	Noise from truck movement (A)	• Truck routing to avoid sensitive areas.	1	3	3 / 4	R	2	N	3
OPERATION AND MAINTENANCE									
Terminal operation	Noise from general equipment operation (A)	• No mitigation is recommended	1	2	5 / 6	R	2	N	3

KEY

Magnitude: 1 = Low (*e.g.*, within the normal variability of baseline conditions; 2 = Medium (*e.g.*, increase/decrease with regard to baseline but within standards and objectives; 3 = High (*e.g.*, singly or as a significant contribution in combination with other sources causing exceedances or impingement upon standards and objectives beyond the property line of the project
Geographic Extent: 1=<500 m^2; 2=500 m^2 – 1 km^2; 3=1-10 km^2; 4=11-100 km^2; 5=101-1000 km^2; 6=>1000km^2
Duration: 1=<1month; 2=1-12 months; 3=13-36 months; 4=37-72 months; 5=>72 months
Frequency: 1=<11 events/year; 2=11-50 events/year; 3=51-100 events/year; 4=101-200 events/year; 5=>200 events/year; 6=continuous
Reversibility: R=Reversible; I=Irreversible
Ecological/Socio-cultural and Economic Context: 1=Pristine area 2= Area affected by human activity; 3=Evidence of adverse effects
Residual Environmental Effect Rating: S=Significant Adverse Environmental Effect; N=Nonsignificant Adverse Environmental Effect; P=Positive Environmental Effect
Confidence: 1=Low level of confidence; 2=Medium level of confidence; 3=High level of confidence

8.1.4 Marine Benthic Habitat and Communities

Marine benthic habitat and communities is a VEC in consideration of the habitat provided by the seafloor for demersal fish species and sedentary invertebrates and the general importance as part of the marine ecosystem. Fish and fish habitat, are protected by the federal *Fisheries Act*. This VEC includes consideration of sediment quality and is closely linked to Marine Fish and Fish Habitat (Section 8.1.5) and Commercial Fisheries and Aquaculture (Section 8.2.3).

A description of existing conditions for marine benthic habitat and communities within the study area is presented in Section 6.1.7.1.

8.1.4.1 Boundaries

Temporal Boundaries

The temporal boundary for benthic habitat and communities is developed in consideration of their presence in the Strait of Canso year round. The temporal boundary of the assessment is continuous during Project construction until recovery to background conditions, and continuous during the operational period with regard to marine infrastructure until the infrastructure is removed.

Spatial Boundaries

The spatial boundary for the assessment of this VEC is the benthic zone of influence associated with the marine infrastructure footprint (*i.e.*, jetty and potential water intake/outfall) at Bear Head as defined by the benthic habitat survey transects (Figure 6.7).

Administrative Boundaries

Marine benthic habitat is a component of fish habitat. Any project discharges that could affect the marine benthic habitat are subject to regulations under the federal *Fisheries Act*. Federal Policy for Management of Fish Habitat applies to projects with potential to alter, destroy or disrupt fish habitat. Project related disturbances and/or deposition of material on the seafloor may be regulated under the ocean disposal provisions of the *Canadian Environmental Protection Act*.

Technical Boundaries

The analysis of benthic habitat and communities was based on a review of available information for the study area as well as a habitat and sediment chemistry sampling program, and video survey and any limitations therein.

8.1.4.2 Residual Environmental Effects Evaluation Criteria

A **significant adverse effect** is one where marine benthic habitat would be altered, either physically, chemically, biologically, in quality or extent, to such a degree that there is a decline in the species diversity of the habitat. This effect would be reflected by a decline in abundance and/or change in distribution of the benthic community within the Strait of Canso, beyond which natural recruitment (reproduction and migration from unaffected areas) would not return that population to its former level within several generations.

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

A **positive effect** is one where the habitat quality is enhanced, the species diversity is increased, or the area of habitat is increased.

8.1.4.3 Potential Interactions, Issues and Concerns

The jetty will be designed as a piled structure. During Project construction, pile driving will result in a loss of marine benthic habitat in the marine structure footprint area. Dredging and infilling is not expected; therefore widespread disturbance or destruction of the benthos will be avoided. It is anticipated that the area lost through the piling will be offset by the vertical habitat created by the steel structures. The rest of the structure is relatively transparent to flow and should not offer any impingement to circulation in the Strait of Canso. Increase in turbidity, siltation and contamination may result from Project construction and/or operation activities (*e.g.*, piledriving, propwash). The addition of new or different substrate types associated with the marine structure could provide opportunities for recolonization with different types of benthic communities compared with those currently resident (*e.g.*, reef effect). It is anticipated that a small amount of benthic habitat would be lost if a water intake or discharge structure is placed on the seafloor. LNG vessels will comply with ballast discharge guidelines (see Section 8.1.5.4) and not discharge ballast water in Chedabucto Bay and the Strait of Canso; therefore no interaction of ballast waters with the study area (*e.g.*, introduction of invasive species) is anticipated.

8.1.4.4 Analysis, Mitigation and Residual Environmental Effects Prediction

Construction

Fisheries and Oceans Canada developed the Policy for the Management of Fish Habitat (1986) which applies to all projects and activities, large or small, in or near water that could alter, disrupt or destroy fish habitats by chemical, physical or biological means. The guiding principle of this policy is to achieve no net loss of the productive capacity of fish habitats. The policy is based on Sections 20 to 22, 30, 32, 35 and 36 to 42 of the *Fisheries Act.* An authorization is required for harmful alteration

disruption or destruction (HADD) of fish habitat. As a general guideline, DFO requires the loss of productive habitat to be replaced at a ratio of three units created for each one lost.

Final HADD calculations to determine net loss of fish habitat will be performed at the time final design specifications are known. However, it is more than likely that the construction of the marine terminal will result in no net loss of fish habitat since the area lost by the footprint of the pilings and small water intake/discharge will be offset by the creation of vertical habitat from the installation of the pilings beneath the high tide water mark.

There is considerable variation in recovery rates of benthic organisms as described in the literature; some recover within two weeks, and some are permanently reduced. The recovery success greatly depends upon the degree of disturbance, sediment properties, species tolerances and the ability of species to repopulate through adult mobility or larval settlement (Jones 1974). Complete recolonization of the rocky habitat with marine seaweeds and a mature benthic community is expected to occur within two to three years (Scarratt 1968). Numerous sessile organisms that do not exist on fine grained sediment such as encrusting species of anemones, tunicates, sponges, bryozoans, hydroids, *etc.* will find opportunity to develop on the hard substrate (Scarratt 1968). Marine seaweeds, which are important to habitat diversity and food supplies, will also quickly colonize the hard substrate. The recolonization will attract other mobile species for feeding and refuge ultimately creating a reef effect; consequently, the biodiversity along the facility may increase significantly.

To minimize siltation during pile driving activities, silt curtains will be installed at the perimeter of the work area, if feasible, to minimize sedimentation of adjacent areas in the marine environment. To prevent sediment-laden runoff from the facility from entering streams or the marine environment, an Environmental Protection Plan will be developed and implemented.

No adverse significant effect is expected to result from construction of the marine terminal as the population of the benthic organisms in intertidal and subtidal zones are common and ubiquitous throughout the Strait. Minor habitat lost through installation of pilings and water intake/outfall structure will likely be offset through provision of additional hard substrate to colonize (steel pilings). If further mitigation is considered necessary by DFO upon review of final jetty design, negotiations for habitat compensation can be undertaken with the proponent as a condition of the HADD authorization.

Operation and Maintenance

In addition to the ongoing presence of the marine infrastructure and the associated change in benthic habitat during Project operation, there will be limited interaction between the Project and benthic (intertidal and subtidal) environment during the operations phase. Stormwater runoff will be controlled through application of a Stormwater Management Plan to control potential siltation and hydrocarbon contaminated runoff into the marine environment. Surface water discharge will meet regulator standards

for TSS (typically 25 mg/L monthly average). Due to the depth of water, there will be limited opportunity for sediment disturbance from vessel propwash.

8.1.4.5 Follow-up and Monitoring

Stormwater runoff will be monitored to ensure that the TSS concentrations meet regulatory standards. Following construction, the marine structure and surrounding area will be monitored by underwater video survey after the site has been allowed to stabilize and benthic communities have established. Underwater video will be undertaken on a yearly basis to verify predictions and make comparisons with the baseline data. The video will be submitted to the DFO area habitat coordinator on a yearly basis. The duration of the monitoring program will be established in consultation with DFO.

8.1.4.6 Summary of Residual Environmental Effects Assessment

The benthic habitat in the proposed marine terminal area is ubiquitous to the area. The value of the added vertical habitat associated with the piling will likely offset the small amount of existing benthic habitat lost.

Provided the recommended mitigative measures are implemented, no significant adverse residual environmental effects on marine benthic habitat and communities are likely to occur. Table 8.6 provides a summary of the residual environmental effects and recommended mitigative action for marine benthic habitat and communities.

Table 8.6 Residual Environmental Effects Assessment Matrix: Marine Benthic Habitat and Communities

Project Activity	Potential Positive (P) or Adverse (A) Environmental Effect	Mitigation	Significance Criteria for Environmental Effects					Residual Environmental Effect	Level of Confidence
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/ Social-cultural and Economic Context		
CONSTRUCTION									
Pile driving and construction of seawater intake/discharge structure	Disturbance of substrate and siltation of adjacent areas (A)	• Silt Curtains, if feasible	1	1	2/2	R	2	N	3
	Loss of benthic habitat possibly offset by addition of hard, vertical substrate (A)	• Habitat compensation, if required by DFO	1	1	5/6	R	2	N	3
Site preparation	Erosion and sedimentation of marine environment (A)	• Stormwater Management Plan	1	3	2/1	R	2	N	3
OPERATION AND MAINTENANCE									
Surface runoff	Erosion and sedimentation of marine environment (A)	• Stormwater Management Plan	1	3	2/6	R	2	N	3

KEY

Magnitude: 1 =Low: (*e.g.*, specific group or habitat, localized, one generation or less, within natural variation); 2 = Medium: (*e.g.*, portion of a population or habitat, 1 or 2 generations, rapid and unpredictable change, temporarily outside range of natural variability); 3 =High: (e.g., affecting a whole stock, population or habitat outside the range of natural variation).
Geographic Extent: 1= <500 m²; 2 = 500 m² -1 km²; 3 = 1-10 km²; 4 = 11-100 km²; 5 =101-1000 km²; 6 = >1000 km².
Duration: 1 = < 1 month; 2 = 1-12 months; 3 = 13-36 months; 4 = 37-72 months; 5 = > 72 months.
Frequency: 1 = < 11 events/year; 2 = 11-50 events/year; 3 = 51-100 events/year; 4 = 101-200 events/year; 5 = >200 events/year; 6 = continuous.
Reversibility: R = Reversible; I = Irreversible.
Ecological/Socio-cultural and Economic Context: 1 = Pristine area; 2= Area affected by human activity; 3 = Evidence of adverse effects.
Residual Environmental Effect Rating: S = Significant Adverse Environmental Effect; N = Non-significant Adverse Environmental Effect; P = Positive Environmental Effect.
Confidence: 1 = Low; 2 = Medium; 3 = High.

8.1.5 Marine Fish and Fish Habitat

Marine fish are a VEC because of their importance to the marine ecosystem and commercial fisheries. Environmental effects on marine fish may in turn affect commercial fisheries and other ecosystem components that rely on species of marine fish as a food source. This analysis considers Project interactions with commercial and non-commercial pelagic and demersal fish and pelagic and bentho-pelagic invertebrates, including eggs, larvae, juvenile, and adult life stages.

Marine fish are linked to other VECs and VSCs discussed in this EA through their ecological and socio-economic relationships. Many fish species are preyed upon by other fish, some invertebrates, marine mammals (Section 8.1.6) and birds (Section 8.1.11). The marine benthos, upon which some bottom - dwelling fish feed, is considered in Section 8.1.4.

A description of existing conditions for marine fish and fish habitat within the study area is presented in Section 6.1.7.2.

8.1.5.1 Boundaries

Temporal Boundaries

The Project could interact with marine fish during the construction and operation of the marine components of the Project (*e.g.*, jetty construction and presence) and if there are marine spills or discharges (*e.g.*, ballast water) (spills are discussed in Section 8.3). Some species are year-round residents, although many migrate seasonally within the area. There are summertime migrations of codfish, haddock and other demersal species from deeper to shallower water, or out of the area and into the Gulf of St. Lawrence, returning in winter. Pelagic species such as mackerel migrate into the area from the south in summer, returning in fall and winter. Lesser-known, but in some cases abundant, species inhabit the full range of marine and estuarine habitats. A few are occasional visitors from warmer water to the south and west, or colder arctic water to the east and north.

Spatial Boundaries

The spatial boundaries for the assessment of marine fish encompasses Chedabucto Bay and the Canso Strait on the south side of the Causeway. Fish, including eggs and larvae, are also distributed vertically within the water column from the surface to the ocean bottom.

Administrative Boundaries

The fisheries of the study area are wholly administered by the Maritimes region of DFO, based in Halifax, NS. Research on all aspects of fish and fisheries is conducted from DFO laboratories in Halifax, NS and St. Andrews, NB.

The protection of fish, including freshwater, diadromous, and marine species, falls under the jurisdiction of the federal *Fisheries Act* and the administration of DFO; however, Environment Canada administers those aspects of the *Fisheries Act* dealing with pollutants affecting fish (Sections 36-42). Fish populations are also affected by government administration of commercial fisheries including fishery closure areas (refer to Section 6.2.3).

The Species at Risk Act (SARA) is a commitment to prevent wildlife species from becoming extinct and to secure the necessary actions for their recovery. Specific actions could include protection of critical habitat. SARA listed fish species are described in section 6.1.7.2.

Technical Boundaries

Technical boundaries include a lack of specific knowledge about recent ichthyoplankton and marine fish surveys in Chedabucto Bay, as surveys conducted in the area were several years ago.

8.1.5.2 Residual Environmental Effects Evaluation Criteria

A **significant adverse effect** to marine fish is defined as one that affects a population of a species or a portion thereof in such a way as to cause a decline in abundance and/or distribution beyond which natural recruitment (reproduction and in-migration from unaffected areas) would not return that population, or any populations or species dependent upon it, to its former level within several generations (*i.e.*, the integrity of the population would be threatened).

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

A positive effect would occur if the overall abundance of a species or population is increased, or natural mortality is reduced, or the area available to a species to occupy and exploit is increased.

8.1.5.3 Potential Interactions, Issues and Concerns

Potential interactions between the Project and marine fish relate primarily to:

- siltation from marine construction;
- removal of small amount of fish habitat through installation of marine infrastructure (*i.e.*, pilings);

- attraction of fish by subsurface structures (*i.e.*, reef effect);
- avoidance of areas by fish due to noise and other disturbances; and
- contamination of marine fish and their food sources due to ship spills or discharges.

Potential adverse effects of the project on marine fish and their environment could include direct mortality of adults, juveniles, larvae or eggs, or a decline in breeding success as a result of chemical contamination. Breeding behaviour could be disrupted as a result of sediment plumes that exceed natural concentrations, or indirectly as a result of temporary physical alteration to the environment. Some species are known to avoid areas of high sediment concentration (Wildish, *et al.* 1977).

While thermally altered water may be discharged from the Project if the seawater option is exercised, the temperature difference within 100 m of the diffuser will be within 3E of ambient temperature. This is within natural variation within the water column in the Strait (Stewart and White, 2001) and is not anticipated to cause significant effects.

Positive effects may occur as a result of the so-called "reef effect" of underwater structures which act as a substrate for the development of epibenthic biota, which in turn attracts other more mobile species. The pilings of the marine terminal will provide a hard substrate for colonization of epiphytic marine organisms and macrophytes as well as provide shelter for lobsters and other marine fish.

Complete recolonization of the habitat with marine seaweeds and a mature benthic community is expected to occur within two to three years (Scarrat 1968). The vertical habitat created by the pilings will result in a change in benthic community assemblage in a very localized area. Numerous sessile organisms that do not exist on fine grained sediment such as encrusting species of anemones, tunicates, sponges, bryozoans, hydroids, etc. will find opportunity to develop (Scarratt 1968). Marine seaweeds, which are important to lobster habitat, will also quickly colonize the hard substrate. The recolonization will attract other mobile species for feeding and refuge along the slope ultimately creating a reef effect, subsequently, the biodiversity will increase. The Project area is not of critical importance (*e.g.*, spawning, overwintering) to any of the SARA listed species.

8.1.5.4 Analysis, Mitigation and Residual Environmental Effects Prediction

Construction

The construction of the marine structures will result in a small loss of existing productive fish habitat due to disruption of the seabed from installation of piles. It is anticipated that aside from the minor loss of water column due to the installation of pilings, the addition of hard substrate will increase biodiversity of benthic communities (see Section 8.1.4) and likely provide additional sources of food and possible reef-type communities. It is not likely that the size and duration of this loss will result in significant adverse effects on fish stocks.

Noise from pile driving is of concern because of the magnitude of the underwater noise and vibrations. Underwater noise from pile driving is discussed in Section 8.1.6.4. It is possible that such noise and vibration could interact with fish larvae and adults. Driving the pilings for the marine jetty (estimated to last 60 days) will likely generate underwater noise levels of up to 135 dB re 1µPa at one km distance from the construction vessel.

The noise from pile driving may cause fish to move out of the affected areas close to the source. There is considerable variation in the hearing ability of fish therefore it is difficult to make general statements about behaviour of many fish species relative to this activity.

Turnpenny and Nedwell (1994) summarized the following physical effects of noise on fish:

- transient stunning at 192 dB re 1 µPa;
- internal injuries at 200 dB re 1 µPa;
- egg/larval damage at 220 dB re 1 µPa; and
- fish mortality at 230-240 dB re 1 µPa.

In addition, Turnpenny (pers. comm. 2002) and Pearson *et al.* (1992) both note that the lower noise threshold that can cause subtle changes in fish behaviour is approximately 160 dB. Extrapolating from Richardson *et al.* (1995), it was calculated that this lower noise threshold (*i.e.*, 160 dB) would occur out to a radius within approximately 1 km from construction site during pile driving.

Based on these anticipated noise levels, no adverse physical effects are expected on adult, juvenile or eggs and larvae of commercial or non-commercial species from pile driving. Although the Project area is not located in critical spawning or migratory area for fish, the precautionary approach is to conduct in-water work in late fall and winter. This schedule avoids potential disturbance to many important species (mackerel, herring, lobster) which usually move offshore in winter.

Operation and Maintenance

Routine discharges from LNG ships may include wastewater from sinks, showers, laundry and sewage, as well as sanitary and food wastes. Seabirds, plankton, fish, benthic invertebrates and bacteria all contribute to the biodegradation of organics at sea. The disposal at sea of all other domestic wastes is not permitted, and such materials are transported to land for disposal or recycling.

Chlorinated wastewater effluents (CWEs) include agents used for disinfection (wastewater treatment) and biofouling control. CWEs have been added to the Schedule 1 of *CEPA* (1999) – List of Toxic Substances. Releasing a listed substance involves the development of a pollution prevention plan and possibly an environmental emergency plan notice. Risk management objectives for CWEs are listed as a Notice in the *Canada Gazette* Vol 123 No. 23. The objective states that the effluent released to

surface water will maintain a total residual chlorine that is less or equal to 0.02 mg/L. The Notice also states that alternatives to discharging CWEs such as ultraviolet irradiation, ozone or dechlorination should be considered in the pollution prevention plan. Finally the Notice states that proponents should consider implementing a monitoring program in relation to Canadian Council of Ministers on the Environment Canadian Water Quality (CCME-CWQ) guidelines for chlorine produced oxidants (total residual chlorine) in marine waters. No significant interaction between marine fish and chlorinated wastewater effluents are expected if the proponent implements the recommendation listed in the Notice requiring the preparation and implementation of a pollution prevention plan with respect to chlorinated wastewater effluents.

Ballast discharges fall under the Guidelines for the Control of Ballast Water Discharge from Ships in Waters under Canadian Jurisdiction (TP 13617 E). These guidelines, implemented September 01, 2000, have been developed by Transport Canada and DFO under the auspices of the Canadian Marine Advisory Council, and as such reflect wide consultation with groups such as ship owners, environmental organizations, government departments and the United States Coast Guard. Ships travelling to and from Bear Head will fall under Annex V of the guidelines; Ballast Water Procedures for Vessels Proceeding to Ports on the East Coast of Canada. This annex states that the delineation of suitable alternative ballast water exchange zones and the determination of possible exemptions is subject to scientific studies and consultation with the appropriate scientific authorities. Locations for Alternative Ballast Water Exchange Zones (ABWEZ) are being investigated and may be included in the Annex V at a future date. In the interim, vessels are encouraged to comply with these guidelines as far as it is safe and practicable. In Section 9 of the guidelines it is stated that vessels utilizing ballast exchange should conduct ballast exchange in locations where water depths are not less than 2,000 m, unless otherwise provided in the appropriate Regional Annex. Such water depths are not found in the vicinity of the study area. Therefore no interaction of ballast waters with the Study Area (Chedabucto Bay and Strait of Canso) is anticipated.

Bilge waters will be managed under the Canada Shipping Act – Oil Pollution Prevention Regulations (SOR/93-3) and as such, bilge water is allowed to be discharged in the area if compliant with discharge criteria. No significant interaction between bilge water discharge and marine fish would result with the application of the Oil Pollution Prevention Regulations.

At the international level, vessels are subject to the International Maritime Organization (IMO) regulatory framework for pollution controls covered under the International Convention for the Prevention of Pollution from Ships, or the MARPOL 73/78 convention, relating to oil, packaged goods, sewage, garbage and air emissions. Domestic pollution regulations are found in Part XV of the Canada Shipping Act (CSA); Pollution Prevention and Response. IMO regulations prohibit vessels from discharging sewage within four miles of the nearest land, unless they have in operation an approved treatment plant. Discharges within four to 12 miles must be broken down, diluted, and disinfected prior

to discharge. Adherence to regulations currently in place will result in no interaction between marine fish and grey water discharge.

8.1.5.5 Follow-up and Monitoring

Stormwater runoff will be monitored to ensure that the TSS concentrations meet regulatory standards.

8.1.5.6 Summary of Residual Environmental Effects Assessment

The marine fish in the Project area are ubiquitous throughout the region. Furthermore the area of the proposed Terminal is not known as an area of importance for fish eggs and larvae. Provided the recommended mitigative measures are implemented, no significant adverse residual environmental effects on marine fish are likely to occur. Table 8.7 provides a summary of the residual environmental effects and recommended mitigative action for marine fish and fish habitat.

Table 8.7 Residual Environmental Effects Assessment Matrix: Marine Fish and Fish Habitat

Project Activity	Potential Positive (P) or Adverse (A) Environmental Effect	Mitigation	Significance Criteria for Environmental Effects					Residual Environmental Effect	Level of Confidence
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/ Social-cultural and Economic Context		
CONSTRUCTION									
Pile Driving	Noise, siltation (A)	• Silt curtains if feasible	2	3	2/1	R	2	N	2
OPERATION AND MAINTENANCE									
Routine Discharges (*e.g.*, biocides) from on site sewage treatment/seawater intake/outfall (A)	Release of chlorinated water into the Strait (A)	• Compliance with *CEPA* requirements	1	1	5/2	R	2	N	2
Routine ship emissions (*e.g.*, bilge, ballast, grey) (A)	Release of routine ship emissions (A)	• Compliance with applicable guidelines and regulations							

KEY

Magnitude: 1 = Low (*e.g.*, within the normal variability of baseline conditions; 2 = Medium (*e.g.*, increase/decrease with regard to baseline but within standards and objectives; 3 = High (*e.g.*, singly or as a significant contribution in combination with other sources causing exceedances or impingement upon standards and objectives beyond the property line of the project
Geographic Extent: 1=<500 m^2; 2=500 m^2 – 1 km^2; 3=1-10 km^2; 4=11-100 km^2; 5=101-1000 km^2; 6=>1000km^2
Duration: 1=<1month; 2=1-12 months; 3=13-36 months; 4=37-72 months; 5=>72 months
Frequency: 1=<11 events/year; 2=11-50 events/year; 3=51-100 events/year; 4=101-200 events/year; 5=>200 events/year; 6=continuous
Reversibility: R=Reversible; I=Irreversible
Ecological/Socio-cultural and Economic Context: 1=Pristine area 2= Area affected by human activity; 3=Evidence of adverse effects
Residual Environmental Effect Rating: S=Significant Adverse Environmental Effect; N=Nonsignificant Adverse Environmental Effect; P=Positive Environmental Effect
Confidence: 1=Low level of confidence; 2=Medium level of confidence; 3=High level of confidence

8.1.6 Marine Mammals

Marine mammals are considered a VEC due to their important role in the marine ecosystem, because of regulatory protection, scientific and public concern, and potential implications for the whale-watching industry. This assessment considers cetaceans and pinnipeds that may potentially live and/or migrate through the study area.

Marine mammals are closely linked to Marine Fish (Section 8.1.5).

A description of existing conditions for marine mammals within the study area is presented in Section 6.1.7.3.

8.1.6.1 Boundaries

Temporal Boundaries

Temporal boundaries for this analysis have been developed in consideration of times during which the Project could interact with marine mammals; for example, pile driving during jetty construction and presence of the jetty and Project vessels during the operations phase. Temporal boundaries also consider the seasonal movements of marine mammals with respect to Project activities (*e.g.*, in pursuit of seasonal fish migration).

Spatial Boundaries

The spatial boundary for the assessment of marine mammals is the Strait of Canso and Approaches; however, the spatial distribution of individual species of marine mammals is not well known in these waters. The majority of research on whale distribution in the northwest Atlantic has focussed on critically endangered species, such as the North Atlantic right whale and the Northern bottlenose whale, which are not known to occur within the study area. Therefore, for the purposes of this assessment, it is assumed that species known to occur in coastal waters of Nova Scotia (Breeze *et al.* 2002 and NSMNH 1997) may occur in the study area and be potentially affected by Project activities.

Administrative Boundaries

Marine mammals species are protected under the federal *Fisheries Act* and administratively managed by DFO. In Nova Scotian waters there is no commercial or subsistence exploitation of marine mammals. Field studies, marking, and collecting samples from marine mammals, both alive and dead, are permitted only with authorization by DFO.

The Species at Risk Act (SARA) is a commitment to prevent wildlife species from becoming extinct and to secure the necessary actions for their recovery. Specific actions could include protection of critical habitat.

Technical Boundaries

There is only limited (*i.e.*, anecdotal) data for marine mammals in the study area. Most research has focussed on only a few (endangered) species.

8.1.6.2 Residual Environmental Effects Evaluation Criteria

A **significant adverse effect** is one that affects a population of marine mammal species in such a way as to cause a decline or change in abundance or distribution of the population over one or more generations; natural recruitment (reproduction and in-migration from unaffected areas) may not re-establish the population to its original level within several generations, or avoidance of the area may become permanent.

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

A **positive environmental effect** is defined as one that results in a measurable population increase and/or enhances the quality of critical habitat for marine mammals.

8.1.6.3 Potential Interactions, Issues and Concerns

Project activities can interact with marine mammals in several ways including underwater noise, vessel collisions and marine spills and discharges.

Noise can result in altered behaviour including: avoidance; changes in migration; changes in reproductive or feeding behaviour; and putting individuals at risk of injury or death due to collisions with vessels. Noise disturbance can also result in communication marking (*e.g.*, interception of vocalizations). Of particular concern is loud, underwater noise from pile driving during jetty construction. Other underwater noise will be created by other aspects of marine construction as well as construction and operational vessel traffic, but will not be as significant as pile driving.

Other Project interactions with marine mammals can include collisions with construction and operational vessel traffic as well as oil spills from vessels. Spills are discussed in Section 8.3. Discharges (*e.g.*, ballast water) are discussed in Section 8.1.5.4. Scheduling of pile driving in winter would also alleviate potential interactions since whale sightings in the Strait area generally occur from spring to fall.

8.1.6.4 Analysis, Mitigation and Residual Environmental Effects Prediction

Construction

Noise associated with jetty installation will occur during the construction phase of the Project. Research exists describing cetacean reactions to anthropogenic noise sources. However, little research has been carried out that specifically addresses impacts of jetty construction, including pile driving, on species of marine mammals which could potentially occur within the study area. Studies examining the effects of pile driving on harbour seals and sea lions in San Francisco Bay measured underwater sound levels at various distances at a depth of 6 m (Caltran 2001). It was found that at 100 m from the pile driving activity, noise levels were 197 to 207 dB re 1µPa, at 400 m were 181 to 191 dB re 1µPa and at 500 m were less than 160 dB re 1µPa. Sea lions and harbour seals observed in the study did not appear to react to pile driving when 500 m or more from the project site, whereas most individuals were observed to flee from the area when closer than 500 m (Caltran 2001). Tyack (1982) corroborates these findings by suggesting that avoidance behaviour due to intermittent sounds, such as those produced during pile driving, occurs only when noise levels exceed 160 to 170 dB 1µPa.

Adverse behavioural and physical effects on cetaceans due to loud underwater noises have been documented in noise studies on shipping and seismic activities. Effects include animals temporarily and permanently leaving noise affected areas (Allen 1991), tissue rupturing and hemorrhaging, hearing loss, swimming off routine migratory paths and aggressive and/or defensive behaviour (Kastak *et al.* 1999). In authorizations for seismic hazards investigation, the National Marine Fisheries Service (NMFS) has considered that the maximum level from impulse sounds to which marine mammals should be exposed are 180 dB re 1 µPa for mysticetes and sperm whales, and 190 dB re 1µPa for odontocetes and pinnipeds. More recently, scientists at two workshops on acoustic noise and marine mammals supported NMFS determination. The rationale for using these levels was provided first in an authorization to the Exxon Corporation for seismic work in southern California in 1995 (60 Federal Register 53753, October 17, 1995). In order to safeguard exposure of whales to noise levels beyond these threshold levels, if a whale is observed within 500 m of the construction site, pile driving will halt until whales are outside this zone of influence. The Project area is not recognized as an area of critical importance to the SARA listed species. The mitigation measures provided for other whale species will also serve to protect any SARA listed species from adverse interactions with the Project.

Vessel activity near the Project area will increase during construction of the jetty. Inshore waters of Nova Scotia have a relatively high ambient sound level and when the background sound levels are augmented by human activity, such as ship noises, acoustic communications and interception may mask vocalizations (Myrberg 1990). Ship manoeuvring noise in the Project area has the potential to interfere with marine mammal sound production, communication, and hearing, and could possibly result in collisions.

Standard vessel operating procedures, including avoidance measures, will further reduce the slight risk of collision with marine mammals. In animals like cetaceans that are highly dependent on sound, the ability to recognize sound signals in the presence of background noise is important in communicating, detecting predators, locating prey, and, in toothed whales, echolocating (Lawson *et al.* 2000). Mammals show a number of adaptations to enable them to minimize the effects of masking (*e.g.*, changes in the intensity and frequency of vocalizations). Mammals have been known to increase the frequency and amplitude of their own signals to compensate for increased ambient noise (Evans 1982; Au *et al.* 1974). Richardson *et al.* (1995) suggest that masking results primarily from continuous noise (*e.g.*, shipping) rather than short pulses associated with pile driving.

It is reasonable to assume that mammal species living in the study area have been able to overcome most, if not all, of the masking sounds to which they have been exposed in the last decade (Lawson *et al.* 2000). Communication masking is therefore not considered to be a significant Project-related issue. It has been suggested that some species may grow accustomed to elevated noise levels (Watkins 1986), such as seals using urban ports or whales frequently targeted by whale watching vessels.

In summary, significant adverse effects on marine mammals from pile driving and increased vessel activity are not predicted as pile driving is temporary (*i.e.*, 60 days), and will halt when a whale is sighted within 500 m of the jetty. Construction and standard vessel operating procedures, including avoidance measures, will further reduce the slight risk of collision with marine mammals.

Operation and Maintenance

Vessel traffic in the Strait of Canso and Approaches is predicted to increase during the operation of the Project (see Section 8.2.3). Inshore waters of Nova Scotia have relatively high ambient sound levels due to both natural forces, such as winds and waves, and anthropogenic sources, such as shipping. As discussed in the previous section, noise attributed to vessel traffic may interfere with marine mammal sound production, communication, and hearing, and possibly result in collisions. It is reasonable to assume that marine mammals found within the study area have been able to overcome most, if not all, of the masking sounds to which they have been exposed due to the increase in industrialization and ship traffic in the general Project area.

Reported ship collisions with whales occur only occasionally, considering the frequency of both whales and ships in many parts of the world (Laist *et al.* 2000). There is a greater problem where shipping lanes traverse traditional areas of whale concentration (*e.g.*, Bay of Fundy), and where transit speeds are high. However, resident marine mammals become familiar with the noise signature, direction, and speed of individual vessels and habituate to ships following a consistent course or frequently present in the area (Richardson *et al.* 1995). Watkins (1986) describes the degree to which reactions of baleen whales to vessels changed over 25 years; interactions of minke whales changed from positive interest to uninterested and fin whales from negative to uninterested. Dolphins are more likely to approach moving

vessels and ride in their wake (Shane *et al.* 1986). Those that have experienced boat-based harassment may, however, avoid boats (Richardson *et al.*1995). Standard vessel operating procedures including avoidance measures will further reduce the slight risk of collision with marine mammals.

In summary, although vessel traffic will increase during the operation of the Project, no significant adverse effects to marine mammals are predicted given their ability to adapt to noises generated by vessel traffic and given avoidance measures included in standard vessel operating procedures.

8.1.6.5 Follow-up and Monitoring

An observer will monitor a 500 m safety zone for whales during pile driving, and should any be sighted, will issue an order to stop pile driving until the area is clear of whales.

8.1.6.6 Summary of Residual Environmental Effects Assessment

Potential interactions between marine mammals and the construction of the jetty are expected to be minimal, based on most species' transitory presence in the study area and the short duration of pile driving. An observer will monitor a 500 m safety zone for whales, and pile driving will stop should a whale be seen entering this safety zone. This will further minimize direct effects on marine mammals.

Vessel activity is expected to increase during the construction and operation of this Project. Standard vessel operating procedures including avoidance measures will minimize interactions between marine mammals and vessels.

Provided the recommended mitigative measures are implemented, no significant adverse residual environmental effects on marine mammals are likely to occur. Table 8.8 provides a summary of the residual environmental effects and recommended mitigative action for marine mammals.

Table 8.8 Residual Environmental Effects Assessment Matrix: Marine Mammals

Project Activity	Potential Positive (P) or Adverse (A) Environmental Effect	Mitigation	Significance Criteria for Environmental Effects					Residual Environmental Effect	Level of Confidence
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/ Social-cultural and Economic Context		
CONSTRUCTION									
Construction of Marine-based Infrastructure	Noise from pile driving (A)	• If whale observed within 500 m, pile driving will halt and resume once whale has left the zone.	1	2	2/5	R	2	N	3
Increased Vessel Activity	Collision, noise (A)	• Standard vessel operating procedures including avoidance measures.	1	4	2/5	R	2	N	3
OPERATION AND MAINTENANCE									
Increased Vessel Traffic	Collision, noise (A)	• Standard vessel operating procedures including avoidance measures.	1	4	5/5	R	2	N	3

KEY

Magnitude: 1 =Low: (*e.g.*, specific group or habitat, localized, one generation or less, within natural variation); 2 = Medium: (*e.g.*, portion of a population or habitat, 1 or 2 generations, rapid and unpredictable change, temporarily outside range of natural variability); 3 =High: (e.g., affecting a whole stock, population or habitat outside the range of natural variation).
Geographic Extent: 1= <500 m²; 2 = 500 m² -1 km²; 3 = 1-10 km²; 4 = 11-100 km²; 5 =101-1000 km²; 6 = >1000 km².
Duration: 1 = < 1 month; 2 = 1-12 months; 3 = 13-36 months; 4 = 37-72 months; 5 = > 72 months.
Frequency: 1 = < 11 events/year; 2 = 11-50 events/year; 3 = 51-100 events/year; 4 = 101-200 events/year; 5 = >200 events/year; 6 = continuous.
Reversibility: R = Reversible; I = Irreversible.
Ecological/Socio-cultural and Economic Context: 1 = Pristine area; 2= Area affected by human activity; 3 = Evidence of adverse effects.
Residual Environmental Effect Rating: S = Significant Adverse Environmental Effect; N = Non-significant Adverse Environmental Effect; P = Positive Environmental Effect.
Confidence: 1 = Low; 2 = Medium; 3 = High.

8.1.7 Freshwater Habitat

Freshwater habitat is a VEC due to the ecological importance and sensitivity of freshwater fish to habitat alteration and destruction. Fish habitat is protected under the Canada *Fisheries Act.* Fish and fish habitat is also closely linked to terrestrial and marine ecosystem components (food and freshwater source, input of nutrient) and recreational activities.

The freshwater habitat VEC includes the potential freshwater habitat occurring in the vicinity of the LNG plant. This VEC includes the chemical, physical, and biological attributes of watercourses and waterbodies which determine the suitability for fish habitat.

A description for existing conditions for freshwater habitat within the study area is presented in Section 6.1.8.

8.1.7.1 Boundaries

Temporal Boundaries

The temporal boundaries for the assessment of freshwater habitat include the period of Project construction and operation when Project activities could interact with freshwater fish and fish habitat. Of particular concern are those times during construction when movements of construction vehicle and unstabilized soil occur potentially contributing to erosion and siltation. Particularly sensitive times for fish populations include periods of migration and spawning (*e.g.*, mid May to mid July and October to December).

Spatial Boundaries

The assessment area for the freshwater habitat VEC includes those streams with the greatest potential to be affected by the Project (Streams A and B, Figure 6.3).

Administrative Boundaries

Fish habitat is explicitly protected under the federal *Fisheries Act* and authorization from DFO is required for harmful alteration, disruption and destruction (HADD) of productive fish habitat. The federal *Species at Risk Act* protects rare or endangered species. Approvals under the provincial *Environment Act* and Regulations may also apply for any work conducted in or around watercourses including: culvert installation; instream work; temporary fording; and withdrawal of water.

Technical Boundaries

The available data and level of knowledge concerning the freshwater habitat environment in the assessment area is considered adequate for the purposes of assessment at this stage in Project planning.

8.1.7.2 Residual Environmental Effects Evaluation Criteria

A **significant adverse effect** is one that affects freshwater fish and fish habitat physically, chemically, or biologically, in quality or extent, to such a degree that there is a decline in the species diversity of the habitat. Such an effect would be reflected by a decline in abundance and/or change in distribution of one or more populations of species dependent upon that habitat. Natural recruitment would not return the population(s), or any populations or species dependent upon the habitat, to their former level within several generations.

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

A **positive effect** is one that may enhance the quality of habitat, increase species diversity, and increase the area of valued habitat.

8.1.7.3 Potential Interactions, Issues and Concerns

The principal interactions between Project activities and freshwater habitat is associated with the construction phase of the Project and any chronic discharges from the operational phase of the Project. Plant construction, access to work areas, and the preparation of sites for the placement and/or erection of buildings and other facilities will require the clearing of vegetation. Earthworks, such as grubbing and stripping topsoil/overburden and the placement of excess material in stockpiles may lead to increased erosion and sedimentation of waterbodies.

The Project site was selected, in part, to minimize interactions with sensitive environmental features such as watercourses and wetlands. In particular, the LNG plant footprint is located and configured to avoid the two nearby streams (A and B) (Figure 6.3), thus, avoiding direct Project impacts on these streams from the plant. Ancillary Project infrastructure (*e.g.*, fencing, water piping) may be required to cross watercourses which will be undertaken according to standard construction practices and permit requirements protective of fish habitat (*e.g.*, culvert approvals).

Erosion and siltation of fish habitat can adversely affect fish directly, or cause a degradation of habitat. These effects can be caused directly during crossing and disturbance of stream banks and substrate, or indirectly during adjacent work where soils or vegetation may be disturbed. Blasting, if required near stream crossings, can also harm fish and habitat. Blasting near stream crossings, if required, will be conducted according to Guidelines for use of Explosives in or Near Canadian Fisheries Waters (Wright

and Hopky 1998). Should stream-crossings by Project infrastructure (water line or roads) be required, follow-up habitat assessments will be conducted. A provincial Water Approval (under the Activities Designation Regulation) will likely be required as well as "no net loss" of fish habitat as specified by DFO policy. Stream crossings, if required, will be conducted according to all other applicable guidelines (*e.g.*, maintaining water flow, fish passage, and implementing erosion control).

The principal interactions between the Project and freshwater habitat, beyond the construction phase and commissioning of facilities, are wastewater, and stormwater disposal throughout the operation of the Project. No routine air emissions from the facility are expected to cause a degradation in surface water quality.

8.1.7.4 Analysis, Mitigation and Residual Environmental Effects Prediction

Construction

The LNG plant has been sited to avoid freshwater streams and their associated habitat. As such, site preparation and plant construction are likely to avoid directly encroaching on the two nearby streams. Mitigative measures will be undertaken to minimize the potential for erosion and siltation of the nearby streams from site runoff while soils are exposed and unstabilized and from movement of construction vehicles. These measures will be specified in erosion and sediment control procedures to be included in the Environmental Protection Plans (EPP). See Section 2.4.2 for details on the types of mitigation to be incorporated in the EPP. In general, these measures will be consistent with NSDEL guidelines (NSDOE 1988).

The precise need for, and location of, temporary road access and work areas during construction, and permanent road and power access to the facility will be determined during the final design. Road and utility corridor and work space will be located following consideration of environmental and engineering constraints and all applicable regulations and guidelines. No significant adverse effects from road access, temporary work areas, or utility corridors are therefore expected given that the mitigative measures in the EPP will be followed.

If the final Project design requires that streams be crossed (*e.g.*, by water pipes, fencing, roads), a number of follow-up and mitigative measures will be undertaken. A habitat assessment will be undertaken at the crossing location extending appropriate distances upstream and downstream. Depending on the quality of habitat encountered, site-specific mitigative plans will be developed and included in the Project EPP. All conditions of Water Approval will be followed. Procedures will be provided to ensure that construction equipment does not enter or cross the streams without due consideration for specific environmental protection procedures (*e.g.*, for fording streams).

General mitigative measures, particularly for any interactions with waterbodies, include:

- establish minimum set backs (60 m) from watercourses for stockpile and storage and equipment refuelling areas;
- minimize disturbance to riparian zones, and leave a 30 m wide undisturbed (vegetated buffer) zone on either side of stream until specific crossing activities commence;
- employ erosion and sediment control measures as per applicable guidelines (*e.g.*, DFO *et al.* 1981; NSDOE 1988);
- provide contingency plans for mitigating potential erosion and stream sedimentation;
- conduct in stream work during low-flow periods (*e.g.*, for culvert installation);
- stabilize banks and revegetate after construction, using native species, if practical.

If appropriate mitigative measures are applied, no significant adverse environmental effects on freshwater habitat are predicted to result from Project construction. While the risk for encountering acid generating bedrock at the site is low (see Section 6.1.1.4), if it should be encountered during site excavation, excavated acid rock will be managed according to the Sulphide Bearing Materials Disposal Regulations and the Guidelines for Development on Slates in Nova Scotia (NSDOE and Environment Canada 1991), which includes requirements for monitoring surface water runoff.

In summary, standard feasible mitigation measures will be applied to minimize construction related environmental effects on freshwater habitat in the Project area. The residual adverse environmental effects on freshwater habitat from the construction phase of the Project are not likely to be significant.

Operation and Maintenance

Wastewater generated from Project operations will be treated, as necessary, to comply with the regulatory requirements prior to discharge. Sanitary wastewater will be treated onsite using an approved package sanitary wastewater treatment unit. Process areas will be paved and curbed to direct runoff to a collector equipped with a sump and oil and water separator to ensure that runoff not meeting regulatory criteria is treated or disposed in accordance with requirements. A Stormwater Management Plan will be developed to prevent sediment-laden runoff from the facility from entering streams or the Strait. This plan will be designed to meet all provincial requirements for surface runoff quality (*e.g.*, suspended solids < 25 mg/L).

In summary, standard mitigation measures will be applied to minimize operation-related environmental effects on freshwater habitat in the Project area. The residual adverse environmental effects on freshwater habitat from the operation phase of the Project are not likely to be significant.

8.1.7.5 Follow-up and Monitoring

Upon final siting of the road, piping, and onshore facilities, a follow up survey may be required to permit the refinement of site-specific mitigative measures and to allow for final adjustments to rights-of-way, if necessary (*e.g.*, for stream crossings). The erosion and sedimentation control structures will be inspected regularly and quarterly surface water sampling protocols will be in place prior to the plant starting operations.

8.1.7.6 Summary of Residual Environmental Effects Assessment

Provided the recommended mitigative measures are implemented, no significant adverse residual environmental effects on freshwater fish habitat are likely to occur. Table 8.9 provides a summary of the residual environmental effects and recommended mitigative action for freshwater habitat.

Table 8.9 Residual Environmental Effects Assessment Matrix: Freshwater Habitat

Project Activity	Potential Positive (P) or Adverse (A) Environmental Effect	Mitigation	Significance Criteria for Adverse Environmental Effects					Residual Environmental Effect	Level of Confidence
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/ Social-cultural and Economic Context		
CONSTRUCTION									
Site or corridor clearing/grubbing, excavation, heavy equipment operation, infrastructure construction and installation	Erosion and sedimentation (A) Water quality degradation (A)	• Implement erosion and sediment control measures • Avoid instream work during sensitive periods (May 15 to July 15 and October to December) • Implement appropriate stream crossing techniques and comply with Water Approval • EPP	1	2	3 / 2	R	3	N	3
OPERATION									
Contaminated surface runoff/ Erosion and sedimentation	Water quality and habitat degradation (A)	• Stormwater Management Plan • Spill prevention/clean up • Maintenance of erosion and sediment controls • EPP	1	2	1/1	R	3	N	3

KEY

Magnitude: 1= Low: *e.g.*, specific group or habitat, localized, one generation or less, within natural variation; 2 = Medium: *e.g.*, portion of a population or habitat, 1 or 2 generations, rapid and unpredictable change, temporarily outside range of natural variability; 3 = High: *e.g.*, affecting a whole stock, population or habitat outside the range of natural variation.
Geographic Extent: 1=<500 m^2; 2=500 m^2 – 1 km^2; 3=1-10 km^2; 4=11-100 km^2; 5=101-1000 km^2; 6=>1000km^2
Duration: 1=<1month; 2=1-12 months; 3=13-36 months; 4=37-72 months; 5=>72 months
Frequency: 0= unlikely to occur; 1=<11 events/year; 2=11-50 events/year; 3=51-100 events/year; 4=101-200 events/year; 5=>200 events/year; 6=continuous
Reversibility: R=Reversible; I=Irreversible
Ecological/Socio-cultural and Economic Context: 1=Pristine area; 2=Area affected by human activity; 3=Evidence of adverse effects
Residual Environmental Effect Rating: S=Significant Adverse Environmental Effect; N=Non-significant Adverse Environmental Effect; P=Positive Environmental Effect
Confidence: 1=Low level of Confidence; 2=Medium level of Confidence; 3=High level of confidence

8.1.8 Wetlands

Wetlands were selected as a VEC because they are an important feature of the landscape, performing many biological, hydrological, social/cultural, and economic production functions. Wetlands provide habitat for plant and animal species, many of which depend on wetland habitats for their survival. Hydrological functions of wetlands include erosion and flood control, contaminant reduction, and groundwater recharge and discharge. Wetlands support various forms of recreational activity, as well as subsistence production, such as harvesting of wildlife and plants, and commercial production, such as cranberry bogs, forestry, and peat extraction.

A description of existing conditions for wetlands within the study area is presented in Section 6.1.9.1.

8.1.8.1 Boundaries

Spatial Boundaries

The spatial boundaries for assessment of Project effects on wetlands is the area found within the property as delineated in Figure 6.3.

Temporal Boundaries

Wetlands are a semi-permanent landscape feature, and may interact with the Project year-round. Specific Project activities may be short-term, but their effects on wetland habitat may persist throughout the year. As such, this assessment considers Project effects on a year-round basis.

Wetlands are most sensitive to physical and noise disturbance during spring and early summer when they are thawed and easily physically disturbed. At this time, birds and herpetiles that use wetlands as breeding habitat are more susceptible to disturbance. Wetland wildlife habitat may also be more sensitive to construction activity in the spring and early fall when large numbers of migrating waterbirds feed and rest in productive areas. Wetlands are least sensitive to construction activity during winter, when the surface is frozen and most birds and herpetiles are not present.

Administrative Boundaries

In Nova Scotia, activities in wetlands are regulated by the Activities Designation Regulation under the Nova Scotia *Environment Act* with specific guidance provided by the Wetlands Directive (NSDOE 1995). Any loss of wetland habitat requires preparation of a wetland evaluation to establish the value of the wetland in relation to the merits of the development. In instances where less than 2 ha of wetland habitat is affected by a development, the wetland can be evaluated using a ten-step evaluation process specified in the Wetlands Directive. In instances where more than 2 ha of wetland habitat are affected,

the wetlands are evaluated using the North American Wetlands Conservation Council (Canada) Wetland Evaluation Guide or an equivalent process approved by NSDEL.

Technical Boundaries

Information on wetlands was derived from available published source field surveys which were undertaken on June 26 and July 27, 2003 to describe the wetlands found within the study area. Additional, data regarding wetland hydrology were derived from a hydrological review of the study area conducted for the site.

8.1.8.2 Residual Environmental Effects Evaluation Criteria

A **significant adverse effect** occurs when there is a net loss of wetland functions in a wetland of significant value as determined through a recognized wetland evaluation system.

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

A **positive effect** may enhance the quality, increase the species diversity, or increase the area of the wetland.

8.1.8.3 Potential Interactions, Issues and Concerns

Construction activity could affect wetlands in the study area in several ways. Some wetland habitat will be lost as a result of physical disturbance associated with construction activity. Activities such as clearing and grubbing, topsoil stripping and grading of terrestrial habitats at the edges of wetlands could result in sedimentation of inundated portions of wetlands. Alteration of the drainage characteristics of the watersheds of wetlands as a result of construction can affect the hydrology of adjacent wetlands. Noise associated with construction or operation of the LNG terminal could disturb wildlife found in nearby wetlands, if the wetland supports species that are particularly sensitive to anthropogenic disturbance. Wetlands and wetland species could be affected by accidental spills of fuel, lubricants, or hydraulic fluids during construction. Improper burning of brush or disposal of smoking materials could result in fires that could damage wetlands. During the operational phase, a fire at the terminal could spread to surrounding areas damaging nearby wetlands.

8.1.8.4 Analysis, Mitigation and Residual Environmental Effects Prediction

Construction

The Project site was carefully selected, in part, to minimize conflicts with sensitive ecological features (*e.g.*, wetlands, streams).

Five of the six wetlands found within the LNG property boundary (refer to Figure 6.3) will be affected in some way by Project construction. Wetland 1 will be partially infilled as a result of construction activity. It is anticipated that 10% of the wetland will be infilled. The hydrology of this wetland will probably be affected by construction. There will be less evapotranspiration of soil water and retention of rainfall will be impeded resulting in greater runoff. Site development will result in an increase in the peak rates of surface runoff. This could result in more frequent flooding of the wetland. Development of the site could also result in sediment laden water entering the wetland. Heavy sediment deposition could result in smothering of wetland plant communities. Deposition of sediment could also change the trophic state of the wetland. Wetland 1 is characterized by low fertility. Sediment deposition would increase the productivity of the wetland resulting in changes in plant community structure and species composition. Species characteristic of relatively fertile marsh habitats such as broad-leaved cat-tail and bulrush would be expected to increase in abundance.

Wetland 2 will be partially infilled as a result of construction activity. It is anticipated that 2% of the wetland will be infilled. It may also have its hydrology affected and could receive inputs of sediment from the construction of the process area that will be located adjacent to this wetland. The security fence located along the property line will pass through this wetland resulting in some physical disturbance of the wetland; however the security fence will not be buried and heavy equipment will skirt around the wetland where feasible during installation.

Wetland 3 should not be adversely affected by the project. No clearing or infilling will occur in or near this wetland and it is not anticipated that this wetland will be affected by hydrological changes or sedimentation.

Wetland 4 will be affected by installation of the security fence. The fence will pass along the western edge of this wetland resulting in some trampling damage to the plant community on the west side of the wetland. The fence will be installed as per the description for Wetland 2. Northern commandra was found in this wetland; however, it is not anticipated that fence installation will affect this species since it is found on the eastern side of the wetland.

While direct impacts to Wetland 5 (*e.g.*, infilling) are not anticipated as a result of construction of the LNG terminal, there could be impacts to its hydrology as a result of facility and road construction on either side of the wetland. This wetland is only 0.1 ha in size and does not support any significant wetland functions.

Wetland 6 may also be affected by installation of the security fence (see discussion above). This wetland is 0.7 ha in size and is located approximately 150 m north of Wetland 2. Wetland 6 was not investigated during the field surveys since the preliminary site layout indicated it was outside of the footprint of the Project. Pending the final alignment of the security fence, it may be necessary to conduct a field survey in Wetland 6 so that a wetland evaluation can be conducted for it.

Noise, olfactory and visual stimuli associated with construction activity could disturb wildlife species that use the wetlands as habitat. None of the wetlands are considered to be important wildlife habitat and none of the species recorded in the wetlands are particularly sensitive to anthropogenic activities (see wetlands discussion in Section 6.1.2 and Section 6.1.9.1).

The effects of the project on the hydrology of Wetlands 1 and 2 can be mitigated in several ways which will be detailed in an EPP (see Section 2.0). Flow retention structures can be used to capture runoff from the site and promote infiltration into the soil as well as more even release of runoff. These structures will also be useful in capturing sediment eroded from the site. The areas cleared during Project construction should to the greatest extent practical be revegetated in order to restore some of the evapotranspiration potential lost as a result of removal of forest cover. Revegetation of the site will also minimize erosion. Wherever practical, native species should be used to replant the site. However, currently there are no native plant species available in sufficient quantities to allow an effective ground cover to be established in a short period of time in order minimize potential for erosion. An alternative plan would be to rapidly establish a vegetation cover using grasses and legumes that are currently widespread in Nova Scotia and have not demonstrated a propensity to invade native habitats (*e.g.*, Purple Loosestrife, Dame's Rocket and European Alder-buckthorn tend to invade natural habitats). This vegetation cover would be supplemented with plantings of low shrubs such as blueberry, lambkill and sweet fern that could be used to develop a low maintenance ground cover. Care must be taken to minimize the potential for introductions of noxious weeds into local wetlands as a result of construction activity. Equipment such as bulldozers and excavators that will be working on the site should be cleaned before being transported to the site to reduce the potential for transfer of noxious weeds to the site.

Physical disturbance of wetland habitat associated with installation of the security fence can be mitigated in several ways. The fence will not be keyed in, thereby minimizing disturbance. No vehicles should be permitted in the wetland when it is unfrozen. Small tracked vehicles may be permitted in the wetland when the surface is frozen deep enough to support the vehicle. Clearing of vegetation along the fence line where it passes through wetland habitat should be kept to a minimum.

The Project has been positioned to minimize the amount of wetland habitat lost to construction activity. The total area of wetland habitat lost to the project is 0.3 ha. None of the wetland habitat lost is of high value. Compensatory wetland habitat can be created, but duplication of the peat land plant and animal communities lost would not be feasible. Compensation for the loss of wetland habitat is not required in Nova Scotia; however, there is a goal of no net loss of wetland function. As such, the Nova Scotia Department of Natural Resources should be consulted to determine if they recommend the implementation of any form of compensation for the loss of wetland habitat from the Project area.

Operation and Maintenance

During the operational phase of the Project, wetlands will be affected by hydrologic alterations and potential sedimentation (Wetlands 1 and 2). Development and implementation of the Stormwater Management Plan including maintenance of vegetation cover on the site will help to minimize these adverse effects.

8.1.8.5 Follow-up and Monitoring

If the security fence along the northern property line passes through Wetland 6, it is recommended that a field survey should be conducted in the wetland to provide the information required to conduct a wetland evaluation for this wetland. The survey should be conducted in June when both northern commandra and southern twayblade can be readily identified. This is also an ideal time to search for four-toed salamander nest sites and breeding birds.

8.1.8.6 Summary of Residual Environmental Effects Assessment

Five wetlands will be affected by construction of the proposed LNG terminal. Four of the wetlands will be physically disturbed and two of the wetlands may have their hydrology altered by construction activities. Wetland 5, the smallest wetland in the study area may incur hydrological impacts as a result of construction on either side of the wetland. Wetland 1 will be partially infilled and there is potential for alteration of the hydrology of this wetland as well as sedimentation. Wetland 2 is located adjacent to the process area and will be partially infilled during construction. As such, there is potential for this wetland to receive inputs of sediment and have its hydrology altered. The security fence will pass through this wetland resulting in some physical disturbance of wetland plant communities. Parts of Wetlands 3 and 6 may be traversed by the security fence resulting in trampling damage to wetland plant communities. With the exception of Wetland 5, construction activities are not expected to significantly alter the functional attributes of the wetlands in the study area. A wetland evaluation of Wetland 5 reveals that it is not a valuable wetland. During the operational phase of the project Wetlands 1 and 2 may be affected by sedimentation, and minor hydrological affects caused by construction may continue. Mitigative measures developed for construction activities will ensure that any residual environmental effects associated with construction and operational activities will be non-significant.

Provided the recommended mitigative measures are implemented, no significant adverse residual environmental effects on wetlands are likely to occur. Table 8.10 provides a summary of the residual environmental effects and recommended mitigative action for wetlands.

Table 8.10 Residual Environme ntal Effects Assessment Matrix: Wetlands

Project Activity	Potential Positive (P) or Adverse (A) Environmental Effect	Mitigation	Significance Criteria for Environmental Effects					Residual Environmental Effect	Level of Confidence
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/ Social-cultural and Economic Context		
CONSTRUCTION									
Clearing and Grubbing Topsoil stripping grading	• Habitat loss (A) • Soil erosion (A) • Noise (A) • Introduction of invasive plant species (A)	• EPP • Spill Management Plan • Minimize ground disturbance in wetlands; • Avoid wetland habitat whenever practical; • Schedule clearing and grubbing outside of the breeding season for most migratory bird species (April through August). • Use of invasive non-native species for reclamation will be avoided • Clean equipment prior to and after working in or near wetlands to minimize potential for introduction of invasive non-native species.	1	2	2/6	I	2	N	3
OPERATION AND MAINTENANCE									
Facility operation	• Sedimentation of wetlands and alteration of wetland hydrology (A)	• Stormwater Management Plan • Ensure that cleared areas are well vegetated.	1	2	5/1	R	2	N	2

KEY

Magnitude: 1 =Low: (*e.g.*, specific group or habitat, localized, one generation or less, within natural variation); 2 = Medium: (*e.g.*, portion of a population or habitat, 1 or 2 generations, rapid and unpredictable change, temporarily outside range of natural variability); 3 =High: (e.g., affecting a whole stock, population or habitat outside the range of natural variation).
Geographic Extent: 1= <500 m²; 2 = 500 m² -1 km²; 3 = 1-10 km²; 4 = 11-100 km²; 5 =101-1000 km²; 6 = >1000 km².
Duration: 1 = < 1 month; 2 = 1-12 months; 3 = 13-36 months; 4 = 37-72 months; 5 = > 72 months.
Frequency: 1 = < 11 events/year; 2 = 11-50 events/year; 3 = 51-100 events/year; 4 = 101-200 events/year; 5 = >200 events/year; 6 = continuous.
Reversibility: R = Reversible; I = Irreversible.
Ecological/Socio-cultural and Economic Context: 1 = Pristine area; 2= Area affected by human activity; 3 = Evidence of adverse effects.
Residual Environmental Effect Rating: S = Significant Adverse Environmental Effect; N = Non-significant Adverse Environmental Effect; P = Positive Environmental Effect.
Confidence: 1 = Low; 2 = Medium; 3 = High.

8.1.9 Rare Mammals

Mammals are considered a VEC due to concern with biodiversity and regulatory protection. Mammals are also a concern due to linkage to recreational and/or traditional hunting. This VEC includes all mammals considered to be rare in Canada (COSEWIC, 2003) and Nova Scotia (Scott, 1994) that may interact with the Project, as well as habitat that is important to mammal species, such as deer wintering areas (DWA).

A description of existing conditions for rare mammals within the study area is presented in Section 6.1.9.2.

8.1.9.1 Boundaries

Spatial Boundaries

The spatial boundary for assessment of mammals includes the area located within the Project property boundary (Figure 1.1). This includes the footprint of the facility as well as a buffer zone approximately 350 m wide.

Temporal Boundaries

Most mammals are non-migratory and are present in the study area year-round. Mammals could, therefore, be affected by construction and operation of the LNG Terminal for the duration of Project activities. Some mammal species are particularly sensitive to disturbance during certain times of year. For example, deer are more sensitive when gathered together in severe winter weather. Some species of bat are particularly sensitive during winter hibernation.

Administrative Boundaries

In Nova Scotia, all mammal species not designated as game animals or other harvestable wildlife under the provincial *Wildlife Act* and Regulations are protected at all times of the year. Certain species such as shrews and voles are considered as other harvestable wildlife and may be harvested without a licence at any time of year by the owner/occupier of a property or an agent of the owner/occupier to prevent property damage. Rare species such as the long-tailed shrew (*Sorex dispar*), and rock vole (*Microtus chrotorrhinus*) are thus technically not protected by legislation. Three mammal species are protected under the Nova Scotia *Endangered Species Act*, including American marten (*Martes americana*), Canada lynx (*Lynx lynx*) and the mainland moose (*Alces alces)* population. Two Nova Scotia mammal species, the Gaspé shrew (*Sorex gaspensis*) and the southern flying squirrel (*Glaucomys volans*), are protected under the federal *Species at Risk Act* (*SARA*).

Technical Boundaries

Information regarding the presence of mammals at or near the proposed LNG Terminal was derived from existing data sources as well as three field surveys (refer to Section 6.1.9.2). These information sources provide a good indication of the presence of rare large mammal species in the vicinity of the proposed LNG terminal. Knowledge of the distribution of rare small mammals in the vicinity of the site is less well known due to their secretive nature and the need to conduct small mammal trapping to determine their presence in an area. Fortunately, many rare small mammals have very specific habitat requirements, which can be used to predict areas where they are likely to be found. Habitat requirements for some small mammals, such as the hoary bat (*Lasiurus cinereus*) and red bat (*Lasiurus borealis*), are poorly understood, since they have been encountered in Nova Scotia on only a few occasions.

8.1.9.2 Residual Environmental Effects Evaluation Criteria

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 (reproduction and immigration from unaffected areas) 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 meet the above criteria is evaluated as **not significant**.

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

8.1.9.3 Potential Interactions, Issues and Concerns

There are no rare mammal populations or sensitive mammal habitat (*e.g.*, deer wintering areas) found in or near the study area; consequently, the Project is not expected to have any adverse effects on them. Other mammals found in or near the study area could be affected by the Project. Construction of the Terminal could result in the loss of habitat, habitat fragmentation, disturbance of larger mammals and possible mortality of small mammals. During the operational phase of the Project, mammal mortality may be increased as a result of collisions with vehicles. Activity at the terminal may disturb sensitive mammals in adjacent habitats resulting in abandonment of otherwise suitable habitat. Installation of a security fence around the Terminal will inhibit the movement of larger mammals to and from the Project property.

8.1.9.4 Analysis, Mitigation and Residual Environmental Effects Prediction

Construction

A number of activities associated with the construction phase could adversely affect mammal species as a result of habitat loss, noise, and related disturbance. Clearing and grubbing will result in the loss of forest cover that provides food and shelter for mammals. The Project footprint does not contain critical habitat for mammal species. The mammals known to inhabit the area are relatively common, therefore the loss of habitat associated with the Project will not threaten the existence of local mammal populations.

Other construction activities such as grading and construction of buildings, tanks and pipe runs will create visual, auditory and olfactory stimuli that may disturb mammals resulting in abandonment of habitat adjacent to the Project. None of the species recorded in the study area is particularly sensitive to anthropogenic activities. Two species recorded in the general area, American black bear and moose, are moderately sensitive to disturbance and, if present in the area, may leave. Both species habituate to human activities and can be expected to eventually return to the area once human activities in the area become routine and fairly predictable.

Clearing of the Project area will result in habitat fragmentation. Construction of the LNG Terminal will result in the formation of a large clearing that some mammals will be reluctant to cross particularly if humans are present on a continuous basis. The present layout of the facility is not expected to result in severe habitat fragmentation such as the creation of small isolated habitat patches, which can result in the isolation of small populations of species and associated inbreeding and increased predation or disease. The proposed site is completely surrounded by forest habitat so it will be possible for mammals to access nearby areas by moving around the terminal site.

The installation of the security fence around the perimeter of the property will also result in habitat fragmentation. The degree of habitat fragmentation will depend on how the fence is constructed. The fence planned for the site, a typical chain link fence, not buried, will not impede the movements of mammals smaller than a squirrel. Medium sized animals up to the size of a racoon will have restricted access but will eventually find a variety of locations where they can go under the fence at streams and in areas of rocky or uneven terrain. Larger animals such as coyote, American black bear and white-tailed deer will have greater difficulty getting through the fence but will eventually find a few areas where they can get through. Very large animals such as moose are unlikely to be able to get through the fence and will be excluded from the fenced in area if it is completely surrounded by fencing. Factors that would make it harder for mammals to get through the security fence would include burying the fence and extending the fence along the shore rather than having it end at the point where the property line intercepts the shore. With the possible exception of moose, the security fence is unlikely to result in mammal populations being isolated within the property or excluded from the property. However, for medium to large prey species it may result in increased predation by providing predators with good ambush sites at locations where these prey species go through the fence. Given the population status of

the mammal species found in or near the study area, the overall residual effects of habitat loss, disturbance and habitat fragmentation on local populations of these species will not be significant.

Operation and Maintenance

The operation phase could adversely affect mammals in two ways. Noise, odours and visual stimuli associated with operation of the terminal could cause disturbance of mammals in habitats adjacent to the facility. Operation of the terminal will increase the amount and speed of traffic on the Bear Island Road resulting in increased incidence of road kill. Disturbance of mammals associated with operational activities at the terminal is not expected to have significant adverse effects on mammals found in the study area. These species are tolerant of anthropogenic activities and readily habituate to the presence of humans. The study area does not provide critical habitat for these species. Moose and American black bear which have been recorded in the general area but not in the study area may be reluctant or unable to make use of the habitat adjacent to the footprint of the terminal due to a combination of disturbance and the presence of the security fence. The exclusion of these species from the study area will not have a significant effect on populations of these species.

The incidence of road kill on the Bear Island Road can be expected to increase during the operational phase of the Project but will not be particularly high due to the limited amount of traffic on the road. The incidence of road kill can be reduced by keeping a reduced speed limit on the road. The incidence of road kill is generally low at speeds under 80 km/h. Overall the effect of the operational phase of the Project on mammal populations will not be significant.

8.1.9.5 Follow-up and Monitoring

No follow-up or monitoring studies of mammals in the study area are anticipated.

8.1.9.6 Summary of Residual Environmental Effects Assessment

Analysis of existing data sources and the results of the field surveys suggest that it is unlikely that any rare mammal species or sensitive mammal habitat are present in the study area. As such, no significant Project related adverse residual effects on rare mammals or sensitive mammal habitat are anticipated.

Given the absence of rare mammals and sensitive mammal habitat in the study area as well as the relatively small footprint of the Project compared with the amount of suitable habitat surrounding the facility, it is unlikely to contribute to significant adverse cumulative effects on rare or sensitive mammal species.

Provided the recommended mitigative measures are implemented, no significant adverse residual environmental effects on rare mammals are likely to occur. Table 8.11 provides a summary of the residual environmental effects and recommended mitigative action for rare mammals.

Table 8.11 Residual Environmental Effects Assessment Matrix: Rare Mammals

Project Activity	Potential Positive (P) or Adverse (A) Environmental Effect	Mitigation	Significance Criteria for Environmental Effects					Residual Environmental Effect	Level of Confidence
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/ Social-cultural and Economic Context		
CONSTRUCTION									
Clearing and grubbing	Habitat loss and fragmentation (A) Disturbance or displacement Mortality (A)	• Minimize area disturbed • Minimize duration of noise disturbance	1	3	2/6	I	2	N	3
OPERATION AND MAINTENANCE									
Operation of facility	Disturbance (A)	• No mitigation recommended	1	3	5/6	R	2	N	2
Increased vehicle traffic	Mortality (A)	• Reduce speed limit on access road	1	3	5/6	R	2	N	2

KEY

Magnitude: 1 =Low: (*e.g.*, specific group or habitat, localized, one generation or less, within natural variation); 2 = Medium: (*e.g.*, portion of a population or habitat, 1 or 2 generations, rapid and unpredictable change, temporarily outside range of natural variability); 3 =High: (e.g., affecting a whole stock, population or habitat outside the range of natural variation).
Geographic Extent: 1= <500 m²; 2 = 500 m² -1 km²; 3 = 1-10 km²; 4 = 11-100 km²; 5 =101-1000 km²; 6 = >1000 km².
Duration: 1 = < 1 month; 2 = 1-12 months; 3 = 13-36 months; 4 = 37-72 months; 5 = > 72 months.
Frequency: 1 = < 11 events/year; 2 = 11-50 events/year; 3 = 51-100 events/year; 4 = 101-200 events/year; 5 = >200 events/year; 6 = continuous.
Reversibility: R = Reversible; I = Irreversible.
Ecological/Socio-cultural and Economic Context: 1 = Pristine area; 2= Area affected by human activity; 3 = Evidence of adverse effects.
Residual Environmental Effect Rating: S = Significant Adverse Environmental Effect; N = Non-significant Adverse Environmental Effect; P = Positive Environmental Effect.
Confidence: 1 = Low; 2 = Medium; 3 = High.

8.1.10 Rare Herpetiles

Rare herpetile (amphibian and reptile) species are a VEC in recognition of the importance of preserving biodiversity and ecological integrity. Rare species are potentially most at risk from development since large proportions of their populations can be affected by even relatively small perturbations if the population is very small and concentrated in a small area. Rare herpetile species are considered a VEC if they are:

- listed as a species at risk at the national level by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) (COSEWIC, 2003); or

- listed as a rare, endangered or sensitive species in Nova Scotia (NSDNR 2003a; NSDNR 2003b).

A description of existing conditions for rare herpetiles within the study area is presented in Section 6.9.1.3.

8.1.10.1 Boundaries

Spatial Boundaries

Habitats with a relatively high likelihood of supporting these species are wetlands of all types, forest habitats adjacent to wetlands, and intervale habitats of rivers and streams. The assessment considers potential Project interactions with rare herpetiles within all habitats that have high potential to harbour these species and that are likely to be disturbed by Project construction or operation. In general, the spatial boundary for the assessment of this VEC includes those high potential habitats within the Project property boundary (Figure 6.3).

Temporal Boundaries

The rare herpetiles identified in this study are resident species or undertake only local seasonal movements, so interactions with the Project could occur at any time during Project construction or operation. Some species may be most sensitive to disturbance when they congregate, mate, and lay eggs in wetland habitats during April and May, with eggs and larvae present from April through July.

Administrative Boundaries

Herpetiles which are hunted for food, such as the snapping turtle and bull frogs, are protected from hunting outside of defined seasons (July 15-September 30). Other herpetiles have no legislative protection unless they are found in a protected area such as a provincial park or are listed as a rare or endangered species under either the federal *Species at Risk Act* or the Nova Scotia *Endangered Species Act.*

Technical Boundaries

Information regarding herpetiles in the study area was derived from existing information sources (*e.g.*, Gilhen (1984), JWEL (1999 and 2003) and interviews with biologists at the Nova Scotia Museum of Natural History), as well as field surveys conducted on June 23 and July 27, 2003 (refer to Section 6.1.9.3).

8.1.10.2 Residual Environmental Effects Evaluation Criteria

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 (reproduction and immigration from unaffected areas) would not return the population to its former level within several generations.

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

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

8.1.10.3 Potential Interactions, Issues and Concerns

Construction of the proposed LNG Terminal can adversely affect herpetile populations by fragmenting habitat and removing or adversely modifying (*e.g.*, through siltation or change in hydrology) core habitat features such as breeding sites. Construction activity can positively affect herpetile populations through the possible creation of habitat such as road side ditch pools which can provide valuable breeding habitat for amphibian species and the creation of habitat edges which favours certain snake species.

8.1.10.4 Analysis, Mitigation and Residual Environmental Effects Prediction

Construction

No rare herpetile species have been recorded in the study area; however, habitat potentially suitable for nesting four-toed salamanders is found at the eastern end of Wetland 1. The suitable habitat is present outside of the footprint of the Project; consequently, there will be no direct loss of this habitat. However, approximately, 10 % of Wetland 1 will be infilled as a result of construction activity. This could result in the alteration of the hydrology of the wetland, which may affect the suitability of the wetland as breeding habitat for this species. The implementation of flow retention/siltation treatment can be used to eliminate any adverse hydrological effects on the wetland, which would minimize potential adverse effects on four-toed salamander breeding habitat and ensure that rare herpetile populations are not significantly affected.

Operation and Maintenance

The only normal operating procedures that could potentially adversely affect herpetiles are vehicle traffic and the use of herbicides to control vegetation around the facility. Vehicle traffic could result in mortality of herpetiles crossing roads. Amphibians would be most sensitive to road kill during the spring when they migrate to nesting sites. Snakes would be most susceptible to road kill during early spring and late fall when they often bask on roads to increase their body temperature. Vehicle traffic associated with the operation of the terminal is not expected to be high so herpetile mortality as a result of roadkill is unlikely to have a significant effect on local herpetile populations. Four-toed salamanders in the study area would tend to be clustered within several hundred metres of their breeding sites which are located to the east of the footprint of the terminal. As such, the effect of vehicle traffic on four-toed salamanders would probably be less than for other amphibians since the centre of their distribution is east of the terminal where no increase in vehicle traffic is anticipated.

Mechanical clearing will be the primary means of vegetation management at the LNG terminal. Herbicide use, as a means of vegetation management, is not anticipated for the Project. Normal operation of the LNG Terminal is not expected to have any significant adverse effect on rare herpetile species.

8.1.10.5 Follow-up and Monitoring

Herpetile surveys will be conducted in Wetland 6 as part of the wetland evaluation process if required (see Section 8.1.8.5). No monitoring studies are recommended.

8.1.10.6 Summary of Residual Environmental Effects Assessment

Analysis of the results of the field surveys as well as existing data sources suggest that the proposed LNG Terminal may affect breeding habitat for an uncommon herpetile species, the four-toed salamander. Habitat marginally suitable for this species was found in Wetland 1 although no four-toed salamanders were encountered during the survey. Habitat for this species will not be directly affected by construction activity; however, there is some potential for the hydrology of the wetland to be altered as a result of construction activity. This species is generally considered to be more abundant than records would indicate and has been shown to be quite adaptable in its choice of breeding habitat. The effect of the construction phase of the Project on populations of four-toed salamanders is not considered to be significant.

Other herpetile species are found in the study area, and the Project may adversely affect them as a result of habitat loss and habitat fragmentation during the construction phase of the Project and roadkill during the operational phase of the Project. These herpetile species are relatively common in the general area, and the effect of the Project on these populations is not considered to be significant. Mitigative measures implemented to reduce the potential adverse effects of the project on four-toed salamanders will be beneficial to other herpetile species found in the study area.

Provided the recommended mitigative measures are implemented, no significant adverse residual environmental effects on rare herpetiles are likely to occur. Table 8.12 provides a summary of the residual environmental effects and recommended mitigative action for rare herpetiles.

Table 8.12 Residual Environmental Effects Assessment Matrix: Rare Herpetiles

Project Activity	Potential Positive (P) or Adverse (A) Environmental Effect	Mitigation	Significance Criteria for Environmental Effects					Residual Environmental Effect	Level of Confidence
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/ Social-cultural and Economic Context		
CONSTRUCTION									
Clearing and grubbing	Direct mortality (A) Habitat loss (A) Erosion and sedimentation of wetlands (A)	• Minimize ground disturbance in and around Project footprint; • Avoid wetland habitat where practical; • Wetland mitigation including erosion and sediment control (Section 8.1.8) • EPP	1	2	2/6	I	2	N	2
OPERATION AND MAINTENANCE									
Facility operations	Sedimentation of wetland and alteration of wetland hydrology (A)	• Stormwater Management Plan • Ensure that cleared areas are well vegetated	1	1	5/1	R	2	N	2

KEY

Magnitude: 1 =Low: (*e.g.*, specific group or habitat, localized, one generation or less, within natural variation); 2 = Medium: (*e.g.*, portion of a population or habitat, 1 or 2 generations, rapid and unpredictable change, temporarily outside range of natural variability); 3 =High: (e.g., affecting a whole stock, population or habitat outside the range of natural variation).
Geographic Extent: 1= <500 m²; 2 = 500 m² -1 km²; 3 = 1-10 km²; 4 = 11-100 km²; 5 =101-1000 km²; 6 = >1000 km².
Duration: 1 = < 1 month; 2 = 1-12 months; 3 = 13-36 months; 4 = 37-72 months; 5 = > 72 months.
Frequency: 1 = < 11 events/year; 2 = 11-50 events/year; 3 = 51-100 events/year; 4 = 101-200 events/year; 5 = >200 events/year; 6 = continuous.
Reversibility: R = Reversible; I = Irreversible.
Ecological/Socio-cultural and Economic Context: 1 = Pristine area; 2= Area affected by human activity; 3 = Evidence of adverse effects.
Residual Environmental Effect Rating: S = Significant Adverse Environmental Effect; N = Non-significant Adverse Environmental Effect; P = Positive Environmental Effect.
Confidence: 1 = Low; 2 = Medium; 3 = High.

8.1.11 Birds

Birds are a VEC because of their ecological importance and regulatory protection. Avifauna-related issues of concern are focussed in this assessment to rare or sensitive bird species (NSDNR 2003a; NSDNR 2003b; COSEWIC 2003), raptors, and colonial nesting aquatic birds. Rare species, by definition, are of interest and often warrant special consideration. Raptors (*e.g.*, eagles, hawks, falcons) are generally sensitive to anthropogenic disturbances, especially during their breeding period. Colonial nesting aquatic birds are also very sensitive to anthropogenic activities since large proportions of local breeding populations may be concentrated into a small area. The populations assessed are those present in Nova Scotia.

A description of existing conditions for birds within the study area is presented in Section 6.1.9.4.

8.1.11.1 Boundaries

Spatial Boundaries

Spatial boundaries for the assessment have been developed in consideration of the fact that rare or sensitive bird species could occur at any location within the property boundary of the Project and marine areas that could be affected by the Project. Certain areas may be critical to bird species. Birds are particularly sensitive to disturbance around nest sites and colonial nesting species, such as terns or cormorants, may be particularly sensitive at these sites, since large numbers of nests may be affected simultaneously. Some species such as aquatic birds may congregate in large numbers during migration in relatively small but important feeding and resting areas. Noise and visual stimuli associated with construction activities around these sites can adversely affect the energy budgets of migrants, possibly increasing mortality rates. This assessment considers potential Project effects on avian species of concern within two distinct areas that include the terminal site and the coastal waters along the approach route to the proposed terminal site. The Terminal site study area includes terrestrial areas that the proposed Terminal will physically disturb as well as a buffer zone extending 500 m from these disturbed areas. The coastal study area includes the Strait of Canso, Chedabucto Bay and the waters around Isle Madame.

Temporal Boundaries

Most avian species are migratory; however, some are considered resident. Temporal boundaries are therefore variable, as some species may be present year-round while others may occupy habitat in the vicinity of the Project only during a critical point in their life cycle. The breeding season (April to August for most species) is generally the most critical period for bird species, which are sensitive to habitat destruction and disturbance at this time, since eggs and nestlings cannot move from the source of

disturbance. Potential adverse effects may result from destruction or permanent abandonment of the nest or increased predation during temporary abandonment.

Administrative Boundaries

Bird species in Canada are protected by the *Migratory Birds Convention Act* of 1917, which protects all bird species except for cormorants, hawks, falcons, owls, kingfishers, jays, crows, blackbirds, non-native species and game birds. In Nova Scotia, the *Nova Scotia Wildlife Act* and Regulations protect all non-game bird species that are not considered pests. The Nova Scotia *Endangered Species Act* and the federal *Species at Risk Act* offer legal protection to some rare species that have been proclaimed as endangered, rare or vulnerable under the Acts.

Technical Boundaries

The breeding status of most bird species of Nova Scotia, at particular sites, cannot be reliably determined outside their breeding season (during which they are actively defending territories, and are readily detectable by song and other behaviours). Information on the distribution and abundance of birds has been obtained mainly through the Maritimes Breeding Bird Atlas (MBBA) database (Erskine, 1992), a review of the Atlantic Canada Conservation Data Centre data base (ACCDC 2003), a breeding bird survey conducted in the study area on June 23, 2003 and supplemental bird surveys conducted on April 14 and July 27, 2003 (refer to Section 6.1.9.4).

8.1.11.2 Residual Environmental Effects Evaluation Criteria

A **significant adverse effect** occurs when the Nova Scotia population of a bird species is sufficiently affected to cause a decline in abundance and/or change in distribution beyond which natural recruitment would not return the population(s), or any populations or species dependent upon it, to its former level within several generations.

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

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

8.1.11.3 Potential Interactions, Issues and Concerns

The Project could adversely affect birds in a number of ways. During the construction phase of the Project bird habitat will be lost as a result of clearing and grubbing of the terminal site. Birds in adjacent habitats may be disturbed by auditory and visual stimuli associated with construction activity. Construction of the LNG Terminal will result in habitat fragmentation and the creation of habitat edge.

During the operational phase of the Project, birds in habitats adjacent to the LNG terminal may be disturbed by activities at the terminal. Seabirds and sea ducks found in the approaches to the LNG terminal could be disturbed by the additional ship traffic. Bird mortality rates could increase as a result of collisions with the structures caused by attraction to lighting at the terminal or as a result of collisions with vehicles.

Lighting of tall structures can have an adverse effect on migrating birds. Under conditions of poor visibility such as low cloud cover or fog, nocturnal migrating birds have difficulty navigating and may be attracted to bright lights. Under cloudy or foggy conditions water droplets in the air refract light creating an illuminated area around the lights. Birds that have lost their celestial navigation aids may enter these illuminated areas and become confused possibly resulting in collisions and/or exhaustion. Strong unidirectional or rotating light sources are most likely to create this problem and red light can create more of a problem than white light. Flood lighting of structures has been demonstrated to cause bird mortality since the strong lighting traps birds close to the lighted structure. Navigational beacons may also affect birds since this lighting is positioned at higher altitudes where night migrating birds are more likely to encounter them. Solid or pulsing red navigation beacons have the strongest ability to hold birds while slow strobe lights have the weakest ability to hold birds.

8.1.11.4 Analysis, Mitigation and Residual Environmental Effects Prediction

Construction

A number of activities (*e.g.*, clearing and grubbing) associated with the construction phase of the Project could interact with sensitive bird species. During construction, potential effects include habitat loss, habitat fragmentation, the creation of habitat edge, noise and related disturbance, and erosion and sedimentation.

Clearing and grubbing will result in the removal of trees and shrubs that provide nesting areas for a variety of bird species. This will result in the displacement of birds nesting in these areas. The effects of clearing and grubbing are most severe when these activities are conducted during the period when most birds are breeding (April to August). Clearing and grubbing at this time of the year will result in the direct mortality of eggs and unfledged nestlings. The killing of migratory birds or the destruction of their eggs or young is an offence under the *Migratory Birds Convention Act*. Clearing and grubbing outside of the breeding season will deny birds habitat. It is recommended that clearing be conducted outside the breeding season where feasible in order to avoid destruction of nests and nestlings. If this is not feasible, alternative mitigation may be developed in consultation with CWS. Efforts should be made during Project design to minimize the overall area to be cleared. The Project footprint is approximately 0.12 km^2 in size and consists almost entirely of second growth softwood forest and mixedwood forest ranging in age from approximately 20 to 50 years. Habitat similar to this supports between 250 and 800

pairs of birds/km^2. As such, clearing of the Project footprint may result in the loss of forest habitat for 30 to 98 pairs of birds.

Sensitive bird species encountered at or near the Project site during the field surveys included Common Tern, Common Loon, Boreal Chickadee, Osprey and Bald Eagle. No direct evidence of Boreal Chickadee breeding activity was recorded during the field surveys. One Boreal Chickadee was heard calling during the June survey in suitable breeding habitat so there is some potential for this species to breed in the study area. The other species were observed foraging in or transiting through the Strait of Canso. The ACCDC considers Boreal Chickadee to be uncommon in Nova Scotia; however, NSDNR considers the Nova Scotia population to be secure. Boreal Chickadees nest in tree cavities and hollow branch stubs in coniferous and mixedwood forest. These habitat types are abundant in the general area. As such, the removal of coniferous and mixedwood forest during Project clearing is not expected to result in significant reductions in either Boreal Chickadee numbers or the availability of suitable nesting habitat for this species.

Most construction activities will generate noise or visual stimuli that can disturb nesting birds. Four of the sensitive species recorded in the study area are sensitive to disturbance around their nest sites. These include Common Tern, Common Loon, Bald Eagle, and Osprey. Boreal Chickadees are tolerant of the presence of humans and anthropogenic activities and it is unlikely that construction activity will cause them to abandon nesting sites near the construction area. Ospreys vary in their sensitivity to disturbance around their nest sites. In developed areas they are often extremely tolerant of human activity and will successfully nest in the middle of cities. In more remote areas where they are not habituated to humans they may become upset when humans approach within 200 m of their nest. There was no evidence to indicate that any of the species sensitive to disturbance nest in or adjacent to the Project site. As such, construction activity is unlikely to have any adverse effects on the nesting of these species. All of these species are relatively tolerant of human activities in their foraging habitat and the presence of construction activity near the Strait of Canso will not result in abandonment of large areas of suitable foraging habitat.

Clearing and grubbing for the Project will result in the creation of habitat edge. Habitat edge has both positive and negative implications for birds. Habitat edges often support a large number of bird species and high bird densities. However, edges also tend to attract generalist predators such as raccoons (*Procyon lotor*), red fox (*Vulpes vulpes*), coyote (*Canis latrans*), dogs (*Canis familiaris*), cats (*Felis domestica*), American Crows (*Corvus brachyrhynchos*), and Blue Jays (*Cyanocitta cristata*). They may also attract Brown-headed Cowbirds (*Molothrus ater*) a nest parasite of passerine (perching) birds. The presence of high concentrations of predators and Brown-headed Cowbirds along habitat edges can result in areas becoming reproductive sinks in which large numbers of birds attempt to breed but have poor breeding success. The deleterious effects of edge habitat may extend 200 to 600 m into the forest interior (Yahner 1988; Canadian Wildlife Service 2004).

Clearing of the project footprint will result in the creation of clearings that will contribute to habitat fragmentation in the area. Habitat fragmentation can adversely affect bird populations in several ways. Habitat fragmentation increases the amount of edge habitat potentially increasing rates of predation and nest parasitism and exclusion of forest interior species such as Ovenbirds. Habitat fragmentation can also limit bird distribution and the availability of suitable habitat by creating barriers to bird movement. The Canadian Wildlife Service (2004) has found that forest songbirds are reluctant to cross gaps greater than 200 m wide. In areas where large gaps are numerous, birds may not be able to reach patches of suitable habitat. Habitat corridors linking patches of suitable habitat must be wide enough to overcome the effects of habitat edge so that forest interior species are able to fully utilize the corridor. A corridor width of at least 900 m is desirable to ensure the long-term viability of forest corridors.

Clearing of the LNG terminal will result in the creation of a square clearing approximately 350 m wide. A clearing this size can be expected to affect bird movement patterns since many songbirds will be reluctant to cross it. Seven other clearings greater than 200 m across are present in the area, to the north, south, east and west of the proposed LNG facility. The area between these large gaps is characterised by the presence of relatively contiguous closed canopy forest ranging in age from approximately 20 to 80 years. Small gaps less than 200 m across are present in this forest matrix and are associated with wetlands and woods roads. These gaps do not form a physical barrier to the movements of most bird species since there are corridors of forest habitat ranging in width between 400 to 1000 m between the habitat gaps. However, some of the gaps may be narrow enough to interfere with the movement of some forest interior species that are very sensitive to the presence of habitat edge.

Habitat fragmentation and edge effects associated with construction of the LNG terminal can be expected to result in localized reduced abundance of forest interior bird species and elevated levels of predation, which will result in a reduction in bird abundance and breeding success. The effect on regional and local bird populations is not considered to be significant and would be similar to that associated with the clearing of a moderately sized clear-cut or agricultural field.

Erosion and siltation associated with site disturbance during the construction phase of the Project could adversely affect bird species that rely on fish as an important component of their diet. Bald Eagle, Osprey, Common Tern, cormorants, and Great Blue Heron feed on fish and rely on visual clues to capture their prey. Turbid water would inhibit their ability to capture food. Turbidity associated with construction activity would affect only a relatively small area of available foraging habitat in the Strait of Canso and would not persist for long periods of time. Significant effects on local populations of fish eating birds is unlikely. The implementation of erosion and sedimentation control measures (see Section 2.4.2) will help ensure that residual environmental effects from erosion and sedimentation on avifauna are non-significant.

Operation and Maintenance

During the operational phase of the Project birds in habitats adjacent to the LNG terminal may be disturbed by activities at the terminal. Seabirds and sea ducks found in the approaches to the LNG Terminal could be disturbed by the additional ship traffic. Bird mortality rates could increase as a result of collisions with the structures caused by attraction to lighting at the Terminal or as a result of collisions with vehicles.

There is little data available regarding the disturbance effects of operations at industrial facilities on birds. However, studies of the effects of highway noise are available and are used here as a surrogate for industrial operations. A study of terrestrial bird abundance, species composition and breeding success in forested habitats adjacent to a busy highway in New Brunswick (JWEL 1998) revealed a reduction in bird abundance 18 to 25 % in plots located 100 and 200 m away from the road relative to control plots 500 m from the road. Evidence of breeding activity was reduced by 34 to 39 % relative to control plots. These reductions were not statistically significant. A similar study conducted in the Netherlands revealed a reduction in the number of singing males from 3.3/ha in control plots to 2.1/ha in areas within 200 m of a highway (Reijnen *et al*. 1995). These data suggest that disturbance associated with operation of the LNG terminal are likely to have a measurable adverse effect on local populations but is not expected to significantly adversely affect regional populations. Reijnen *et al*. (1995) noted that the degree of disturbance to birds by highway traffic was best correlated with noise levels. As such, the best means of mitigating disturbance associated with operation of the LNG terminal is to minimize noise levels (refer to Section 8.1.3).

Vehicle traffic associated with the operation of the LNG terminal can adversely affect birds as a result of bird/vehicle collisions. Roadkill is generally not considered as a significant source of mortality for bird populations (Leedy and Adams 1982). This is supported by a study which demonstrated that the survival rates of male Willow Warblers (*Phylloscopus trochilus*) was equal in areas near and far from highways (Foppen and Reijnen 1994). Roadkill data collected for a 100 Series Highway, secondary highway and city streets in Nova Scotia over a two year period yielded an average rate of roadkill of 0.9 birds/km/yr for the 100 Series highway, 1.2 birds/km/yr for the secondary highway and 0.7 birds/km/yr for city streets (M. Crowell unpublished data). It is estimated that only a small number of birds in the vicinity of the LNG Terminal (<50/yr) would be killed by the increase in road traffic and effects on local populations would be insignificant. The number of birds killed in collisions could be reduced by establishing a moderate speed limit on the access road. This would provide sufficient reaction time for most birds to avoid oncoming vehicles.

Project related vessel movements could potentially affect seabirds and sea ducks as a result of disturbance. Vessel traffic may frighten birds feeding or resting in the shipping lanes. Birds which tend to forage underwater such as sea ducks, cormorants and alcids tend to be more disturbed by vessel traffic than birds which tend to forage while in flight such as gulls, terns, shearwaters, and storm petrels. This

disturbance is not expected to have a significant adverse effect on local bird populations since the presence of the vessel generally disturbs only birds within a few hundred metres of the vessel and typically only birds sitting on the water. Birds quickly return to the area once the vessel passes. The number of LNG vessel passages through the area is relatively low (*i.e.*, 70 to 135 annually) so the total area affected by vessel traffic represents only a small fraction of the available habitat. Some birds such as gulls, shearwaters and storm petrels are attracted to ships. Vessels will not pass near breeding colonies where seabirds are most vulnerable to disturbance so no disturbance is expected to occur at these sites.

The proposed LNG Terminal will have pole mounted and tank mounted lighting to provide security lighting and illumination for cameras that will monitor the condition of equipment and piping. No navigational beacons will be required on the tanks. This lighting system could cause bird mortality under conditions of low cloud cover or fog. Such mortality events would be sporadic and are unlikely to have significant effects on populations of birds migrating through the area. Nevertheless, reasonable efforts should be made to reduce the effect of lighting on migrating birds. Where possible, tank mounted lighting should be kept at low heights so that it is less likely to illuminate birds flying through the area. Tank mounted and pole mounted lighting should be directed down and shielded from the top and sides. Wherever possible, low intensity lighting should be used rather than high intensity lighting.

The facility will be equipped with a flare that will be used to burn gas during emergency situations. The flare will be equipped with an invisible pilot light, used to ignite the gas. The operating flare is unlikely to have a significant adverse effect on migrating birds since it will be used only in an emergency. The probability of having the flare operating during weather conditions amenable to the attraction of night migrating birds and having large numbers of birds present is very low. The pilot light is not visible, consequently, it will not attract night migrating birds.

With the implementation of the above measures, the residual environmental effects associated with the operation phase are predicted to be non-significant.

8.1.11.5 Follow-up and Monitoring

In the event of a sizeable spill of oils, it is anticipated that the spill response program (refer to Section 8.3) will include oiled bird monitoring and recovery.

Routine site monitoring will include maintaining records of bird mortality noted on site to enable identification of potential issues related to lighting. Should it be determined that significant lighting related moralities are occurring, CWS will be consulted to discuss mitigative strategies.

8.1.11.6 Summary of Residual Environmental Effects Assessment

Provided the recommended mitigative measures are implemented, no significant adverse residual environmental effects on bird species of concern are likely to occur. Table 8.13 provides a summary of the residual environmental effects and recommended mitigative action for bird species of concern.

Table 8.13 Residual Environmental Effects Assessment Matrix: Birds

Project Activity	Potential Positive (P) or Adverse (A) Environmental Effect	Mitigation	Significance Criteria for Environmental Effects					Residual Environmental Effect	Level of Confidence
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/ Social-cultural and Economic Context		
CONSTRUCTION									
Clearing and grubbing	Habitat loss, direct mortality of eggs and nestlings (A) Noise (A) Erosion and sedimentation (A)	• Clear and grub outside of the breeding season for most bird species (April to August) • Clear only as much habitat as required for the project • No mitigation recommended • Implement erosion control measures minimize effects on aquatic bird habitat and foraging activities.	1	3	2/6	I	2	N	3
OPERATION AND MAINTENANCE									
Operation of LNG terminal	Noise/disturbance Roadkill (A) Attraction of birds to lights (A)	• Establish low speed limit on access road • Keep tank mounted lighting at low heights • Use low intensity lighting and direct light downward • Record bird mortality during routine site monitoring	1	3	5/6	R	2	N	3
Vessel traffic	Noise/disturbance (A)	• None recommended	1	3	1/2	R	2	N	3

KEY

Magnitude: 1 =Low: (*e.g.*, specific group or habitat, localized, one generation or less, within natural variation); 2 = Medium: (*e.g.*, portion of a population or habitat, 1 or 2 generations, rapid and unpredictable change, temporarily outside range of natural variability); 3 =High: (e.g., affecting a whole stock, population or habitat outside the range of natural variation).
Geographic Extent: 1= <500 m²; 2 = 500 m² -1 km²; 3 = 1-10 km²; 4 = 11-100 km²; 5 =101-1000 km²; 6 = >1000 km².
Duration: 1 = < 1 month; 2 = 1-12 months; 3 = 13-36 months; 4 = 37-72 months; 5 = > 72 months.
Frequency: 1 = < 11 events/year; 2 = 11-50 events/year; 3 = 51-100 events/year; 4 = 101-200 events/year; 5 = >200 events/year; 6 = continuous.
Reversibility: R = Reversible; I = Irreversible.
Ecological/Socio-cultural and Economic Context: 1 = Pristine area; 2= Area affected by human activity; 3 = Evidence of adverse effects.
Residual Environmental Effect Rating: S = Significant Adverse Environmental Effect; N = Non-significant Adverse Environmental Effect; P = Positive Environmental Effect.
Confidence: 1 = Low; 2 = Medium; 3 = High.

8.1.12 Rare Vegetation

Rare vegetation was selected as a VEC because it is a rare element of indigenous biodiversity and is often indicative of rare habitats that harbour unique assemblages of plants and animals. Preserving a rare plant species often ensures that rare habitats and their unique assemblages of species are preserved. Rare vegetation is designated in the following ways:

- being listed as a species at risk at the national level by COSEWIC (COSEWIC 2003); and/or
- being listed as a rare species in Nova Scotia (Pronych and Wilson, 1993; NSDNR 2003a).

The VEC assessed in this section is the Nova Scotia population of any lichens, bryophytes or vascular plant species listed as rare in Nova Scotia or Canada.

The Rare Vegetation VEC is related to the Wetland VEC (Section 8.1.8).

A description of existing conditions for rare vegetation within the study area is presented in Section 6.1.9.5.

8.1.12.1 Boundaries

Spatial Boundaries

Rare plant species occur only at specific places where the local habitat is suitable for their establishment and growth. Habitats with a relatively high likelihood of supporting rare species in the study area are barrens, wetland, riparian, and sea beach habitats. It is anticipated that potential Project interactions with this VEC would occur mainly within the footprint of the project where clearing and grubbing will remove vegetation cover, as well as in wetlands adjacent to the footprint where hydrology may be affected by construction activities.

Temporal Boundaries

Because rare plants are always present in their habitats, the opportunities for Project interaction are continuous. Potential effects on plant habitation and soils caused by construction activities and vehicle movements may be more severe when the ground is soft (*e.g.*, Spring).

Administrative Boundaries

Rare plants are currently protected by law in Nova Scotia only if they are growing in a protected area such as a provincial park or are listed under the Nova Scotia *Endangered Species Act* or federal *Species at Risk Act*. Most rare species at most locations in Nova Scotia are not protected by law. However, the

presence of rare vegetation is considered to be an environmental constraint under the environmental assessment process. The degree to which they pose a constraint depends on the rarity of the species and their sensitivity to the Project.

Technical Boundaries

Most of the rare plant species of Nova Scotia cannot be reliably identified outside of the growing season and many species can only be reliably identified while in flower or fruit which may limit the time period during which they can be detected. A rare plant modelling exercise was carried out prior to conducting the field surveys in order to determine the optimal times to conduct rare plant surveys.

8.1.12.2 Residual Environmental Effects Evaluation Criteria

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 would not return the population to its former level within several growing seasons.

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

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

8.1.12.3 Potential Interactions, Issues, and Concerns

Rare vegetation populations found at the site could be affected by a variety of activities during construction. Clearing and grubbing would be most likely to affect rare vegetation populations. Sedimentation of wetlands or watercourses could alter soil conditions in, or smother, wetland or aquatic habitats that support rare plant species.

Rare plant species are unlikely to be affected during the operational phase, since vegetation management will be conducted mainly by mechanical means and confined to the footprint of the LNG Terminal and the thermal radiation buffer established around the storage tanks. The rare plants found in the study area are located outside of these areas.

8.1.12.4 Analysis, Mitigation and Residual Environmental Effects Prediction

Construction

The two rare plant species found in the study area are not present within the area where construction activity will occur. The patch of southern twayblade is located approximately 67 m west of the edge of the area to be cleared. The nearest patch of northern commandra is located approximately 97 m west of

the area to be cleared (refer to Figure 6.3). It is unlikely that clearing and grubbing of the site will directly affect these species.

Southern twayblade is found within the floodplain of a small stream which drains Wetland 2. Erosion of the grubbed areas could smother southern twayblade if sediment deposition in the flood plain were significant. A variety of mitigative measures will be used to minimize erosion and sedimentation including the establishment of a buffer zone of undisturbed forest habitat between the process area adjacent and Wetland 2. Additional measures will be included in the Project EPP; many are described in Section 8.18.

Overall, with the implementation of the above mitigative measures, the residual environmental effect of construction on rare vegetation is predicted to be non-significant.

Operation and Maintenance

Operational activities that could affect rare plants, such as vegetation management, will be restricted to within the footprint of the LNG terminal. The southern twayblade and northern commandra populations are found outside of the areas where vegetation management will occur. The Stormwater Management Plan will ensure that the wetland habitats where the rare plant reside are not adversely affected by stormwater runoff. Normal operation of the facility is, therefore, not expected to significantly adversely affect these species. Use of herbicides is not anticipated on the site as vegetation controls along pipe runs and cryogenic lines will be achieved through the placement of gravel and/or concrete.

8.1.12.5 Follow up and Monitoring

A follow-up rare plant survey should be conducted in June 2004 to assess the distribution and abundance of southern twayblade in the study area. Southern twayblade flowers in mid-June and begins to senesce soon after setting seeds in early July. The southern twayblade population was discovered on July 27, 2003 and at the time of the survey it was very difficult to identify the specimen to species. It is possible that other plants in the population were missed or that other small populations may be present in the footprint of the project. It is unlikely that southern twayblade is widespread in the study area since it was not detected during the rare plant survey conducted on June 23, 2003.

8.1.12.6 Summary of Residual Environmental Effects Assessment

Analysis of existing data sources, as well as the results of field surveys, indicates that two rare plant species are found in the study area but outside of the project footprint. There is some potential for these species to be adversely affected by sedimentation during the construction phase of the Project. No adverse affects are anticipated to occur as a result of normal operation of the LNG terminal. Mitigative

measures developed for the various phases of the Project would help ensure that any adverse environmental effects would be non-significant.

Provided the recommended mitigative measures are implemented, no significant adverse residual environmental effects on rare vegetation are likely to occur. Table 8.14 provides a summary of the residual environmental effects and recommended mitigative action for rare vegetation.

Table 8.14 Residual Environmental Effects Assessment Matrix: Rare Vegetation

Project Activity	Potential Positive (P) or Adverse (A) Environmental Effect	Mitigation	Significance Criteria for Environmental Effects					Residual Environmental Effect	Level of Confidence
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/ Social-cultural and Economic Context		
CONSTRUCTION									
Clearing and grubbing	• Direct mortality (A) • Habitat alteration (A)	• Establish undisturbed buffer between process area and Wetland 2; and • Erosion and sediment controls as specified in EPP.	1	2	2/6	I	2	N	3
OPERATION AND MAINTENANCE									
Plant Operation	• Direct mortality (A)	• Stormwater Management Plan	1	2	5/1	R	2	N	3

KEY

Magnitude: 1 =Low: (*e.g.*, specific group or habitat, localized, one generation or less, within natural variation); 2 = Medium: (*e.g.*, portion of a population or habitat, 1 or 2 generations, rapid and unpredictable change, temporarily outside range of natural variability); 3 =High: (e.g., affecting a whole stock, population or habitat outside the range of natural variation).
Geographic Extent: 1= <500 m²; 2 = 500 m² -1 km²; 3 = 1-10 km²; 4 = 11-100 km²; 5 =101-1000 km²; 6 = >1000 km².
Duration: 1 = < 1 month; 2 = 1-12 months; 3 = 13-36 months; 4 = 37-72 months; 5 = > 72 months.
Frequency: 1 = < 11 events/year; 2 = 11-50 events/year; 3 = 51-100 events/year; 4 = 101-200 events/year; 5 = >200 events/year; 6 = continuous.
Reversibility: R = Reversible; I = Irreversible.
Ecological/Socio-cultural and Economic Context: 1 = Pristine area; 2= Area affected by human activity; 3 = Evidence of adverse effects.
Residual Environmental Effect Rating: S = Significant Adverse Environmental Effect; N = Non-significant Adverse Environmental Effect; P = Positive Environmental Effect.
Confidence: 1 = Low; 2 = Medium; 3 = High.

8.2 Valued Socio-economic Components

8.2.1 Archaeological and Heritage Resources

Archaeological and heritage resources are included as a VSC in this assessment in recognition of the interest of First Nations, the general public, and provincial and federal regulatory agencies in ensuring the effective management of these resources. For the purposes of this assessment, archaeological and heritage resources are defined as physical remains that inform us of the human use of, and interaction with, the physical environment. These resources may be above and below the surface of the ground and cover the earliest pre-Contact times to the relatively recent past. Pre-Contact refers to the time before the arrival of non-Aboriginal peoples.

Heritage resources are generally considered to include historic period sites such as cemeteries, heritage buildings and sites, monuments, and areas of significance to First Nations or other groups.

A Mi'kmaw Knowledge Study is currently in progress and will include: a historical review of Mi'kmaw use in the study area; a Mi'kmaw use study to determine recent past use of the study area; and a Mi'kmaw Species of Significance Survey. Further details are included in Section 8.2.5.

A description for existing conditions for potential archaeological and heritage resources within the study area is presented in Section 6.2.1.

8.2.1.1 Boundaries

Spatial Boundaries

Spatial boundaries for the assessment of archaeological and heritage resources include the study area as indicated in Figure 6.11. The study area was designed to encompass the land surrounding the proposed Project footprint, but it was expanded to the east to address the elevated potential for Aboriginal archaeological resources along the eastern shore. The assessment of potential Project effects on archaeological and heritage resources is focused principally on those Project activities that cause ground disturbance.

Temporal Boundaries

Temporal boundaries for archaeological and heritage resources consider that these resources are relatively permanent features of the environment. Construction activities carried out at any time of year can therefore affect the integrity of any archaeological or heritage site encountered. Any potential adverse effect on archaeological and heritage resources will be permanent. Temporal boundaries also

consider that archaeological and heritage sites may be affected in the long term by an increase in accessibility.

Administrative Boundaries

The archaeological survey falls under the jurisdiction of the Nova Scotia Museum, specifically the Nova Scotia *Special Places Protection Act*. All archaeological work conducted in Nova Scotia is done under a Heritage Research Permit issued by the Nova Scotia Museum.

Technical Boundaries

Information used for the assessment of archeological and heritage resources was derived from published sources, some of which were old and potentially limited in accuracy. Also, the potential presence of subsurface remains are by nature often difficult to locate during most types of low intrusive surveys. The assessment was based on a preliminary site plan; the construction of additional features causing ground disturbance (*e.g.*, roads, pipelines, laydown areas) may require investigation once located.

8.2.1.2 Residual Environmental Effects Evaluation Criteria

A **significant adverse effect** is defined as any Project-related disturbance to, or destruction of, archaeological or heritage resources considered by affected First Nations, communities, or provincial heritage regulators to be of major importance due to factors such as rarity, condition, spiritual importance, or research importance, and that cannot be mitigated.

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

A **positive effect** is one that results in enhanced understanding of local, regional, or cultural heritage through increased knowledge, or provides physical protection for a site that might otherwise have been destroyed through natural or non-Project anthropogenic events, in the absence of the Project.

8.2.1.3 Potential Interactions, Issues and Concerns

Certain activities associated with Project construction (*i.e.*, grubbing, grading) will cause surficial or subsurface disturbance which could affect archaeological and heritage resource sites. These disturbances, if unmitigated, could result in the loss of the resource and the potential knowledge to be gained from its interpretation. As noted in Section 6.2.1.1, the proposed Project area has little potential for prehistoric archaeological resources. The four historic-period cellars identified during the archaeological survey date from the second half of the nineteenth century are not considered to be significant.

The operation phase will not have an adverse effect on significant archaeological resources. If no areas beyond the final Project area are disturbed during maintenance, no other adverse affects on archaeological or heritage resources are anticipated.

8.2.1.4 Analysis, Mitigation and Residual Environmental Effects Prediction

Construction

Project construction will cause surficial or subsurface disturbance which could affect archaeological and heritage resources. As a result of this assessment, four heritage resources have been identified within the Project area. The resources, their significance, and predicted degree of impact are shown in Table 8.15.

Table 8.15 Identified Heritage Resources, Bear Head LNG Terminal Area

Resource	Heritage Significance	Approximate Distance to Project Footprint	Potential Impact	Recommended Mitigation
D. O'Brien cellar	Moderate	1.1 km	Unlikely	Avoidance
J. Mackie cellar	Moderate	1.1 km	Unlikely	Avoidance
R. Mackie cellar	Moderate	960 m	Unlikely	Avoidance
T. Mitchell cellar	Moderate	960 m	Unlikely	Avoidance

The most significant heritage resources identified during the archaeological survey were the four cellars/foundations that were shown on the A.F. Church map. These resources have moderate significance but are well outside of the proposed Project area to be disturbed and will not be negatively impacted. The potential presence of Aboriginal archaeological resources is considered low to moderate. However, the archaeological survey was limited to a proposed Project showing only a very basic plant footprint and jetty facilities. There will be other work such as road building and upgrading and the establishment of laydown/work areas. The potential effects of these activities on the archaeological resources has not been evaluated and any changes to the Project must be subject to an archaeological assessment. It is anticipated that any archaeological resources encountered during subsequent archaeological assessments can be successfully mitigated to insignificant levels as described below.

Any features, artifacts or other cultural material that is found during ground disturbance should be reported to the Nova Scotia Museum prior to proceeding with construction activities. It is recommended that an Archeological Contingency Plan be developed and implemented during construction to address any unanticipated resources discovered during ground disturbance.

Provided that the proposed mitigative measures are implemented, no significant residual environmental effects on archaeological and heritage resources during construction are likely. With the amount of potentially valuable information which might be gathered on archaeological and heritage resources in the general area the residual effect of the Project could be considered positive.

Operation and Maintenance

The primary source of potential adverse effects on archaeological and heritage resources during operation is anticipated to be vandalism or inadvertent surficial disturbance at sites due to maintenance procedures. However, it is not anticipated that Project operation will increase the threat of vandalism to the identified heritage resources. Any new roads or areas of construction should be subject to the same mitigative measures as the Project construction phase.

There are not likely to be any significant adverse residual environmental effects on archaeological and heritage resources as a result of Project operation.

8.2.1.5 Follow-up and Monitoring

Follow-up work for the Project will, at a minimum, adhere to the follow-up work to be implemented as mitigation described in Section 8.1.2.4. If alterations to the project are anticipated, any new areas under consideration will be subjected to a heritage resources impact review.

If previously unidentified archaeological or heritage resources are identified by site personnel during construction activities, the procedures in the Archaeological Contingency Plan should be followed including immediate contact with the Nova Scotia Museum.

8.2.1.6 Summary of Residual Environmental Effects Assessment

The development of the Project area will involve ground disturbance, which could affect any archaeological or heritage sites that may exist within the zone of surficial and subsurface disturbance.

Provided the recommended mitigative measures are implemented (*i.e.*, notification of regulatory authorities and development/implementation of Archaeological Contingency Plan), no significant adverse residual environmental effects on archaeological and heritage resources are likely to occur. Table 8.16 provides a summary of the residual environmental effects and recommended mitigative action for archaeological and heritage resources. With new information being gathered and made available to researchers, communities, regulators, and other stakeholders, the potential overall effect could be seen as positive.

Table 8.16 Residual Environmental Effects Assessment Matrix: Archaeological and Heritage Resources

Project Activity	Potential Positive (P) or Adverse (A) Environmental Effect	Mitigation	Significance Criteria for Environmental Effects					Residual Environmental Effect	Level of Confidence
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/ Social-cultural and Economic Context		
CONSTRUCTION									
Ground disturbance during plant construction, road building/upgrading, work/laydown areas	Disturbance of any archaeological or heritage resources (A)	• Report any features, artifacts or other cultural material to NSM prior to proceeding with construction activities • Archaeological Contingency Plan	1-2	4	3/2	I	2	N	2
Construction of marine facilities	Disturbance of any archaeological or marine heritage resources (A)	• Report any features, artifacts or other cultural material to NSM prior to proceeding with construction activities • Archaeological Contingency Plan	1-2	3	2/2	I	3	N	2
OPERATION AND MAINTENANCE									
Construction of new roads or work areas	Disturbance of any archaeological or heritage resources (A)	• Report any features, artifacts or other cultural material to NSM prior to proceeding with construction activities • Archaeological Contingency Plan	1-2	4	5/6	I	2	N	2

KEY

Magnitude: 1 =Low: *e.g.*, all or part of a site of minor importance, common resource with virtual duplicates; 2 = Medium: *e.g.,* all or part of a site not fully assessed, part of a rapidly depleting group of sites; 3 =High: *e.g.*, all or part of a site considered to be of major importance due to individual attributes or rarity.
Geographic Extent: 1= <100 m²; 2 = 100 m² - 500 m²; 3 = 500 m² -1 km²; 4 = 1-10 km²; 5 =10-100 km²; 6 = >100 km².
Duration: 1 = < 1 month; 2 = 1-12 months; 3 = 13-36 months; 4 = 37-72 months; 5 = > 72 months.
Frequency: 1 = < 11 events/year; 2 = 11-50 events/year; 3 = 51-100 events/year; 4 = 101-200 events/year; 5 = >200 events/year; 6 = continuous.
Reversibility: R = Reversible; I = Irreversible.
Ecological/Sociocultural and Economic Context: 1=Area relatively undisturbed by human activity; 2=Area affected by human activity; 3=Evidence of adverse effects
Residual Environmental Effect Rating: S = Significant Adverse Environmental Effect; N = Non-significant Adverse Environmental Effect; P = Positive Environmental Effect.
Confidence: 1 = Low; 2 = Medium; 3 = High.

8.2.2 Marine Transportation

Marine transportation is a VSC in consideration of potential effects of Project related marine traffic and marine infrastructure on existing patterns of marine transportation and associated navigation safety concerns. Vessel traffic in the Strait of Canso will be increased by Project construction vessels as well as those involved during the operational phase (LNG carriers, tugs, pilot vessels).

The VSC includes the movement of commercial vessels and vessels reporting to the Marine Communications and Traffic Services (MCTS) centres in accordance with the Eastern Canada Vessel Traffic Services (VTS) Zone Regulations. Eastern Canada VTS Zone (ECAREG) receives information from vessels entering Canadian Waters. "Canso Traffic" is the Local VTS Zone centre monitoring information from and for vessels in the Strait from a "calling-in point" at the entrance to the traffic separation scheme off the Canso Ledges. It does not include the movement of all fishing vessels, small craft and pleasure craft. Normal traffic into the Strait of Canso includes very large crude carriers (VLCCs) up to 400,000 tonnes deadweight, smaller coastal tankers, chemical tankers, general cargo vessels, bulk carriers, tugs, tugs with barges or other towed units, government vessels, fishing vessels, passenger vessels, and pleasure craft.

A description of existing conditions for marine transportation within the study area is presented in Section 6.2.2.

8.2.2.1 Boundaries

Spatial Boundaries

The spatial boundaries for the assessment of marine transportation are generally the Approaches to the Strait of Canso, and the Strait of Canso. Specifically, the proposed terminal will be situated approximately 1,260 m to the northwest of Bear Head Light, extending into the Strait of Canso to the 20 m charted water depth. Vessels approaching this berth from foreign ports will enter the traffic separation scheme to the East of the Canso Ledges, proceed to the pilot boarding station where the Cape Breton Pilot will embark all vessels with a length overall (LOA) in excess of 223 m (Figure 6.12). Six anchorages exist to the east of the track, in Chedabucto Bay. A line between Red Head and the south peninsula on Janvrin Island defines the limits of the waters of the harbour of Port Hawkesbury (J. Langley, pers. comm., 2003). To the north of the track in Inhabitants Bay and Lennox Passage there are nine anchorages. These pilotage areas and waterways also serve terminals and facilities in the Strait of Canso.

Temporal Boundaries

The temporal boundaries for the assessment of marine navigation are developed in consideration of the fact that vessels are present in the study area on a year round basis, and LNG vessels will also be making deliveries to the terminal consistently throughout the year. A vessel will be delivering to the terminal every five days if the Project employs 70 vessels per year, and every two or three days if the project employs 135 vessels per year.

LNG carriers are comparatively fast vessels. An average "sea speed" of 19.5 knots will be reduced to about 15 knots for "full speed" when manoeuvring. The vessel will maintain sea speed as long as possible but will be at manoeuvring speeds before it reaches the Pilot Boarding Station (Figure 6.12). Table 8.17 is an estimate of transit times in the Strait of Canso and Approaches. If the berth is occupied or otherwise unavailable when the LNG carrier enters the approaches, the vessel will be required to anchor at a suitable designated anchorage.

Table 8.17 Transit Times in the Strait of Canso and Approaches

Area Travelled (Figure 6.12)	Distance (km)	Time Traveled
From entrance to the Traffic Separation Scheme at calling in points 1A or 1C To Pilot Boarding Station	37.8	1.2 hours
From Pilot Station to Harbour Limits	18.4	0.7 hours
From Harbour Limits to Position off Berth	10.3	1.0 hours
Total Transit Time	66.5	2.9 hours

Administrative Boundaries

Movement of vessels in Canadian waters is governed by the *Canada Shipping Act* and Regulations, the *Oceans Act*, the *Canadian Marine Act*, and for the construction of the Terminal, the *Navigable Waters Protection Act*. Routing of vessels in Canadian Waters is monitored by VTS, assisted by Pilots and permitted by Customs and Port Authorities. Movement of the vessels in the local area will be discussed with the Marine Pilots in the Strait of Canso and the Atlantic Pilotage Authority.

As detailed in the following sub-sections, the Canadian Coast Guard, the Atlantic Pilotage Authority, and Transport Canada have jurisdiction over Marine Navigation within the Strait of Canso and Approaches. The International Maritime Organization (IMO) is the international body that, through its Conventions, produces resolutions that, when ratified by member States, are the least standards to which the member States must adhere when developing their regulations. The Safety of Life at Sea (SOLAS) Convention is constantly being modified, and the National Regulations are structured accordingly. The *Canada Shipping Act* (CSA) is empowered to develop regulations and where the Conventions of IMO so direct, the Regulations meet or exceed the IMO standards. Classification Societies, (*e.g.*, Lloyds Register (LR), American Bureau of Shipping (ABS), Det Norske Veritas (DNV), etc.) oversee the construction of vessels, and develop standards at least to the standards required by IMO.

Canadian Coast Guard

Aids to Navigation are the responsibility of the Canadian Coast Guard, who verify that the lights and shapes meet the National Levels of Service Standards for all Canadian Waters. These aids are frequently reviewed and are subject to public consultation. The buoys in the Strait of Canso and Approaches meet with the standards; markers and range lights (keeping vessels on the designated tracks) exceed these standards. The 'CA', 'CC' and 'CE' buoys in the Traffic Separation Zone are being considered to be discontinued, and if approved will not exist at the time of Project initiation. At the public meeting for the Project held in Port Hawkesbury (25 September 2003), a representative for the community organization Keepers of the Beacon expressed a concern about the discontinuance of the light at Eddy Spit. This light was deemed to be surplus to the standards and scheduled to be removed following consultation with the port users. Lighthouses throughout Canada have been reviewed for discontinuance, and a majority has now been removed. Lighthouse preservation societies have taken over and preserved some of the lighthouses (D. Gaudet, pers. comm., 2003).

With the carriage of electronic aids and the capability of monitoring the position of vessels in the MCTS centres, the safety of navigation has increased. Electronic Aids to Navigation exist as follows and are received by receivers aboard ship:

- Differential Global Positioning System (DGPS);
- Loran C;
- Radar and Racon Beacons;
- Radio Direction Finders; and
- Automated Information Systems (AIS) (carriage to be made mandatory following IMO ratification and National regulation development).

Canadian Coast Guard supplies the services provided by MCTS (ECAREG and Canso Traffic). These are aids to navigation and include the monitoring of traffic entering Canadian waters and local zones. The Coast Guard also: advise vessels of other vessels in the zones; relay messages between the Pilots, Harbour Authorities, Government Agencies and ships; monitor and advise on hazards, weather and Notices to Mariners; advise on the safety of navigation in the area; and report on non-compliance.

The Canadian Coast Guard Emergency Preparedness and Response is responsible for ensuring that oil handling facilities, ships, and ports are prepared for spills of persistent oils. Response Organizations are industry owned operations that are certified to meet the standards required in the CSA Response Organization and Oil Handling Facilities Regulations, to respond to oil spills from its members. The requirement is to have Response Organizations in an area and to have these certified. The Canadian

Coast Guard issues a certificate of compliance to the Response Organization, stating that it complies with the requirements.

Depending on the capability of the Organization, it is certified to respond to spills of various sizes. These are identified, in Table 8.18, as Tiers 1 through 4 (F. Campbell, pers. comm., 2003).

Table 8.18 Response Time of Response Organizations to Various Sized Spills

Size of Spill	Quantity of Oil	Time Required to Respond
Tier 1	150 tonnes	6 hours (for equipment to be deployed on-site)
Tier 2	1,000 tonnes	12 hours (for equipment to be deployed on-site)
Tier 3	2,500 tonnes	18 hours (for equipment to be on-site)
Tier 4	10,000 tonnes	72 hours (for equipment to be on-site)

For certification, the Response Organization requires that personnel are trained, that approved plans exist, and that the plans are exercised. Ships carrying persistent oil must be represented by a Response Organization, which, in the Strait of Canso, is the Point Tupper Marine Services (PTMS).

Pilotage Areas

The Atlantic Pilotage Authority (APA) is the Crown Corporation responsible for pilotage in the Canso Area (P.Gates, pers. comm., 2003). The Authority is governed by the *Pilotage Act* and Regulations. There are six marine pilots (Cape Breton Pilots) employed year round, augmented by an additional pilot in the summer months (E. Dorey, pers. comm., 2003). The number of pilots necessary to maintain the service is regularly reviewed. Vessels with a LOA in excess of 223 m are required to embark pilots at the outer boarding station. The Compulsory Pilotage area D is bound by a line between Fox Island and Green Island (Figure 6.12). Vessels with an LOA of 223 m or less may embark a pilot at the Compulsory Pilotage area C, which is bound by a line between Red Head and Crichton Island Light. Pilotage is compulsory to all terminals in the Strait of Canso, in accordance with the Atlantic Pilotage Regulations.

Harbour Limits

The Port Hawkesbury Public Harbour is a Transport Canada harbour and the body responsible for the safety of operations in the harbour under the *Canadian Marine Act* and Regulations (R. Carpenter, pers. comm., 2003). The waters of the harbour are bound by the Harbour Limits defined in the south by a line between Red Head and the southern peninsular on Janvrin Island, and in the north by the Canso causeway and the Canso Lock (J. Langley, pers. comm., 2003). Within this area, the Harbour Master is responsible for the designation of vessel movement, anchorages and the safety of operation. Transport Canada is the government department responsible for the Public harbour and is the owner of the seabed in which the terminal is to be constructed.

Technical Boundaries

Transport Canada Marine Safety (TCMS) will review the Project with respect to potential impacts on marine safety through the TP743-TERMPOL Review Process. The process may be modified subject to information being supplied elsewhere (*e.g.*, through this environmental assessment). TCMS is aware of the Project and are prepared to activate the TERMPOL Review Committee (M. Balaban, pers. comm., 2003). Meetings between the ANEI, the proponent's agents, and the Committee will define the scope of the review.

8.2.2.2 Residual Environmental Effects Evaluation Criteria

A **significant adverse effect** on marine navigation is determined against the established significance evaluation criteria with respect to:

- a substantial increase in economic costs for marine transportation; or
- a reduction in the level of safety or service currently in the Strait of Canso and Approaches that is unacceptable to the relevant regulatory authorities.

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

A **positive effect** is one that:

- enhances infrastructure for marine navigation as part of the Project activities and therefore improves the safety and efficiency of marine navigation; or
- increases the opportunities for economic growth of the area.

8.2.2.3 Potential Interactions, Issues and Concerns

Construction

The construction phase of the terminal will result in increased marine traffic. Activity on the construction site will necessitate the employment of various types and numbers of vessels. Depending on the construction process, some of the following vessels could be employed:

- If materials need to be located at the construction site, small cargo vessels or barges will be used. These will either be anchored, or secured alongside a work barge so that the materials may be accessed easily. Materials used to construct the plant may be landed close to the site using vessels capable of handling the project cargo.

- Work barges and floating cranes may be required to place, manufacture, pile drive, inspect, coat, and serve as construction offices. These will be positioned and secured in place by spuds and/or anchors.

- Small craft will be employed to move the work force to and from the construction equipment and the shore.

- Small craft will be employed to ensure that other craft stay clear of the construction area and act as safety boats for the construction crew.

Operations

Following terminal completion, operations at the facility will be 24 hours per day and seven days per week, year round. The number of vessels discharging at the facility will depend on the market, capacity of the vessel, and continued maintenance of the facility. It is anticipated that there will be a vessel discharging at the facility every two to five days.

The terminal will be designed and constructed to serve the largest vessels currently in service or on order. The Project design vessel is a vessel of 12 m draught with a liquid capacity of between 125,000 and 160,000 m^3. At this date, the largest in service has a deadweight of 83,228 tonnes, with principal dimensions of LOA 274 m, breadth 41 m, and a draught 13.3 m. The largest on order but not commenced has a deadweight of 67,300 tonnes, with principal dimensions of LOA 288 m, breadth 49 m, and a draught 11 m. Line handling vessels will be required to carry the mooring lines from the ship to the bollards on the jetty.

The present complement of the Cape Breton Pilots is sufficient to handle the volume of shipping presently using the terminals in the Strait of Canso. The LNG project will increase this volume by 70 to 135 vessels per year, an equivalent of at least 140 to 270 movements. The Atlantic Pilotage Authority will review this complement, and if necessary, increase the number of Cape Breton Pilots operating in this area.

Ice will accumulate on the Northeast coast of Cape Breton and in normal years will not encroach into the shipping lanes in the Traffic Separation Scheme in such a way as to cause a hazard to shipping. This ice is pan ice, rotting, and generally driven by the wind. In February and March, 2003, the ice accumulation was greater than normal, and while causing minor delays to arriving vessels it caused no damage; large commercial vessels without Ice Class, a designation that the vessel is built with extra strength to operate in ice, were able to navigate through it. In these cases, Cape Breton Pilots board vessels outside the Compulsory Limits and serve as Ice Advisors. An Ice Advisor is a competent mariner with a superior certificate and experience in ice infested waters who advises on the movement of the vessel through the ice. Once the vessels enter the Compulsory Pilotage areas, the Ice Advisors assume their duties as Pilots.

The increase in volumes of traffic in the ECAREG and Canso Traffic areas will not significantly increase the workload for the operators. However, any additional legislation, restriction or requirement that is placed on the movement of LNG carriers will be monitored by the operators. They will issue safety notices in the form of *Notices to Shipping* as required.

LNG carriers berthing at the LNG terminal will require the services of tugs of a specified manoeuvrability and horsepower, which may or may not be available in the Strait of Canso at present. If the existing tugs are used for the LNG operation, the likelihood of delays to vessels berthing or sailing will increase. The use of tugs will need to be reviewed and consideration given to increasing the number of tugs in the harbour. Restrictions on vessel movements to berth and departure from the berth during high winds should be considered, as LNG carriers have large windage, and are therefore subject to making leeway particularly at slow speeds.

Customs, Immigration, Transport Canada, and other agencies will be required to clear the ships inbound and outbound. It is not anticipated that this will be a significant increase in the workload. Every vessel coming into Canadian Ports is subject to clearance from these authorities. The increase in shipping of a maximum of one vessel every two days is not onerous. The Shipping Agents, who have a commercial interest in the increased traffic, will provide the necessary documentation to facilitate the operation. The cargo clearance will be less onerous than it would be for a general cargo ship, and similar to that of a crude oil tanker delivering to the Port.

8.2.2.4 Analysis, Mitigation and Residual Environmental Effects Prediction

Construction

Before construction can commence, the application for the construction of the Project will be presented to the Navigable Waters Protection Branch (NWP) of DFO who administers the *Navigable Waters Protection Act* (*NWPA*). The *NWPA* approval process will ensure that construction of the marine structure does not represent an unacceptable risk to navigation and may stipulate lights or other navigation aides. The NWP is responsible for the final approval of the construction, but will require that the other Agencies and Government Departments who have affiliated responsibilities are informed and have either no concern, or require mitigation for the development of the project. NWP will monitor the construction to ensure that their stipulations are met. The approval of the Project under *CEAA* will be subject to the approval under the *NWPA*.

MCTS Canso Traffic issue *Notices to Shipping* in the area and *Notices to Mariners*, giving information about all aspects of safety in the harbour. These will include notice about delivery of product, and construction at the LNG Terminal Site, and dependant on the operational manuals, any restrictions that are to be in place when LNG is being discharged at the terminal, or throughout the transit of the vessel in the waters of the Strait and Approaches. The Harbour Master, through Canso Traffic, can require that

vessels passing the site, pass at slow speed, or place any other restriction on the movement of vessels in the harbour.

Any restriction placed on the movement of vessels in the vicinity of the construction will be promulgated by MCTS in either the *Notices to Mariners* or *Notices to Shipping.* Pilots, having local knowledge of the operations in the Strait of Canso, will advise Masters of all vessels requiring their services of these restrictions.

Tugs, floating cranes, work barges, crew vessels, supply vessels and cargo vessels may be employed at various stages of the construction phase. All vessels will be subject to the standards and regulations made under the *Canada Shipping Act,* the *Labour Code*, and the *Oceans Act.* The movement of the vessels will be subject to the *Practices and Procedures for Public Harbours,* made under the *Canada Marine Act* and administered by Transport Canada.

Provided the controls and mitigative measures described above are undertaken, significant Project related effects on marine navigation during construction are not considered likely.

Operation and Maintenance

LNG carriers entering the approaches to the Strait of Canso will be operated by a crew qualified at least to the requirements of the *IMO Standards for Training and Certification of Watchkeeper.* These ships are well-found and equipped to meet the standards of the Classification Societies (Lloyd's Register, American Bureau of Shipping, Det Norske Veritas, *etc.*). All will be subject to inspections by Transport Canada Marine Safety Inspectors under the *Port State Control* legislation.

The terminal and the Harbour Authority will identify the size and numbers of tugs necessary for the berthing process. The design criteria for the Terminal, approved by the Transport Canada (TERMPOL) Review Committee, will identify the safe berthing speed for the vessel to come alongside the Terminal and the size and number of mooring lines required.

Because of the large area of the vessel above the water, high winds, particularly on the beam of the vessel when berthing or letting go from the terminal, are a concern. Tug requirements will address this to a large extent. However it will be necessary to identify at what wind forces it will be considered imprudent to berth or let go the vessel.

The expectation for the vessel to be in a situation where it will be necessary to stop pumping because of the movement due to swell of the vessel along the quay or the vertical movement against the quay is low (E. Dorey, pers. comm., 2003). However, the criteria for stopping pumping and for disconnecting the product transfer piping will be identified in the Operations Manual of the Terminal.

The Operations Manuals from the Terminal and from the Harbour Authority will be produced during the construction stages of the project and approved by the Transport Canada (TERMPOL) Review Committee before a vessel is allowed to berth.

Provided the controls and mitigative measures described above are undertaken, significant Project related effects on marine navigation during operations are not considered likely.

8.2.2.5 Follow-up and Monitoring

The TERMPOL Review Process and current navigation and safety regulations built into the protocols for navigating in and near the Strait of Canso make up the necessary monitoring regime for the Project.

8.2.2.6 Summary of Residual Environmental Effects Assessment

Provided the recommended mitigative measures are implemented, no significant adverse residual environmental effects on marine transportation are likely to occur. Table 8.19 provides a summary of the residual environmental effects and recommended mitigative action for marine transportation.

Table 8.19 Residual Environmental Effects Assessment Matrix: Marine Transportation

Project Activity	Potential Positive (P) or Adverse (A) Environmental Effect	Mitigation	Significance Criteria for Environmental Effects					Residual Environmental Effect	Level of Confidence
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/ Social-cultural and Economic Context		
CONSTRUCTION									
Construction of marine-based infrastructure	Increased marine traffic during construction of Marine-based Infrastructure (A)	• MCTS Notices to Mariners and Notices to Shipping • All vessels subject to the standards and regulations under the Canada Shipping Act, the Labour Code, and the Oceans Act. • Movement of vessels subject to the Practices and Procedures for Public Harbours under the Canada Marine Act.	2	3	3/6	R	2	N	3
OPERATION AND MAINTENANCE									
Project vessel traffic	Potential interactions with marine traffic (A)	• Crew of LNG carriers qualified to IMO Standards for Training and Certification of Watchkeeper. • LNG Vessels meet standards of the Classification Societies. • Inspections by Transport Canada Marine Safety Inspectors under the Port State Control legislation. • Tugs will be used in the berthing process.	2	5	5/4	R	2	N	3
Presence of marine infrastructure	Potential obstruction to navigation (A)	• NWPA approval process • Navigation aides as required	2	2	5/6	I	2	N	3

KEY

Magnitude: 1 = Low (*e.g.*, within the normal variability of baseline conditions; 2 = Medium (*e.g.*, increase/decrease with regard to baseline but within standards and objectives; 3 = High (*e.g.*, singly or as a significant contribution in combination with other sources causing exceedances or impingement upon standards and objectives beyond the property line of the project
Geographic Extent: 1=<500 m^2; 2=500 m^2 – 1 km^2; 3=1-10 km^2; 4=11-100 km^2; 5=101-1000 km^2; 6=>1000km^2
Duration: 1=<1month; 2=1-12 months; 3=13-36 months; 4=37-72 months; 5=>72 months
Frequency: 1=<11 events/year; 2=11-50 events/year; 3=51-100 events/year; 4=101-200 events/year; 5=>200 events/year; 6=continuous
Reversibility: R=Reversible; I=Irreversible
Ecological/Socio-cultural and Economic Context: 1=Pristine area or area not affected by human activity; 2=Evidence of adverse effects
Residual Environmental Effect Rating: S=Significant Adverse Environmental Effect; N=Nonsignificant Adverse Environmental Effect; P=Positive Environmental Effect
Confidence: 1=Low level of confidence; 2=Medium level of confidence; 3=High level of confidence

8.2.3 Fisheries and Aquaculture

Fisheries and aquaculture are considered a VSC due to their importance to the regional economy and importance as a socio-cultural activity among maritime communities. There is a concern that jetty construction and operation and/or ship manoeuvring could affect local fisheries. The fisheries considered for this assessment include all finfish and shellfish harvested commercially or recreationally. Aquaculture includes all commercial aquaculture operations and foreshore lease holdings. This VSC is linked to Marine Fish (Section 8.1.5) and Marine Benthic Habitat and Communities (Section 8.1.4) and Marine Transportation (Section 8.2.2).

A description for existing conditions for fisheries and aquaculture within the study area is presented in Section 6.2.3.

8.2.3.1 Boundaries

Temporal Boundaries

The temporal boundaries for Fisheries and Aquaculture have been developed in consideration of the time periods of construction and operation of marine infrastructure (*i.e.*, jetty, water discharge) and ship manoeuvring. The temporal boundaries also consider time periods when fisheries are most active in the study area (*e.g.*, during fishing seasons) and during migration periods.

Spatial and Administrative Boundaries

For commercial fisheries, the assessment considers all fisheries associated with DFO Unit Area 4Wd, which in turn includes portions of Lobster Fishing Areas (LFA) 29 and 31A, and Crab Fishing Area (CFA) 24A. These management units define the spatial and administrative boundaries. These areas encompass the Strait of Canso (east of the Causeway) and Chedabucto Bay, including the inshore shipping route and jetty area. DFO assumes responsibility for the management of fish stocks in this area.

For recreational fisheries, the assessment considers all fisheries located within the Strait of Canso (east of the Causeway) and Chedabucto Bay. For aquaculture, the assessment similarly considers all existing commercial operations and foreshore lease holdings within the Strait of Canso and Chedabucto Bay.

Technical Boundaries

Information available for commercial fisheries varies between fisheries because of differences in the research or catch information that is collected for each fishery. DFO catch data, research survey data, and published literature were the primary sources for all information related to commercial fisheries. All information on recreational fisheries was collected through interviews conducted with key

informants specifically for this assessment. The key informants included individuals knowledgeable of recreational fishing activities within the defined spatial boundaries.

For aquaculture, public records of foreshore leases available from the Nova Scotia Department of Agriculture and Fisheries provided the necessary information on the location and characteristics of operations.

8.2.3.2 Residual Environmental Effects Evaluation Criteria

A **significant adverse effect** on fisheries and aquaculture is defined as:

- A Project related, uncompensated reduction in the incomes of commercial fishers or fishing profitability as a result of effects on target marine fish populations, damage to fishing gear or vessels, or loss of access to fishing grounds; or

- A Project related, uncompensated reduction in incomes or profitability of commercial aquaculture operations associated with individual leases as a result of loss of access to lease areas, effects on farmed species, or damage to equipment.

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

A **positive effect** is one that enhances incomes or profitability of commercial fisheries or aquaculture operations, or that enhances the catch levels of recreational fishers.

8.2.3.3 Potential Interactions, Issues and Concerns

Potential interactions between the Project and fisheries and aquaculture include:

- Effects on target marine fish populations or farmed species through Project construction and operation, principally of marine components (see Marine Fish and Fish Habitat, Section 8.1.5);

- Damage to fishing gear, aquaculture equipment or vessels through gear fouling and/or interference with fishing vessels;

- Loss of access to fishing grounds or aquaculture leases through direct imposition of marine infrastructure and/or creation of fishing exclusion zones; and

- Reduced market or market value due to tainting or perception of tainting associated with marine spills of oils or other substances.

Residual environmental effects on Marine Fish and Fish Habitat and Marine Benthic Habitat and Communities after the application of proven mitigation measures during construction and operation of the Project have been described as not significant for both VECs (Section 8.1.4 and 8.1.5).

8.2.3.4 Analysis, Mitigation and Residual Environmental Effects Prediction

Construction

During construction of the jetty and during operation while an LNG vessel is at dock, other vessels will be restricted from coming near the jetty as a small exclusion zone will be established around the Terminal site. This safety zone will reduce the risk of collisions between fishing vessels and Project vessels (refer to Figure 6.12). Though fishing occurs in the area of the proposed Terminal (lobster, mackerel), the level of fishing activity is not intensive (C. Warner, pers. comm., 2004). The timing and duration of these exclusions are of concern to the commercial fisheries should they result in a loss of access to fishing grounds. Where there is loss of access to existing fishing grounds, this may result in a loss of income and fishers relocating elsewhere, which in turn can disrupt historical fishing patterns. Communications with fishing industry (*i.e.*, *Notices to Mariners*, community meetings) and planning for construction in late fall or winter when fishing effort is limited will reduce the number of fishers potentially affected by the construction of the jetty since the main fishery in the area of the Project occurs primarily from spring to fall.

Increasing vessel traffic due to construction activities may also lead to temporary loss of access to fishing grounds and damage to fishing and aquaculture gear and vessels. Communications and dialogue with the fisheries industry is essential. Efficiency and safety are maximized through the use of pilots, where required, and use of established shipping lanes and navigation protocol (refer to Section 8.2.3). Should construction activities result in gear or vessel damage, compensation will be available as established in the Fisheries Compensation Plan to be prepared for the Project. Interaction with aquaculture sites during Project construction is not anticipated due to the separation distances (refer to Figure 6.18).

In summary, mitigation associated with the construction phase includes: establishing communications and dialogue with fishing industry; targeting construction in the fall or winter; complying with navigation safety procedures; and where necessary, providing compensation for gear or vessel damage. Significant adverse effects on fisheries and aquaculture due to construction activities are therefore not anticipated.

Operation and Maintenance

A particular concern was expressed by a fisherman who operates mackerel traps in an area between Middle Melford and Steep Creek. The increase in ship activity during operation (both LNG carriers and tugboats) in the immediate area of the proposed Terminal may affect the distribution/migration of

mackerel and ultimately decrease catches (C. Warner, pers. comm., 2004). Though vessel traffic is expected to increase, this increase is modest (see Marine Transportation Section 8.2.2) and within the capacity of existing shipping lanes and the existing marine industrialized area. Another concern regarding both operations is loss of gear (aquaculture, mobile and fixed gear) in the event that ships do not utilize the marked shipping lanes. This concern can be alleviated by ensuring that all pilots concerned are aware of the positioning of the shipping lanes in the Project area relative to aquaculture sites and fixed gear leases.

Local fishers state that the new terminals (both at Bear Head and the new coal terminal) will result in a substantial increase in vessel traffic which warrants the re-opening of the station at Eddy Point (C. Warner and P. Kehoe, pers. comm., 2004). This in turn would help in having ships stay in the marked shipping lanes and ultimately reduce the amount of gear damaged by vessels outside of the shipping lanes (P. Kehoe, pers. comm., 2004). Aquaculturists are also concerned with increased shipping activity in the area (E. MacEachern and S. Dockendorff, pers. comm., 2004). Marine navigation safety processes are well established in the Project area (see section on Marine Navigation), and the TERMPOL process, in which ANEI will participate, is an important mechanism to enforce navigation safety procedures.

Operation of the Terminal will likely include an exclusion zone around the terminal. The loss of access to this area may result in a loss of income. However the area of the Terminal is not heavily fished and is small relative to the available area. A demonstrated, Project related loss of income for fishers or aquaculturists will be addressed in the Fisheries Compensation Plan to be developed by ANEI.

In summary, the proponent will keep the fishing industry informed of the location and scheduling of activities and other potential hazards through issuance of a *Notices to Mariners*. The proponent will develop a Fishery Compensation Plan to address claims for compensation for any direct damage to fishing gear or vessels and/or loss of access resulting in loss of income due to their operations. Pilots, established shipping lanes, and relevant marine navigation safety measures (see section on Marine Transportation) will maximize vessel safety in the Project area. Thus, significant adverse effects on fisheries and aquaculture due to operational activities associated with the Project, are not likely.

8.2.3.5 Follow-up and Monitoring

ANEI will engage the TERMPOL planning process and the *NWPA* application process to enhance navigation safety for all vessels including fishers. ANEI will maintain good communications with the local fishing industry throughout Project planning and construction and will develop a Fisheries Compensation Plan to address demonstrated damage/loss of gear or access.

8.2.3.6 Summary of Residual Environmental Effects Assessment

The area of the marine terminal is small relative to the available fishing area within 4Wd, which minimizes interactions with commercial fishing. ANEI will communicate with the fishing industry regarding the Project and fishing schedule and avoidance of interactions.

Provided the recommended mitigative measures are implemented, no significant adverse residual environmental effects on fisheries and aquaculture are likely to occur. Table 8.20 provides a summary of the residual environmental effects and recommended mitigative action for fisheries and aquaculture.

Table 8.20 Residual Environmental Effects Assessment Matrix: Fisheries and Aquaculture

Project Activity	Potential Positive (P) or Adverse (A) Environmental Effect	Mitigation	Significance Criteria for Environmental Effects					Residual Environmental Effect	Level of Confidence
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/ Social-cultural and Economic Context		
CONSTRUCTION									
Jetty Construction	Noise and turbidity causing fish avoidance (A) Loss of access to fishing grounds (A)	• Establishing communications and dialogue with fisheries industry. • Targeting construction in fall or winter will reduce the number of fishers potentially impacted by construction.	1	2	2/1	R	2	N	3
Vessel Traffic	Temporary loss of access to fishing grounds (A) Damage to gear and vessel (A)	• Establishing communications and dialogue with fisheries industry. • Using established shipping lanes and other navigation safety protocols (see Section X). • Fisheries Compensation Plan.	1	3	2/2	R	2	N	3
OPERATION AND MAINTENANCE									
Presence of jetty	Permanent loss of access to fishing grounds (A)	• Establishing communications and dialogue with fisheries industry. • Fisheries Compensation Plan	1	1	5/6	1	2	N	3
Vessel traffic	Temporary loss of access to fishing grounds (A) Damage to gear and fishing vessel (A)	• Establishing communications and dialogue with fishing industry. • Using established shipping lanes and other navigation safety protocols. • Fisheries Compensation Plan. • Participating in TERMPOL process and NWPA application.	1	3	5/3	R	2	N	3
Vessel unloading	Temporary loss of access to fishing grounds (A)	• Establishing communications and dialogue with fishing industry.	1	1	1/3	R	2	N	3

Table 8.20 Residual Environmental Effects Assessment Matrix: Fisheries and Aquaculture

Project Activity	Potential Positive (P) or Adverse (A) Environmental Effect	Mitigation	Significance Criteria for Environmental Effects					Residual Environmental Effect	Level of Confidence
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/ Social-cultural and Economic Context		

KEY

Magnitude: 1 =Low: (*e.g.*, specific group or habitat, localized, one generation or less, within natural variation); 2 = Medium: (*e.g.*, portion of a population or habitat, 1 or 2 generations, rapid and unpredictable change, temporarily outside range of natural variability); 3 =High: (e.g., affecting a whole stock, population or habitat outside the range of natural variation).
Geographic Extent: 1= <1 km²; 2 = 1-10 km²; 3 = 11-100 km²; 4 = 101-1000 km²; 5 =1001-10000 km²; 6 = >10000 km².
Duration: 1 = < 1 month; 2 = 1-12 months; 3 = 13-36 months; 4 = 37-72 months; 5 = > 72 months.
Frequency: 1 = < 11 events/year; 2 = 11-50 events/year; 3 = 51-100 events/year; 4 = 101-200 events/year; 5 = >200 events/year; 6 = continuous.
Reversibility: R = Reversible; I = Irreversible.
Ecological/Socio-cultural and Economic Context: 1 = Pristine area; 2= Area affected by human activity; 3 = Evidence of adverse effects.
Residual Environmental Effect Rating: S = Significant Adverse Environmental Effect; N = Non-significant Adverse Environmental Effect; P = Positive Environmental Effect.
Confidence: 1 = Low; 2 = Medium; 3 = High.

8.2.4 Land Use

Land use is a VSC because of its fundamental importance to socio-economic development. Land use includes all existing industrial, commercial and residential development, as well as settlement areas, lands used for recreation, and other areas of special community or social value. It is important to consider the compatibility of the Project with existing land uses, municipal land use plans and zoning designations. The nature and extent of developed lands, areas used for recreation, and other areas of special value are important determinants of the socio-economic character of the community. One of the most evident Project effects will be to change the current use of land at Bear Head. Development of lands within the industrial park are also closely related to the VSCs Community Services and Infrastructure (*e.g.*, traffic) (Section 8.2.6) and Economic Development (Section 8.2.7).

A description of existing conditions for land use within the study area is presented in Section 6.2.4.

8.2.4.1 Boundaries

Temporal Boundaries

The temporal boundaries for the assessment of land use have been developed in consideration of the time periods during which land use at Bear Head will be affected. This will include the 32 month period of construction and throughout the operational life of the Project (*i.e.*, at least 20 years).

Spatial Boundaries

The spatial boundaries for the assessment of land use primarily include all lands within the ANEI property boundaries (Figure 1.1). They also extend to all lands outside the property boundaries that could potentially be affected by a large scale release of LNG and possible associated fire (refer to risk assessment summary Section 3 and full risk assessment Appendix C).

Administrative Boundaries

The lands on which the Project is to be built and operated are provincial Crown Lands. ANEI has an option to purchase these lands. The Project is located in the Point Tupper/Bear Head Industrial Park within the Municipality of the County of Richmond, which has developed a Municipal Planning Strategy to guide development and land uses in the Point Tupper, Point Malcolm and Port Richmond areas (Rural Cape Breton District Planning Commission 2000a). The Municipal Planning Strategy has been prepared in compliance with the Nova Scotia *Municipal Government Act* and obtained the approval of the Department of Housing and Municipal Affairs, Government of Nova Scotia. The Land Use By-law of the West Richmond Plan Area defines development prohibitions and permit requirements (Rural

Cape Breton District Planning Commission 2000b). There are no existing mineral rights on the subject property (NSDNR 2003).

Technical Boundaries

The assessment of the potential interactions of the Project on land use relies on existing available information and data. In addition, interviews with key informants were used to confirm and supplement the document review process. Key informants contacted included:

- Nova Scotia Trails Federation;
- Nova Scotia Sport and Recreation Commission;
- Municipality of the County of Richmond;
- Rural Cape Breton District Planning Commission;
- Nova Scotia Department of Environment and Labour, Port Hawkesbury;
- Nova Scotia Department of Agriculture and Fisheries;
- Strait Area Fish and Game Association;
- Fisheries and Oceans Canada; and
- Nova Scotia Community College (NSCC), Port Hastings.

8.2.4.2 Residual Environmental Effects Evaluation Criteria

A **significant adverse effect** on land use occurs when a change in existing patterns and land uses (*e.g.*, residential, commercial, industrial, institutional, recreational, etc.) are disrupted to a widespread degree adversely affecting all or a portion of a community's use and enjoyment of the lands and/or is inconsistent with intended use as designated through a regulatory land use planning process.

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

A **positive effect** may enhance a community's use and enjoyment of lands or enhance the social value of lands consistent with its intended use.

8.2.4.3 Potential Interactions, Issues and Concerns

There are several Project related interactions with existing land use. The primary interaction is that there will be an important change to land use at the Project site. Operating within existing administrative and industrial park zoning parameters, the Bear Head Terminal will be built on an undeveloped site zoned for port industrial development. The Project will have a positive effect, as the development will complement and enhance other existing or planned land uses in keeping with the Municipal Planning Strategy and, in general, with the socio-economic character of the community.

Construction and operation of the Project will also exclude use and, in some cases, current access to informal recreational sites. This includes recreational use of the existing Bear Island Road, which has limited use by local residents for walking and accessing Bear Head. It will also impede the activities of the NSCC, who currently have two silviculture sites in and near the Project area. One of the sites is located within the Project footprint. The other site is located off a road constructed by the NSCC, which feeds off of Bear Island Road (Figure 6.21). NSCC built the access road that leads to the silviculture training site north of the Project area and they may consider building an additional access road for their sites.

The Project is also likely to create a higher level of land-based transportation activities in the Point Tupper area. Specifically during the construction phase of the Project, there will be a higher road-based use in the area related to vehicle access. This may lead to some road congestion for other businesses at Point Tupper. Mitigation and planning for transportation issues are addressed (Section 8.2.6).

8.2.4.4 Analysis, Mitigation and Residual Environmental Effects Prediction

Construction

During the construction phase of the Project there will be positive effects related to the changes of land use from an undeveloped area to an actively used port industrial site, consistent with designated land use and general community support for economic development (see Section 6.2.4). At this stage of the Project, there will also be exclusion of minor recreational activities within the project boundaries as well as access to the NSCC silviculture sites. Recreational users will be notified of restricted access by signage and/or security personnel at the entry to the construction site. Restriction of the minor, informal recreational use of Bear Head may be an inconvenience to some users, but is not likely to be significant.

NSCC will be notified well in advance of Project construction to allow ample time to either find alternative training sites or build new road access to the existing sites. While this adjustment may not be welcomed by NSCC, they have understood that future industrial development could displace these activities, and adequate planning time should ensure that the effects are not significant.

Operation and Maintenance

During the operational phase of the Project, positive changes to land use from the development of an appropriate industrial facility will remain ongoing and require no mitigation activities. The exclusion of current uses (*i.e.*, informal recreation, silviculture training) in the area as a result of the Project will also remain ongoing. During the operational phase, ANEI may take under consideration the potential development of a trail around the perimeter of the site for nature walking and access to Bear Island Head. Planning for potential trail development would be undertaken in consultation with community members and officials knowledgeable of local recreational patterns and interests.

8.2.4.5 Follow-up and Monitoring

There is no required or recommended follow-up with respect to the effects of the Project on land use. The existing Municipal Planning Strategy will continue to guide future land development in the vicinity of the Project that is compatible with heavy industry.

8.2.4.6 Summary of Residual Environmental Effects Assessment

NSCC access to training sites will be addressed through sufficient notification to allow development of alternative access or training sites. ANEI will, through consultation with local community members, consider development of a trail around the site to permit continued recreational access to the Bear Island Head. Significant residual adverse environmental effects on land use are, therefore, not likely to occur. The development of a major industrial facility consistent with the intended land use is a positive effect on land use.

Provided the recommended mitigative measures are implemented, no significant adverse residual environmental effects on land use are likely to occur. Table 8.21 provides a summary of the residual environmental effects and recommended mitigative action for land use.

Table 8.21 Residual Environmental Effects Assessment Matrix: Land Use

Project Activity	Potential Positive (P) or Adverse (A) Environmental Effect	Mitigation	Significance Criteria for Environmental Effects					Residual Environmental Effect	Level of Confidence
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/ Social-cultural and Economic Context		
CONSTRUCTION									
Clearing, grubbing and grading Construction of land based infrastructure	Changes in land use (P)	• Compliance with zoning stipulations	2	3	3 / 6	I	2	P	3
	Exclusion of current uses (recreational, silviculture) (A)	• Sufficient notification to NSCC to allow for planning of alternate access or training sites • Signage and/or security personnel to inform recreational users of restricted access	1	3	3 / 6	R	2	N	3
OPERATION AND MAINTENANCE									
Presence and routine operations of land based facilities	Changes in land use (P)	• Compliance with zoning stipulations	2	3	5 / 6	I	2	P	3
	Exclusion of current uses (recreational, silviculture) (A)	• ANEI will take under consideration the development of a trail around the perimeter of the site for potential use for nature walking and access to Bear Island Head.	1	3	5 / 6	R	2	N	3

KEY

Magnitude: 1 = Low (*e.g.*, within the normal variability of baseline conditions; 2 = Medium (*e.g.*, increase/decrease with regard to baseline but within standards and objectives; 3 = High (*e.g.*, singly or as a significant contribution in combination with other sources causing exceedances or impingement upon standards and objectives beyond the property line of the project
Geographic Extent: 1=<500 m^2; 2=500 m^2 – 1 km^2; 3=1-10 km^2; 4=11-100 km^2; 5=101-1000 km^2; 6=>1000km^2
Duration: 1=<1month; 2=1-12 months; 3=13-36 months; 4=37-72 months; 5=>72 months
Frequency: 1=<11 events/year; 2=11-50 events/year; 3=51-100 events/year; 4=101-200 events/year; 5=>200 events/year; 6=continuous
Reversibility: R=Reversible; I=Irreversible
Ecological/Socio-cultural and Economic Context: 1 = Pristine area; 2= Area affected by human activity; 3 = Evidence of adverse effects.
Residual Environmental Effect Rating: S=Significant Adverse Environmental Effect; N=Nonsignificant Adverse Environmental Effect; P=Positive Environmental Effect
Confidence: 1=Low level of confidence; 2=Medium level of confidence; 3=High level of confidence

8.2.5 First Nations Land and Resource Use

A Mi'kmaw Knowledge Study (MKS) has been commissioned by ANEI. The scope includes the following:

- An historical review to identify all existing information on Mi'kmaw use within the study area (generally 250 years or more from the present day);

- A Mi'kmaw use study to determine the recent past use of the study are by Mi'kmaq (generally within 250 years to the present); and

- A Mi'kmaw species of significance survey to determine the effect of the Project on species of significance to Mi'kmaq.

The interim MKS has been completed that reports the results of the historical review and the Mi'kmaw use study. This report is included in Appendix J. Upon completion of a study of plants of significance to Mi'kmaq in the summer of 2004, the final MKS will be prepared.

According to the interim MKS (Appendix J), the potential Project impacts on Mi'kmaw land and resource use are as follows:

- "Eel and scallop harvesting for food is occurring at the present day in the study area. Temporary loss of access to fishing grounds as a result of vessel traffic is a potential impact of the Project. Eel and scallop harvesting are aboriginal rights enshrined under section 35 of the Constitution. All infringements of aboriginal rights are considered significant. Because the increase in vessel traffic owing to the project is modest, within the capacity of existing shipping lanes, and within the existing marine industrialized area, the impact of increased vessel traffic on Mi'kmaq resource use is evaluated as not likely significant.

- The study of plants of significance to Mi'kmaq will be completed in June 2004. It is as yet unknown if the Project will impact any plants of significance to Mi'kmaq. Significance of any impacts on plants of significance to Mi'kmaq will be evaluated in the final version of the MKS to be submitted in the summer of 2004. A significant impact of the Project on a plant or plants of significance to Mi'kmaq would be the destruction of a plant or plants that do not exist in the surrounding area and that have been identified in the MKS as in current or present day use by Mi'kmaq."

The interim MKS recommends the following:

- In the event that Mi'kmaw archaeological deposits are encountered during construction or operation of the Project, all work should be halted and immediate contact should be made with the Nova Scotia Museum and the Confederacy of Mainland Mi'kmaq (CMM).

- That ANEI maintain good communications with Mi'kmaw fishers throughout the planning, construction, and operation of the Project in order to address any rights-based issues that could result from loss of access to fishing grounds in the future. The CMM/UNSI Technical Committee advises the Assembly of Nova Scotia Mi'kmaq Chiefs on all rights-based issues. It is not thought to be necessary to discuss the potential impacts of the Project on aboriginal rights with the CMM/UNSI Technical Committee at this time. Any rights-based issues identified via communications between ANEI and Mi'kmaw fishers in the future would be referred to the CMM/UNSI Technical Committee. The CMM/UNSI Technical Committee and ANEI would negotiate necessary next steps to resolve the issues.

- The study of plants of significance to Mi'kmaq will be completed in the summer of 2004 and the final MKS submitted to regulators. It is anticipated that any mitigative measures related to plants of significance to Mi'kmaq will be considered for further action by the Proponent and regulators at the time. If a plant or plants of significance to Mi'kmaq is identified within the study area the following recommendations would likely be provided:

    a. If the identified plant or plants of significance to be impated by the Project are available to potential users in the surrounding area, no mitigative measures would be proposed.

    b. If the identified plant or plants of significance to be impacted by the Project are not available to potential users in the surrounding area, a recommendation would be made to explore possible design changes to the Project to protect the plant or plants of significance. If no design changes were possible, a recommendation for restitution measures would be made (*e.g.*, harvesting the plant or plants of significance and providing them to the community or replanting the plant or plants of significance in another location).

    c. If the identified plant or plants of significance to be impacted by the Project are identified in the MKS as in current or present day use by Mi'kmaq and are not available in the surrounding area, a recommendation for mitigative measures that would allow Mi'kmaq to continue to access the plant or plants of significance would be made. In the event that no mitigative measures would be successful in protecting Mi'kmaq access to the plant or plants of significance, a recommendation that the Proponent consult with the Mi'kmaq via the CMM/UNSI Technical Committee would be made.

ANEI respects the rights asserted by First Nations and has focussed on ensuring that the Project does not have a significant impact on the exercise of those asseted rights. Based on the information provided in the MKS study, ANEI is confident that all of the potential Project impacts can be mitigated.

8.2.6 Community Services and Infrastructure

Community services and infrastructure is a VSC in recognition of the demand the Project may have on local emergency response services (fire, medical and police) and on-going support services (health and social services). These services may be affected by the occurrence of an accidental event, or by the routine presence of workers associated with the construction and operation of the Project. During the construction phase of the Project, there may be effects on the availability of local accommodation, and food and entertainment services, as well as effects on local transportation with the additional traffic volume. This VSC also considers potential effects on the community water supply, Landrie Lake.

A description of existing conditions for community services and infrastructure within the Study area is presented in Section 6.2.5.

8.2.6.1 Boundaries

Temporal Boundaries

Potential demands on community services and infrastructure can take place any time during Project construction and operation. However, it is expected that this demand will peak sharply during the approximately 32 month construction period when an average of approximately 400-600 workers (700-1,000 peak) are expected to be on site. Because the existing construction, tourism and recreation industries are seasonal in nature, any conflicting demands for services may be most apparent during the summer months.

Spatial Boundaries

For accidental events, the potential zones of interaction and the timing of the interactions with local emergency response services are determined using information from the risk assessment modelling (Section 3, and Appendix C). Thermal radiation flux from a design spill fire or the dispersion of unignited gas, should it occur, will be within the requirements of the code (CSA Z276-01) developed to protect public health and safety.

During construction and operation, the spatial boundaries of potential interactions between the Project and local emergency response and social services are defined by the local public service areas. These will primarily be provided out of the Town of Port Hawkesbury.

During the construction phase of the Project, any impacts on the supply and availability of local accommodation, and food and entertainment services will be felt directly in the Town of Port Hawkesbury, as well as potentially other smaller nearby communities, including Port Hastings, Aulds Cove, and Mulgrave.

Road access to the Project site is from Trunk 4 in Port Hawkesbury to Bear Island Road. Trunk 4 is a Nova Scotia arterial road, which connects to Trans Canada Highway 104 and 105.

The community water supply for the Town of Port Hawkesbury is provided by Landrie Lake. Water is pumped from the Landrie Lake Reservoir to a treatment plant at Point Tupper (Strait-Highlands Regional Development Agency 2002). The drainage area of the watershed is approximately 16 km^2, and the reservoir is located about 1.9 km north of the Project site (see Figure 6.2, Surface Water and Groundwater Supply).

Administrative Boundaries

Local fire emergency response to the Project will be provided by the Port Hawkesbury Fire Department. Local medical services are provided by the Guysborough Antigonish Strait Health Authority (GASHA), which is the provincial district health authority for the regions of Guysborough County, Inverness County, Richmond County and Antigonish County. Under the jurisdiction of the GASHA, the nearest medical treatment facility is the Strait Richmond Hospital in Evanston, Richmond County. Community health programs in the area are coordinated through the Strait Richmond Community Health Board. With regard to policing services, the Port Hawkesbury Detachment of the RCMP is directly responsible for the Point Tupper area.

Facility design and personnel training requirements are defined by CSA Z276-01. The code describes requirements for the plant site, equipment and training provisions for addressing fire, safety and security incidences (among other required design provisions).

Under the Nova Scotia *Occupational Health and Safety Act*, the Occupational Safety General Regulations (amended to NS Reg. 151/2003) define requirements to maintain a safe workplace. Similarly, the Occupational Health and Safety First Aid Regulations (amended to NS Reg. 104/2001) define the requirements for staff first aid certification, and the provision of first aid services and supplies, and first aid rooms.

The Industrial and Construction Camps Regulations (NS Reg. 40/42), under the *Health Act* of the Province of Nova Scotia, applies to the establishment of any construction camp that may be provided for the housing and feeding of labourers or employees.

Technical Boundaries

The assessment was based on existing documented information. Interviews with key informants were used to confirm and supplement the information gathered during document review. Key informants contacted included:

- Port Hawkesbury Fire Department;
- Guysborough Antigonish Strait Health Authority;
- Cape Breton Regional Hospital; and
- Royal Canadian Mounted Police, Port Hawkesbury Detachment.

8.2.6.2 Residual Environmental Effects Evaluation Criteria

A **significant adverse effect** on community services and infrastructure is determined against the established significance evaluation criteria with respect to:

- a prolonged or frequent reduction in the capacity of local emergency response (fire, medical and police) and on-going support services (health and social services) to provide mandated services;

- a sustained reduction in the availability of local accommodation, and food and entertainment services;

- an interruption in the supply of water to the community from Landrie Lake, or a reduction in water quality; or

- a sustained or frequent increase in traffic volumes or collisions on local roads.

An adverse effect that does not meet the above criteria is evaluated as **not significant**.
A **positive effect** is one that enhances the capacity of local emergency response and on-going support services; enhances the availability of local accommodation, and food and entertainment services; leads to the enhancement of the quality and quantity of water provided to the community water supply; or enhances the unutilized capacity on local roads or decreases the rate of collisions.

8.2.6.3 Potential Interactions, Issues and Concerns

Ultimately, all companies operating in the Point Tupper/ Bear Head Industrial Park are responsible for their own fire protection (Strait-Highlands Regional Development Agency 2002). The local fire departments would be relied upon in an emergency situation. The occurrence of an accidental event, or the routine presence of workers associated with the construction and operation of the Project, will place extra demands on local emergency response services (fire, medical and police) and on-going support

services (health and social services). The adequacy of local service capacities and emergency response capabilities is of concern.

During the construction phase of the Project, there may be impacts on the supply and availability of local accommodation, and food and entertainment services. Over the 32 month construction period, the number of workers will average approximately 400 - 600, reaching a peak of 700 - 1,000. Hotel and other temporary accommodation currently within Port Hawkesbury and the surrounding area is limited. In addition, local food and entertainment services will potentially be challenged with having to accommodate a large number of workers during off-work hours.

During peak construction periods in 2006; it is anticipated that about 650 passenger vehicle per day will access the site via Industrial Park Road and Bear Island Road. There will also be large numbers of heavy trucks transporting concrete, structural steel, steel plates, and insulation. During operation of the terminal, there will be from 32 to 40 employees with anticipated addition of only about 100 vehicles per day on Industrial Park Road and Bear Island Road.

The Point Tupper area has recently supported a large construction project; Stora Enso Port Hawkesbury Ltd. has undertaken a $1 billion expansion of its paper manufacturing facility, and at peak periods there were 2,500 workers on site in addition to 800 Stora Enso staff (B. Parks, pers. comm., 2003; B. O'Neill, pers. comm., 2004). In this case, the Port Hawkesbury RCMP worked with Stora Enso to develop a security plan. The main issues that the RCMP identified included security (*i.e.*, defining security perimeters around the site to deter theft), crime mitigation measures (*e.g.*, manifesting all equipment on site) and traffic control (*e.g.*, locating officers at key intersections to direct traffic) (B. Parks, pers. comm., 2003). For the Stora Enso construction project, the Town of Port Hawkesbury was able to absorb the demands on accommodations, and food and entertainment services (B. O'Neill, pers. comm., 2004). There was no construction camp, with the vast majority of workers hired in Cape Breton and either commuting to the site from nearby regions or staying with people in their homes nearby (organized by the workers themselves) (B. O'Neill, pers. comm., 2004).

During the construction phase of the project, Stora Enso also worked with other emergency response providers to ensure a safe and efficient emergency program. A plan was developed with EHS to have an additional ambulance posted in Port Hawkesbury during the construction phase. A plan was also developed with the local fire department in Port Hawkesbury (B. O'Neill, pers. comm., 2004). Stora Enso worked with the NSDEL Occupational Health and Safety Division to ensure the province was involved in the project planning (B. O'Neill, pers. comm., 2004).

The Stora Enso expansion is a useful case study. The construction project was over 50% larger in terms of labour employment, of the construction force for the proposed Bear Head LNG Terminal. With the Stora Enso project, there were no substantial negative impacts on local emergency response and on-

going support services reported. Impacts on accommodations and food and entertainment services were positive with respect to the increase in business, without reaching an overwhelming level of demand.

With respect to the community water supply provided by Landrie Lake, surface drainage from the Project property flows primarily into two streams that drain separately into the Strait of Canso and Bear Island Cove. It is estimated that approximately three-quarters of the site's surface drainage is directed to these streams, while the remainder of the surface flow drains south directly into the Strait of Canso. Thus, the Project property is not part of the Landrie Lake Watershed (Section 6.1.1). Based on the natural topography of the area and areas potentially affected by the Project, the Landrie Lake Reservoir will not be affected by any routine or accidental releases from the Project. There will be no foreseeable impact on the community water supply, either in terms of amount of water available to the community or water quality.

8.2.6.4 Analysis, Mitigation and Residual Environmental Effects Prediction

Construction

ANEI will work with the Port Hawkesbury RCMP to develop a security plan. The plan will define, at a minimum, security perimeters around the site, crime mitigation measures, and traffic control. ANEI will also work with local emergency fire and health responders to ensure that adequate planning is undertaken and the necessary resources are in place (*e.g.*, additional ambulances) to be able to service any foreseeable accidental events. This planning will be closely linked to ANEI's Emergency Response and Contingency Plan. With implementation of these measures, there is not anticipated to be a significant impact on local emergency response services.

It is not anticipated that a construction camp will be required to provide room and board for workers. If a construction camp were to be established for the Project, the Nova Scotia Industrial and Construction Camps Regulations define the requirements for camp cooking facilities, washing facilities, sleeping facilities, sanitation, and waste management. Based on past experience in the area with projects of equal or greater size, particularly the recent Stora Enso construction which did not require provision of a construction camp for workers, there is not anticipated to be a significant effect on the availability of local accommodation, and food and entertainment services. Similarly, there is not predicted to be a significant impact on on-going support services (health and social services). ANEI will ensure that the construction schedule is communicated to local businesses (*e.g.*, through the local chamber of commerce) to help in planning efforts.

The following summarizes the assessment of impacts on local transportation infrastructure:

1. Industrial Park Road was constructed in the early 1970's to provide construction access for many major industrial projects, and the road continues to provide daily access needs of several hundred employees in the Point Tupper area, as well as several hundred truck loads of pulp to Stora Enso and gypsum to the Georgia Pacific terminal.

2. Existing traffic volumes are relatively low on Industrial Park Road. Average weekday two-way volumes near Trunk 4 are about 5,350 vehicles per day, including peak hour volumes of about 450 vehicles per hour. South of the NS Power plant volumes drop to about 750 vehicles per day, including peak hourly volumes of about 75 vehicles per hour. Also, volumes on the Bear Island Road are extremely low.

3. The last kilometre of Bear Island Road is classified as abandoned; however, the road can be upgraded at the expense of those who need access.

4. While the maximum allowable gross vehicle weight on the Bear Island Road is 41,500 kg, a request can be made to the NSTPW to change the road classification to permit higher allowable weights. Also, a Special Move Permit can be arranged to permit movement of loads not normally permitted by *Weights and Dimensions of Vehicles Regulations*.

5. It is expected that construction traffic for the LNG Terminal can be accommodated by the existing road system, and by reconstructing the last kilometre of Bear Island Road, with only temporary disruptions to normal traffic movement.

Traffic generated during operation of the Bear Head LNG Terminal will not cause any significant impacts to existing traffic movement. A traffic management plan will be developed for the construction period to ensure that noise and dust from large construction vehicles is kept to acceptable levels.

Operation and Maintenance

During operation, it is estimated that the Project will employ 32 to 40 full-time personnel. The majority of these can be expected to reside in the Port Hawkesbury and Richmond Country region. Given the relatively small number of employees relative to the population of the region, the extra demands on local emergency response services (fire, medical and police) and on-going services (health and social services) will be reduced compared with the construction phase. Ongoing planning (*e.g.*, Emergency Response and Contingency Plan) and close communication with the RCMP and emergency fire and health responders will ensure the appropriate level of service is available and that any special requirements (*e.g.*, LNG spill response evacuation plans) are adequately provided including the necessary training.

8.2.6.5 Follow-up and Monitoring

ANEI will develop a security plan with the RCMP, and fire and emergency health response plans with local providers.

8.2.6.6 Summary of Residual Environmental Effects Assessment

Significant residual adverse environmental effects on community services and infrastructure are not likely. With the development of security and emergency response plans and by meeting the requirements of the CSA Z276-01 code (including development of an emergency response plan) with respect to fire protection, safety and security, there will be no significant effects on local emergency response services. The extra demand placed on ongoing support services (health and social services), accommodation, and food and entertainment services is expected to be within the capacities of the Port Hawkesbury region. The Landrie Lake Reservoir will not be affected by any routine or accidental releases from the facility. The traffic generated during construction and operation of the Bear Head LNG Terminal is not predicted to cause significant impacts on existing traffic movements.

Provided the recommended mitigative measures are implemented, no significant adverse residual environmental effects on community services and infrastructure are likely to occur. Table 8.22 provides a summary of the residual environmental effects and recommended mitigative action for community services and infrastructure.

Table 8.22 Residual Environmental Effects Assessment matrix: Community Services and Infrastructure

Project Activity	Potential Positive (P) or Adverse (A) Environmental Effect	Mitigation	Significance Criteria for Environmental Effects					Residual Environmental Effect	Level of Confidence
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/ Social-cultural and Economic Context		
CONSTRUCTION									
Construction of land and marine based infrastructure	Demands on local emergency response services (fire, medical and police) and on-going services (health and social services) (A)	• Development of a security plan with RCMP • Planning with local fire and emergency health responders • Emergency Response and Contingency Plan	1	4	3/6	R	1	N	3
	Reduction in the availability of local accommodation, and food and entertainment services due to large number of construction workers (A)	• Communication of construction schedule with local businesses.	2	4	3/6	R	1	N	3
	Additional traffic and conflicts with local transportation (A)	• Reconstruction of last km of Bear Island Road • Development of traffic management plan (primarily to reduce noise and dust from construction vehicles)	2	4	3/6	R	1	N	3
OPERATION AND MAINTENANCE									
Presence of routine operations of land and marine based facilities	Demands on local emergency response services (fire, medical and police) and on-going services (health and social services) (A)	• Development of a security plan with RCMP • Planning with local fire and emergency health responders • Emergency Response and Contingency Plan	1	4	5/6	R	1	N	3

Table 8.22 Residual Environmental Effects Assessment matrix: Community Services and Infrastructure

Project Activity	Potential Positive (P) or Adverse (A) Environmental Effect	Mitigation	Significance Criteria for Environmental Effects					Residual Environmental Effect	Level of Confidence
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/ Social-cultural and Economic Context		

KEY

Magnitude: 1 = Low (*e.g.*, within the normal variability of baseline conditions; 2 = Medium (*e.g.*, increase/decrease with regard to baseline but within standards and objectives; 3 = High (*e.g.*, singly or as a significant contribution in combination with other sources causing exceedances or impingement upon standards and objectives beyond the property line of the project
Geographic Extent: 1=<500 m^2; 2=500 m^2 – 1 km^2; 3=1-10 km^2; 4=11-100 km^2; 5=101-1000 km^2; 6=>1000km^2
Duration: 1=<1month; 2=1-12 months; 3=13-36 months; 4=37-72 months; 5=>72 months
Frequency: 1=<11 events/year; 2=11-50 events/year; 3=51-100 events/year; 4=101-200 events/year; 5=>200 events/year; 6=continuous
Reversibility: R=Reversible; I=Irreversible
Ecological/Socio-cultural and Economic Context: 1 = Pristine area; 2= Area affected by human activity; 3 = Evidence of adverse effects.
Residual Environmental Effect Rating: S=Significant Adverse Environmental Effect; N=Nonsignificant Adverse Environmental Effect; P=Positive Environmental Effect
Confidence: 1=Low level of confidence; 2=Medium level of confidence; 3=High level of confidence

8.2.7 Economic Development

Economic development is a VSC because it is a fundamental aspect of the socio-economic well being of a community. Economic development is evaluated with respect to regional employment and business. The focus is on job creation, impacts on economic output, and general changes to the local economy.

This VSC is linked to the VSC Community Services and Infrastructure (Sections 6.2.6 and 8.2.6) in terms of provision of local services (*e.g.*, hospitality, entertainment). A description of the existing conditions for economic development in the study area is provided in Section 6.2.7.

8.2.7.1 Boundaries

Temporal Boundaries

Temporal boundaries for the assessment of economic development have been developed in consideration of those times that Project development can interact with the local and regional economy of the Project area. The main economic effects will occur during the 32 month construction period (2005 to 2007) including effects on employment, incomes, economic output, and labour supply. These effects will persist, to a lesser extent, during Project operations.

Spatial Boundaries

The spatial boundaries for the assessment include the area that could reasonably be affected by the potential employment, income, economic output, and labour supply impacts associated with the Project. This includes, in particular, the Strait of Canso area, Cape Breton, and northern mainland Nova Scotia. The Province of Nova Scotia, as a whole, will also be affected.

Administrative Boundaries

The Project lies within the Municipality of the County of Richmond, which has partial responsibility for the development and implementation of economic development strategies. The regional development authority with jurisdiction is the Strait-Highlands Regional Development Agency. The Province of Nova Scotia has primary responsibilities with respect to the management of economic development throughout the province.

Technical Boundaries

The assessment is based on existing information. This included information available from:

- Statistics Canada;
- The Municipality of the County of Richmond;

- The Strait-Highlands Regional Development Agency; and
- Various published documents and reports.

8.2.7.2 Residual Environmental Effects Evaluation Criteria

A **significant adverse effect** on economic development is one in which there are negative impacts on regional employment, incomes, and gross economic activity, negative impacts on other regional commercial or industrial activities, or negative impacts on the regional labour supply of such magnitude and duration that the capacity of the socio-economic environment to adjust in the short-term is exceeded.

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

A **positive effect** is one that enhances regional employment, incomes, and gross economic activity, other regional commercial or industrial activities, or the regional labour supply.

8.2.7.3 Potential Interactions, Issues and Concerns

Project construction and operation will create direct, indirect and induced employment and income. This will also be reflected by impacts on overall regional and provincial economic output and value added (Gross Domestic Product-GDP). These effects will be positive; thus, there are no potential issues or concerns.

For the construction phase of the Project, there are potential negative effects on the availability of the local labour supply. The concern is that a large local demand will cause regional or provincial shortages of labour and, thus, inhibit other economic development or create deleterious competition for labour.

8.2.7.4 Analysis, Mitigation and Residual Environmental Effects Prediction

Construction

An average of 400 - 600 individuals will be employed over a 32 month construction period from 2005 to 2007. Over a 12-month period in that time, employment will reach a peak of approximately 700 - 1,000. Total direct employment is estimated at approximately 1,600 person years. The primary skills required for the work include truck drivers, concrete trades, equipment operators, piping trade, industrial welders, and general labourers. ANEI will attempt to source labour locally (*i.e*, the Strait Region, Cape Breton and northern mainland Nova Scotia) where qualified, although this will depend somewhat on the hiring practices of the contractors and businesses that are used during construction.

Total construction expenditures are estimated at $300 to $475 million over 32 months, or $113 to $175 million on an annualized basis. This will have an estimated direct and indirect GDP impact to the Province of Nova Scotia of $51 to $80 million per year (based on 1999 Nova Scotia input-output multipliers for oil and gas engineering construction). The GDP impact is a measure of the value added to the economy directly and indirectly through local employment income and business profits.

There is a total work force of approximately 13,600 in the Strait Region (Statistics Canada 1996). Of these, 1,500 are experienced in primary industries, 1,800 in manufacturing, 1,000 in construction and 900 in transportation. The available experienced labour is substantial within Cape Breton and northern mainland Nova Scotia. Given the current labour availability in the region relative to the demand for the Project during construction, there are not anticipated to be significant negative impacts on the labour supply. ANEI and/or its primary contractors will communicate labour and material requirements to labour unions and local suppliers well in advance of tenders to allow the local markets time to prepare for bids and adjust the labour force and training requirements where practical. This communication may include vendor information sessions.

Operation and Maintenance

During the operation of the facility, employment is estimated to be between 32 to 40 (full time equivalents). The employment income to these workers will be from $2.2 to $2.8 million per year. Based on the operating costs of the labour force, the GDP impacts, direct and indirect, to the Province of Nova Scotia will be $6.5 to $8.0 million per year.

8.2.7.5 Follow-up and Monitoring

No follow-up or monitoring is recommended with respect to the effect of the Project on economic development.

8.2.7.6 Summary of Residual Environmental Effects Assessment

There are no significant adverse environmental effects on economic development. Impacts on the local labour supply are anticipated to be relatively low in overall magnitude, although extending throughout Cape Breton and mainland Nova Scotia. The labour supply impact will be within the variations previously experienced in the region for other major construction projects. Impacts on local employment, incomes and economic activity in the region will be positive; they will be greatest during construction, and less substantial during the operation of the terminal.

Provided the recommended mitigative measures are implemented, no significant adverse residual environmental effects on economic development are likely to occur. Table 8.23 provides a summary of the residual environmental effects and recommended mitigative action for economic development.

Table 8.23 Residual Environmental Effects Assessment Matrix: Economic Development

Project Activity	Potential Positive (P) or Adverse (A) Environmental Effect	Mitigation	Significance Criteria for Environmental Effects					Residual Environmental Effect	Level of Confidence
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/ Social-cultural and Economic Context		
CONSTRUCTION									
General Terminal Construction	Impacts on local labour, incomes and gross economic activity (P)	• Communication with labour unions and local suppliers	1-2	5	3/6	R	1	P	3
	Impacts on other local commercial and industrial activities (P)	• Communication with labour unions and local suppliers	1-2	5	3/6	R	1	P	3
	Impacts on labour supply (A)	• Communication with labour unions and local suppliers	1-2	5	3/6	R	1	N	2
OPERATION AND MAINTENANCE									
Routine Operations of Terminal	Impacts on local labour, incomes and gross economic activity (P)	• No mitigation recommended	1	5	5/6	R	1	P	3
	Impacts on other local commercial and industrial activity (P)	• No mitigation recommended	1	5	5/6	R	1	P	3

KEY

Magnitude: 1 = Low (*e.g.*, within the normal variability of baseline conditions; 2 = Medium (*e.g.*, increase/decrease with regard to baseline but within standards and objectives; 3 = High (*e.g.*, singly or as a significant contribution in combination with other sources causing exceedances or impingement upon standards and objectives beyond the property line of the project
Geographic Extent: 1=<500 m^2; 2=500 m^2 – 1 km^2; 3=1-10 km^2; 4=11-100 km^2; 5=101-1000 km^2; 6=>1000km^2
Duration: 1=<1month; 2=1-12 months; 3=13-36 months; 4=37-72 months; 5=>72 months
Frequency: 1=<11 events/year; 2=11-50 events/year; 3=51-100 events/year; 4=101-200 events/year; 5=>200 events/year; 6=continuous
Reversibility: R=Reversible; I=Irreversible
Ecological/Socio-cultural and Economic Context: 1 = Pristine area; 2= Area affected by human activity; 3 = Evidence of adverse effects.
Residual Environmental Effect Rating: S=Significant Adverse Environmental Effect; N=Nonsignificant Adverse Environmental Effect; P=Positive Environmental Effect
Confidence: 1=Low level of confidence; 2=Medium level of confidence; 3=High level of confidence

8.3 Assessment of Malfunctions and Accidental Events

Malfunctions and accidental events associated with the Project can have potential environmental effects. Potential malfunctions and accidental events associated with the Project include: failure of sedimentation/erosion control structures; fires and explosions; marine vessel traffic accidents and related cargo spills; hazardous materials spills (*e.g.*, diesel oil, fuels, chemicals); and LNG release.

8.3.1 Failure of Sedimentation/Erosion Control Structures

During the Project construction phase, there is potential for failure of erosion and sedimentation control measures. The VECs that have the potential to interact with such an event include marine benthic habitat and communities, marine fish and fish habitat, wetlands and freshwater habitat. The potential effect to all VECs is habitat degradation.

Design features and methods that will be used to control surface runoff, reduce the potential for erosion, and prevent offsite siltation of any receiving waters will be specified in an EPP for construction and a Stormwater Management Plan for operations. Site inspections will be undertaken to ensure the ongoing suitability and good repair of these erosion control measures. In particular, inspections will be undertaken before and after heavy precipitation events. The site runoff will be treated (*i.e.*, ponds and oil separators), if required, and checked for compliance with provincial and/or federal standards prior to being discharged to the surrounding watershed or the marine environment. Mitigation measures to control sedimentation during marine construction include silt curtains and silt/debris booms, if necessary and technically feasible. Failure of erosion and sedimentation controls (*i.e.*, breaches) will be identified and rapidly repaired. Repair materials will be kept on site at all times to ensure immediate repair. Maintenance, inspection and response/repair of erosion and sedimentation controls will be specified in the EPP.

Damage or failure of erosion/sedimentation control measures are unlikely to cause a significant effect to habitats as frequent inspection will ensure the breach is not prolonged. In the event of a damaged or malfunctioning sedimentation or erosion control structure, the effects are expected to be localized, of short duration and reversible. The time required for ecological systems to recover would depend on several factors, including the type of habitat affected and the amount of material that breached the structure. With implementation of mitigation, as described above, significant residual environmental effects due to failure of sedimentation/erosion control structures on marine benthic habitat and communities, marine fish and fish habitat, wetlands and freshwater habitat are not likely.

8.3.2 Fires and Explosions

LNG, as a liquid, will not burn or explode because it contains no oxygen to react with the fuel. The potential however, does exist for fires and explosions associated with accidental releases of LNG, where

the necessary conditions for flammability (*i.e.*, specific oxygen/LNG ratio) exist. These extremely unlikely incidents resulting in an LNG release and fire or explosion are discussed in detail in Section 3 and in the full risk assessment document (Appendix C). In addition to LNG releases, other activities during Project construction and operation could result in fires and/or explosions (*e.g.*, equipment re-fuelling, careless smoking and brush burning).

Fires could result in terrestrial habitat alteration, wetland habitat loss, and direct mortality of rare plants, mammals, birds and herpetiles. Fire fighting chemicals and any spilled materials from the facility could enter the freshwater, wetland and marine environments and adversely affect biota and habitat if allowed to disperse and persist. Fires and explosions have the potential for adverse effects on air quality and could pose risks to human health and safety.

The LNG facility and LNG vessels will be robustly designed for safety and reliability including active and passive systems to prevent accidents (Section 2.6). An Emergency Response and Contingency Plan will be developed for the Project and implemented in the unlikely event of fire and/or explosion in order to rapidly respond to the incident and restrict the dispersion of fire fighting chemicals and other spilled materials. The Plan will also address prevention and response to forest fires. The facility is designed to minimize the incidence and effects of a fire or explosion. Specific mitigation includes: proper supervision of brush fires; compliance with conditions of burning permit(s); clearing and burning brush during the late fall, winter or early spring when forested habitats are less flammable; regular inspections of the work site; establishment of a cleared thermal radiation buffer zone to prevent ignition of adjacent forested areas; training of personnel in fire fighting techniques; provision of fire fighting equipment; installation of specialized equipment to detect fires; and the installation of fire fighting systems in the facility. Any facility fires spreading to the surrounding vegetation would likely be rapidly controlled by trained first responders (*e.g.*, municipal fire departments and provincial forest fire fighting forces, if necessary).

Fire protection, safety and security shall be provided for all LNG facilities as part of the design and operation (Section 11 of CSA Z276-01). As stated by the Code, the extent of fire protection shall be determined by an evaluation that shall determine, as a minimum (Section 11.1.2):

a. the type, quantity, and location of equipment necessary for the detection and control of fires, leaks and spills of LNG, flammable refrigerants, or flammable gases;

b. the type, quantity, and location of equipment necessary for the detection and control of potential non-process and electrical fires;

c. the methods necessary for protection of the equipment and structures from the effects of fire exposure;

d. fire protection water systems;

e. fire extinguishing and other fire control equipment;

f. the equipment and processes to be incorporated within the emergency shutdown (ESD) system, including analysis of subsystems, if any, and the need for depressurizing specific vessels or equipment during a fire emergency;

g. the type and location of sensors necessary to initiate automatic operation of the ESD system or its subsystems;

h. the availability and duties of individual plant personnel and the availability of external response personnel during an emergency; and

i. the protective equipment, specific training, and qualification needed by individual plant personnel as specified by NFPA Standard 600 for their respective emergency duties.

The Code describes a number of specific requirements with regard to ESD systems, fire and leak control, fire protection water systems, fire extinguishing and other fire control equipment, security, and personnel safety. In addition, the Bear Head LNG Terminal will have documented procedures applying to operation, maintenance and training, and will establish a documented emergency plan (Section 12 of the Code). Training will be provided to instruct all facility personnel with respect to carrying out the emergency procedures that relate to their duties. The emergency plan will consider the procedures for responding to emergencies, including the notification of personnel, the appropriate use of equipment, and shutdown or isolation. In the event of an uncontrolled emergency, procedures will be established to minimize the harm that may come to facility personnel and the public, and to provide prompt notification of the emergency to the appropriate local officials.

The Project will establish liaison with local authorities (*i.e.*, Port Hawkesbury Fire Department and RCMP) to inform them of their emergency plans and their role in emergency situations. The Port Hawkesbury Fire Department, as well as other fire departments in Richmond County, are available to respond during an emergency and assist plant personnel with any fires or spill events, should they occur. The Port Hawkesbury Detachment of the RCMP is available to provide security and access control during an emergency. Methods will be developed to advise the relevant fire department and RCMP personnel of:

- the quantity and location of fire equipment;
- potential hazards at the facility; and
- communication and emergency control capabilities at the facility.

The Project will also establish liaison with the Richmond County Emergency Measures Coordinator, who is paid by the municipality to organize all emergency procedures and make decisions about evacuation, health and safety of residents and other emergency-related activities (C. Frost, pers. comm., 2004).

With these mitigation measures in place, there will not be a significant reduction in the capacity of local emergency response (fire, medical and police) to provide mandated services.
In consideration of the mitigation measures noted above, the effects of a fire and/or explosion are expected to be localized (*e.g.,* limited to the facility "footprint" and areas designed to contain such events), of short duration and reversible. Should a fire occur during Project construction or operation in the vicinity of Wetlands 3 and 4, it could result in the loss of some provincially rare plant species (southern twayblade and northern commandra). Loss of the southern twayblade population within the property boundaries could be regionally significant though this is not likely to happen. In summary, significant effects on terrestrial, freshwater, wetland and marine VECs due to fires and explosions are not likely.

Significant adverse effects on air quality (*i.e.*, exceeding regulatory limits) and human health and safety could result due to fires and explosions; however these accidents are unlikely to occur, and would be rapidly controlled by trained first responders (*e.g.,* trained on-site crews and municipal emergency response forces). Any such effects on air quality would be localized and temporary. Flaring to reduce gas pressures during an emergency situation such as a fire will result in the release of a large quantity of carbon dioxide. Although this is not desirable, it may be necessary in an emergency situation; however it is predicted that this will likely not occur in the lifetime of the plant. Significant effects on air quality are therefore unlikely. Emergency response and contingency plans will minimize the threat to human health and safety. Significant effects on human health and safety in the surrounding communities as a result of fires and explosions are not predicted (Section 3).

8.3.3 Vessel Accidents and Related Cargo Spills Other than LNG

This section discusses vessel accidents and related cargo releases excluding LNG releases, which are addressed in Section 8.3.4. Vessel accidents have the potential to interact with several VECs and VSCs in this assessment. There is potential for impacts to marine fish and fish habitat; marine mammals; birds and their habitat; marine transportation; and damage to fisheries and aquaculture equipment, as well as loss of market or market value. Of particular concern are Project related vessel collisions resulting in the release of oil or other deleterious substances. LNG carriers use LNG as their primary fuel source but carry relatively small amounts of oil as back-up fuel and for use to generate power when loading or unloading LNG. LNG vessels are robustly designed to safely handle LNG cargo; the risk of release of fuel oil from these vessels is extremely low. Of greater concern, though also extremely unlikely, is the collision of one LNG vessel with another vessel carrying large amounts of oil that could result in a

relatively larger spill. Discharge of oily bilge or ballast water in the Strait of Canso will not be permitted (Section 8.1.5).

While approaching and departing from the LNG terminal, vessels will be under the jurisdiction of Canadian Coast Guard (CCG) and subject to mandatory pilotage requirements. In addition, protection of the LNG ship during navigation, berthing and unberthing, and while docked and unloading is a critical design consideration. The Terminal has been sited to take advantage of the relatively sheltered conditions at the Bear Head location and generally favourable navigational features associated with the Strait of Canso. Mitigation associated with malfunctions and accidents include the establishment of a safety zone around the marine terminal, following established Marine Navigation Protocol and Safety procedures, and the development of formal communication mechanisms with the fishing industry.

LNG vessels are all well found, comparatively new, and carry up-to-date, anti-collision, and navigational systems. Crews on these vessels meet or exceed the standards of competence required by the International Convention, Standards of Training and Certification for Watchkeepers (STCW). The vessels and crews are monitored under the International Convention, Port State Control, with inspections carried out by the Marine Safety Inspectors in Canada, and the equivalent inspectors from other nations. Risk of incident for vessels in the approaches to, and the waters of, the Strait of Canso are increased due to the proximity of other vessels and shallow waters; however a well-equipped, competently-crewed vessel is less likely to be involved in an incident than others.

Transportation Canada Safety Board (TSB) maintains records of specific accidents and incidents occurring in Canadian waters. This reporting requirement is identified in the *Canada Shipping Act* (A. Millen, pers. comm., 2003). 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 (Table 8.24). Due to the low incidence of accidents involving LNG carriers, the number of accidents and reportable incidents in the Strait of Canso is unlikely to increase.

Table 8.24 Types of Incidents or Accidents Within the Vicinity of the Strait of Canso in the Last Ten Years

Type	Number
Grounding	3
Touching Bottom	2
Striking/Contact With Structure or Ice	9
Equipment /Machinery Malfunction	7
Collision	3
Fire Aboard	2
Man Overboard	1
Personal Injury Alongside or at Anchor	4
Total	31

Source: Transport Canada Safety Board

Since, however there is a slight degree of risk, the following scenarios have been selected as those being the most likely, albeit with low probability, to occur.

1. A collision involving an LNG carrier and another vessel in the junction zone in the vicinity of calling in points '2A/2B' in the Traffic Separation Scheme, where vessels are crossing and merging (Figure 6.12).

2. A collision in the anchorage between an LNG carrier and another vessel.

3. A grounding of an LNG carrier in the vicinity of buoy 'C13' at Eddy Spit.

4. Contact with the jetty at the LNG Terminal.

5. Grounding of an LNG carrier between the LNG Terminal and Bear Island.

Types of marine activity currently in the Strait include:

- Commercial fishing activity as described in Section 8.2.3.

- Deep-sea fishing, which according to the Nova Scotia Department of Tourism and Culture, occurs in the waters off Glasgow Harbour (T. Cyr, pers. comm., 2003; D. McNeill, pers. comm., 2003). This activity is unlikely to be affected by the movement of the LNG carriers, as in this area they will be maintaining their courses inside the Traffic Separation Scheme.

- Tour boating. At this time, the Nova Scotia Department of Tourism and Culture is aware of only one tour operator in the Strait of Canso (D. McNeill, pers. comm., 2003). It may be considered to be a positive interaction between the tour vessels and the LNG carriers and terminal, as the development and operation should increase public interest in the area.

- Pleasure boating through the Port Hawkesbury yacht club with an average of about 200 pleasure craft operates between June and September (D. Deveau, pers. comm., 2003). It is necessary that each operation is aware of the other, but no conflicts are predicted.

- Military activities occur in the Department of National Defence Exercise areas. Part of Exercise Area 'J' exists in the vicinity of the Traffic Separation Scheme. The area extends down to Sable Island. Exercises are infrequent, about once every three months, and are generally related to surface vessels towing SONAR equipment, occasionally submarines and support aircraft. The part of the area to the north of the routing into the Canso Strait is seldom used for anything but diving operations. No firing practice or live ammunition is used in this exercise area (M. Klein, pers. comm., 2003). Notices to Mariners and Notices to Shipping are originated in the operations centre

at the Maritime Forces Atlantic HQ in Halifax, and are promulgated and broadcast by CCG MCTS Centres to ensure that traffic is aware when the area is being used by the Department of National Defence. Ship to ship communications are also used to enhance the safety of operations.

The LNG carriers may encounter other vessels in the Strait and Approaches and these may include very large crude carriers up to 400,000 tonnes deadweight, smaller coastal tankers, chemical tankers, general cargo vessels, bulk carriers, tugs, tugs with barges or other towed units, government vessels, fishing vessels, passenger vessels, and pleasure craft.

The following malfunctions and accidents have been considered based on the magnitude of the prospective event and the likelihood of the occurrence. The probabilities discussed in the various scenarios were calculated based on the reported number of vessel movements within the Strait of Canso over a twelve month period (refer to Table 6.26 in Section 6.22) and reported types of accidents in the vicinity of the Strait of Canso (Table 8.24). Calculated probabilities of incident occurrence, based on the site specific information are presented in Table 8.25.

Table 8.25 Calculated Probabilities of Incident Occurrence

Incident	Number of Collisions in Ten years	Probability of One Incident in Ten Years	Probability of Incident in One Year
Collision	3	1:5,970	1:59,700
Grounding and Touch Bottom	5	1:3,582	1:35,820
Contact with Structure	9	1:1,990	1:19,900
*Calculation based on 1,791 movements per year.			

Scenario 1 - Collision of an LNG carrier and another vessel in the vicinity of calling-in points 2A/2B

Vessels approaching the Traffic Separation Scheme may do so from the east, or from the southeast. At the calling-in point, 2A/2B (Figure 6.12), vessels approaching from the southeast cross the east bound traffic lane and merge with the west bound traffic lane. The Collision Regulations identify the responsibility of any vessel that may find itself in a close quarters situation; however, risk is greater at this time than at any other time during the approach. Vessels at this time will not be operating at reduced maneouvring speed. An accident at this time would be likely to be a moderate impact collision causing hull damage to both vessels involved. Because of their propulsion system, LNG carriers carry limited amounts of fuel oil. For example, a sample LNG carrier with a liquid cargo capacity of 138,000 m^3 will carry 5,900 m^3 (4,130 tonnes) heavy fuel oil and 350 m^3 (210 tonnes) of diesel oil.

The impact required to damage the containment integrity of an LNG tank is quite significant and it is unlikely that the LNG tanks would be damaged. By the time this Project is completed, most oil tankers will be required to be double hulled (LNG vessels are currently double hulled). If the other vessel is an oil tanker, the tanks may be penetrated, and oil may be released into the marine environment. In this worst-case scenario, likely 10,000 tonnes of liquid hydrocarbon (persistent oils) would be released into

the environment, a quantity identified for a Tier IV response by a response organization. This is the maximum amount of oil for which the response organizations are certified. A tanker would typically have a number of tanks carrying the cargo. An example would be a 300,000 tonnes deadweight tanker with fifteen tanks carrying approximately 20,000 tonnes in each tank. For this assumption, half of the oil in one tank escapes, although it is more likely that once the level of the rupture is reached, and the pressures are equalized, a lesser quantity would escape.

The casualty reports for the past 10 years (Table 8.24) show that three vessels in the Strait of Canso were in collision. Vessel movements in the Strait of Canso during the last year amounted to 1,791. Extrapolating this information would give a probability of 1:5,970 for a collision in the Strait or Approaches, in the next 10 years, or for each year of probability of 1:59,700. It is therefore considered that the probability is very low. This calculation accounts for all vessel collisions in the Strait of Canso. The probability would be reduced further if the assumption were that one of the vessels is an LNG carrier. Table 8.26 illustrates the reported incidents since 1978 on a Worldwide basis. The data suggests that LNG carriers have a better safety record than any other vessel type. The statistical probability of a collision involving an LNG carrier with a loss of persistent hydrocarbons should therefore be reduced still further.

Table 8.26 Summary of Serious Accidents Involving LNG Carriers

Hull and Machinery Damage	9
Wrecked or Stranded	7
Collision	2
Fire or Explosion	3
Foundered	1
Miscellaneous	1
Total Severe Casualties	23
Casualties where Vessel was a Total Loss	2
Casualties where Pollution Occurred	0
Note: Four of the 23 vessels were casualties as a result of "hurricane MAEMI" in South Korea, 14 September 2003.	
Source: Lloyd's Register Fairplay Sea Web Site	

Transport Canada Marine Safety and Transportation Safety Board would investigate any incident. The appointed Response Organization (Point Tupper Marine Services) would respond on the direction from the Master, Owner, or Agent for the vessel. The Response Organization has mutual aid agreements for support from other response organizations (ECRC in Dartmouth) and has the capability of responding to a spill of 10,000 tonnes. The CCG and the Port Authority would monitor the situation. If the hull can be repaired in the Canso area with the vessel afloat this would be carried out. If the vessel were required to carry out the repair in drydock the vessel(s) would proceed to the location either under its (their) own power or be towed.

Scenario 2 - Collision in the anchorage between an LNG carrier and another vessel

A vessel approaching or departing the anchorage area will be manoeuvring at slow speed. It is assumed that the collision would occur through the malfunction of one or more of its manoeuvring components such as electrical blackout, loss of power from main engines, steering machinery failure, *etc*. Since there is a requirement for built-in redundancy, duplication of equipment, or emergency control, this collision is a low probability. For the purpose of this assessment it is assumed there is limited hull damage to both vessels and a small quantity of liquid hydrocarbon (150 tonnes equivalent to Tier I response released into the marine environment). Transport Canada Marine Safety and the Transportation Safety Board would investigate the incident. Repairs and response would be as in Scenario 1. The likelihood of such an occurrence is the same as indicated in Scenario 1.

Scenario 3 - Grounding of the LNG carrier in the vicinity of buoy C13 at Eddy Spit

As a result of steering failure, human error, or blackout, an LNG carrier is very unlikely to go aground in the vicinity of Eddy Spit. The vessel's maximum draught is expected to be 12 m and the depth of water adjacent to the C13 Buoy is 16 m, with the closest point of shallow water where the vessel would go aground being approximately 925 m south of the buoy.

Hull damage to the vessel would likely occur in the forepart of ship, and a small amount of liquid hydrocarbon (*i.e.*, heavy or diesel oil used to fuel the LNG carrier) would be released into the marine environment (less than 150 tonnes). Although the vessel would be clear of the channel, it is probable that the port would be closed until the situation could be assessed. This would enable tugs, divers and officials access to the vessel without fear of undue movement caused by wash and wake. As soon as practical, the port would be reopened. Transport Canada Marine Safety and the Transportation Safety Board would investigate the incident. The vessels would be refloated as soon as possible and, if practical, discharged. Repairs and response would be as discussed in Scenario 1. Incident and accident reports show that three vessels have grounded, and two touched bottom in the area during the last 10 years (Table 8.24). Vessel movements in the Strait of Canso and Approaches during the last year amounted to 1,791. Extrapolating this information gives a probability of 1:3,582 of a grounding or a vessel touching bottom in the next ten years, or for each year, a probability of 1:35,820. It is therefore considered that the probability is very low. The probability would be further reduced if it were assumed that one of the vessels were an LNG carrier. The reported incidents on a Worldwide basis since 1978 (Table 8.26) suggests that LNG carriers have a better safety record than any other vessel type. The statistical probability of a grounding or touching bottom incident involving an LNG carrier, with a loss of hydrocarbons should therefore be reduced still further.

Scenario 4 - Contact with the jetty at the LNG terminal

The terminal and the ship are both built to withstand identified forces at the time that the vessel berths. Landing on the breasting dolphins at a speed that would exert greater forces, or at an angle exerting a point force could cause damage to both the vessel and the terminal. Such damage would slow the discharge of the vessel and may delay its sailing. Other vessels awaiting a berth at the terminal would also be delayed. In the case of severe damage to the terminal, the terminal could be closed until the operation could be normalized. The incident is a low probability, as the vessel would be assisted by tugs and the master would be under the advice and guidance of the pilot. Transport Canada Marine Safety and the Transportation Safety Board would investigate the incident. Hull damage would, in all probability, be above the waterline and could be repaired after discharge. Damage to the Terminal, Terminal equipment, and piping would be repaired by local trade services.

Incident and accident reports indicate that nine vessels have been involved in striking/contact with structures or ice in the Strait of Canso over the past ten years. Vessel movements in the Strait of Canso and Approaches during the last year amounted to 1,791. Extrapolating this information would give a probability of 1:1,990 for a collision in the Strait or Approaches in the next ten years, or for each year, a probability of 1:19,900. It is therefore considered that the probability is very low. This accounts for all vessels in all accidents of striking/contact with ice or a structure in the Strait of Canso. The probability would be further reduced if the assumption were that one of the vessels is an LNG carrier. The reported incidents since 1978 on a Worldwide basis suggests that LNG carriers have a better safety record than any other vessel type. The statistical probability of a collision involving an LNG carrier, with a loss of hydrocarbons (*i.e.*, heavy or diesel oil used to fuel the LNG carrier) should therefore be further reduced.

Scenario 5 - Grounding of an LNG carrier between the LNG terminal and Bear Island

For this scenario, it is assumed that the vessel is being assisted from the terminal by tugs in high onshore wind conditions. After the vessel has let go all lines from the terminal and is manoeuvring off the dock, the tug on the forward end loses power or its line parts. Still at slow speed, probably with its anchors on the bottom, the vessel could go aground in shallow water between the south end of the terminal and Bear Island. This incident has a low probability as the tugs will meet the standards of the ISM code and the vessel will have the capability of manoeuvring without the tug. Hull damage would be limited to the area forward of the collision bulkhead and the vessel refloated as soon as practical. Once again, there is a probability that the port would be closed to allow the investigation to be completed, but reopened as soon as possible. Transport Canada Marine Safety and Transportation Safety Board would investigate the incident. Significant hull damage would require the vessel to be dry-docked. The probability of an occurrence would be the same as in Scenario 3.

8.3.4 Effects of Oil Spills on Marine VECs/VSCs

The accidental release of a large quantity of hydrocarbons to the marine environment, although unlikely, has the potential to interact with marine fish and fish habitat, marine mammals, aquatic birds and shoreline habitat, fisheries and aquaculture and marine navigation. Sources of potentially significant oil spills are related to potential for collisions with oil tankers or to a release of heavy or diesel fuel oil (used as back up fuel) from an LNG carrier. LNG vessels carry relatively small amounts of heavy oils compared to dedicated oil tankers. Potential interactions include habitat alteration and loss, and injury/direct mortality to individuals. Sources of potentially significant oil spills are primarily limited to collisions with tankers carrying oil or to a release of heavy or diesel fuel or carried by an LNG carrier.

The potential effects of an accidental release of hydrocarbons (excluding LNG) on marine birds can include external exposure to oil when birds are present at the water surface. This may result in a loss of waterproofing, thermoregulatory capability (hypothermia) and buoyancy (drowning) due to the matting of feathers (Wiese 1999; Minerals Management Service (MMS) 2001; Wiese *et al.* 2001). Oil may also be ingested from excessive preening/cleaning (of even slightly oiled feathers (Stout 1993)), resulting in lethal and sublethal effects, including starvation due to increased energy needs to compensate for heat loss (Peakall *et al.* 1980; 1982; MMS 2001).

Most marine mammals can withstand some oiling without toxic or hypothermic effects. Whales and seals use blubber to maintain core body temperature, and are not affected by a covering of oil. Hypothermia is possible however, if a young seal pup is covered in oil because it takes several months to build up a blubber layer sufficient to maintain body heat. Oil can also cause irritation of the mammal's eye if it comes in direct contact (Geraci and Smith 1976).

Whales can also ingest oil if they eat oil-contaminated food or if they feed in an area of an oil spill. Baleen whales are especially vulnerable because they ingest large volumes of water during feeding, which can coat their baleen and reduce filtering capacity. All mammals can digest and metabolize some oil, other components may be excreted, but oil is not usually bioaccummulated in mammals. Some oil can be absorbed, however, and cause toxic effects (LGL Limited 2000). Mammals may also ingest vaporized hydrocarbons during breathing near the waters surface. Irritation of the respiratory tract can be expected and continued exposure may cause absorption into the blood stream.

Although unlikely, an oil spill may affect water quality, fish eggs and larvae, and may directly affect juvenile and adult fish. The nature and degree of such an interaction would depend on the severity, timing and location of the spill. Direct mortality of fish, eggs or larvae could result, as well as biophysical effects on larval or juvenile stages. This is unlikely and would be limited in area and effect. Sublethal physiological effects leading to reduced breeding success that might be attributable are also unlikely to be significant. The frequency of such is extremely low, and the effects would be restricted to the immediate vicinity of the accidental event, in contrast to the dispersed nature of fish populations. In

the unlikely event of an oil spill, oil would remain on the sea surface and not likely reach the seafloor. Effects on plankton and zooplankton are short-lived, because their life cycles are short and they reproduce frequently. Fish feeding on plankton which have ingested oil droplets will ingest the oil as well, since plankton cannot metabolize oil.

There is a substantial body of literature that analyzes the social and economic effects of large oil spill events, primarily concerning the Exxon Valdez and Amoco Cadiz spills (*e.g.,* Grigulunas 1982; Grigulunas *et al.* 1986; Cohen 1993, 1995). Although economic and social losses are highly site specific, the most serious effects from major spills have typically been loss of market or market value, loss of access to fishing grounds, damage to fishing gear and fish tainting (real or perceived). Fish mortality as a result of oil spills, although it does occur, is usually not the most critical effect of oil spills on fisheries (see Baker *et al.* 1991; DeBlois *et al.* 1997; and LGL Limited 2000 for reviews of potential biological effects on fish). The international experience with respect to the effects of spills has forced the development of compensation mechanisms.

The potential environmental effects described above have the potential for significant effects to marine birds and fisheries and aquaculture resources; however due to industry standards, strategies and practices that have been developed to minimize the potential of vessel accidents, the related release of cargo is highly unlikely.

Summary

Considering the mitigation and safety measures in place, the probability of marine vessel collision is low. The vessels will be subject to the use of established shipping lanes and pilotage requirements when docking. All normal federal safety standards and additional contingency plans for the unlikely event of a marine vessel accident will be in place to deal with the situation. Any effects on access to the harbour and local fishing grounds would be of relatively short duration. A Fishery Compensation Plan will be developed to ensure compensation for fishers and aquaculturists in the unlikely event of damage to equipment and/or loss of access to fishing grounds. Effects on marine VECs and VSCs from a vessel collision and a related cargo spill are predicted to be significant on marine birds and fisheries and aquaculture resources. Due to industry standards, strategies and practices that have been developed to minimize the potential for vessel accidents, a significant release of oil is highly unlikely.

8.3.5 LNG Release

The potential exists for an LNG release from the terminal site or from the LNG vessels. LNG release could result in injury and direct mortality of wetland plants, terrestrial vegetation, mammals, herpetiles, birds and humans in the immediate area of the release. Community services and infrastructure can be affected due to demands on local emergency response services. Fishers and aquaculturists may be

potentially affected by temporary loss of fishing grounds and loss of market values for commercial fish and aquaculture species.

LNG is colourless, odourless, non-toxic and leaves no residue. LNG and LNG vapour are not soluble in water therefore an LNG release does not require any environmental clean-up effort. Environmental effects of an LNG release are largely due to vapour dispersion and thermal radiation. When a release occurs, the LNG will escape from containment, vaporize and disperse. Asphyxiation (due to oxygen depletion) and frostbite due to the low temperature of the vapour can occur to individuals (humans and animals) in the immediate area of the vapour cloud. Vegetation could suffer direct mortality if frozen by the cryogenic liquid. Since LNG becomes a vapour at –160°C, well below the freezing temperature of water, the likelihood of a spill of LNG entering the water table is remote.

Four general scenarios are associated with LNG release:

- vapour cloud dispersion;
- vapour cloud ignition and burn-back to the release point;
- pool fires at the release point; and
- rapid phase transition when LNG comes into contact with water.

Further discussion of LNG spill behaviour and physical effects (*e.g.*, embrittlement of metallic structures) is discussed in the risk assessment (Appendix C).

Vapour Cloud Dispersion

Vapour cloud dispersion would occur as the water warms the LNG. With LNG release, the LNG drops the temperature of the surrounding air to below the dew point of the air, resulting in an easily visible fog. LNG is well within the visible cloud of condensed water vapour present in the air. Humans can recognize the area of immediate danger and escape; however an animal may not recognize the hazard. As the gas cloud warms to ambient temperature, it will become lighter than air and will rise away from the surface. As LNG will vaporize and is non-toxic, significant direct environmental damage caused directly by a spill is unlikely.

Dispersion calculations (see Risk Assessment, Appendix C) have shown that the largest LNG plumes could be generated from ship grounding and the transfer pipeline full bore rupture. The maximum plume distance (lower flammable limit (LFL))from the ship grounding would be approximately 554 m and 773 m to one half LFL, which could extend over the terminal boundaries if the spill were to take place at or near the jetty shoreline. The dispersion contours of a full bore pipeline release would be approximately 1.2 km to LFL and 2.13 km to one half LFL. An unignited plume does not pose a hazard to more densely populated areas, which are situated approximately 5 km to the east of the terminal.

Cryogenic effects are limited to the immediate point of release. Based on historical records for LNG offloading to onshore plants worldwide, both events have an extremely low probability of occurrence. Further discussion of vapour cloud dispersion is discussed in the risk assessment (Appendix C).

Vapour Cloud Ignition and Pool Fires

An additional hazard is the potential for direct mortality if the vapour cloud comes in contact with an ignition source and is ignited. If ignited, the vapour cloud would not expand any further, but would burn back to its source, resulting in a localized pool fire at the source. As a result, individuals not in the vapour cloud at the time of ignition could escape.

Depending on the wind direction, a gas cloud at the Bear Head Terminal would spread and drift either inland in a north, northwest direction towards Port Hawkesbury, or in a southwest direction across the Strait of Canso towards Guysborough County or in an easterly direction across Inhabitants Bay towards Isle Madame. It is expected that this cloud would encounter ignition sources at the Bear Head Terminal. Ignition and sustained combustion of a vaporized LNG cloud is difficult under normal release conditions. However, due to the number of ignition sources on land, multiple gas cloud ignitions are likely, probably resulting in an eventual burn-back to source. Ignition would be a slow flame rather than a detonation type explosion.

As a result, any release inland would be likely to ignite quickly and prevent the gas cloud from reaching the populated area of Port Hawkesbury apart from the LNG Terminal itself. There will be no detonation type overpressures that will affect the general public beyond the boundary of the LNG Terminal. Potential detonations would be limited only to confined areas and buildings with the Terminal.

Based on the risk assessment modelling results, the proposed Bear Head LNG facility siting and layout meets the CSA required thermal radiation protection distances for LNG releases in sumps and drainage trenches, for unconfined pools within the transfer pipeline areas, and for releases within the vaporization area. For confined releases within the dikes the 9 and 5kWm^{-2} contour is at 351.4 m and 486.2 m respectively from the perimeter of each dike and therefore, they would extend beyond the Terminal boundaries, while the 30 kWm^{-2} contour is within the boundary of the proposed site at 154.1 m from each dike perimeter. The 9 and 5 kWm^{-2} contours outside the Terminal site do not have any offsite significance as there are no populated areas near the boundaries, and is thus acceptable.

Further discussion of vapour cloud ignition and pool fires is included in the risk assessment (Appendix C).

Rapid Phase Transition

LNG discharged to the marine environment would initially cause freezing of water at the surface but the ice would melt quickly and the marine environment would return to normal with no residual trace of the incident. There is potential for Rapid Phase Transition (RPT) of LNG on contact with the water resulting in localized physical explosions (without ignition), producing measurable overpressure. RPT occurs when enough LNG is spilled on the water at a high enough rate. Heat is transferred from the water to the LNG, causing the LNG to instantly convert from its liquid phase to its gaseous phase. A large amount of energy is released during this rapid transition between phases and physical explosion can result. These explosions occur very close to the source and could lead to direct mortality or injury to marine species within close proximity. Multiple rapid phase transitions of varying strengths can occur over the area of the release, the shock waves from each contributing to the initiation of others. Overpressures have a limited capability for damage to structures due to the physical explosive effects.

Further information on rapid phase transition can be found in the risk assessment report (Appendix C).

LNG releases are unlikely due to a number of design and safety features which include:

- vessels in the Strait will be under the control of a licensed pilot;
- manoeuvring for berthing and turning will be assisted by tugs;
- LNG ship's cargo tanks are surrounded by insulation within the double hull construction;
- code design for LNG facilities (CSA Z276-01) requires that seismic, wind and weather factors are taken into account;
- LNG ships are designed to be seaworthy in all types of weather;
- LNG ships usually do not dock in winds exceeding 25 knots;
- crew members would monitor weather conditions to avoid being in restricted waters during a storm;
- unpredicted acts of nature such as earthquakes are highly unlikely to occur in this seismic zone;
- LNG storage areas will be bermed to contain any spilled LNG;
- process instruments will routinely monitor conditions such as pressure, flow and temperature, which can give early indications of malfunctions;

- should an LNG leak occur, the pipes carrying LNG have catch basins and sumps that can accommodate the full volume of flow for a period of ten minutes;

- the facility will be equipped with a spill detection system and an emergency shut down system;

- in the event of a large spill, these systems will be capable of detecting the spill and initiating an emergency shut down (thereby isolating the release source) in less than two minutes;

- the firefighting systems required by code to be installed are intended to prevent fires from spreading to storage tanks and process equipment;

- LNG ships and personnel will be monitored under the new International Ship and Port Facility Security Code (ISPS Code), which has been established by the International Maritime Organization (IMO), effective July 1, 2004;

- the new ISPS Code will require a written Port Facility Security Plan;

- LNG terminals are required by CSA Z276-01 to have significant security features built into the LNG facility; and

- LNG terminals are not attractive terrorist targets due to their "low political profile", difficulty of attack and high level of security.

Summary

Considering the mitigation and safety measures in place, the accidental release of LNG is highly unlikely. A release incident at the terminal can be expected to be of relatively short duration and would be contained within the property boundaries. Immediately following an LNG release on land, the area would be suitable for animals and humans to repopulate. An LNG release on the water would be contained to the immediate area due to evaporation, however there is potential for vapour dispersion and burn back to the source, if a source of ignition is encountered. Refer to Section 8.3.2 for a discussion of potential effects on the terrestrial environment from fire (*e.g.*, significant effect on southern twayblade). Any effect on access to fishing grounds (*i.e.*, fishing exclusion) would be of relatively short duration. Demands on local emergency response services would be coordinated through the development and use of the Emergency Response and Contingency Plan. The effects of an LNG release are expected to be localized, of short duration and reversible. Significant effects on Project VECs/VSCs from an LNG release event are not likely.

8.3.6 Hazardous Materials Spills

Hazardous materials spills could occur during construction and operation of the facility. In addition to the potential for vessel related hydrocarbon cargo spills (discussed in Section 8.3.3) and LNG release (discussed in Section 8.3.4), there is potential for accidental release of small volumes of other materials such as diesel fuel, hydraulic fluids, lubricants, oil and other deleterious substances.

Diesel fuel will be stored on site to run emergency generators. The tanks in which the fuel is stored will have secondary containment according to provincial regulations. Hazardous materials such a lubricating oils, sodium hypochlorite, methanol, and acid/caustic will be used on site. Localized minor spills could alter marine, aquatic, terrestrial and wetland habitat, impact groundwater quality, and cause injury and mortality to birds, mammals, herpetiles, rare plants, marine fish, freshwater fish and marine mammals.

Various factors would determine the degree to which ecosystems would be affected by spills, including the nature, location and quantity of material spilled. Spills could cause degradation of surface water quality and mortality of affected plants or wildlife.

Unmitigated hazardous materials spills could migrate vertically downward to the water table, and thence trend in a southwest direction toward the Strait of Canso.

To minimize, contain and control any potential releases of hazardous materials, a site-specific Spill Management Plan will be developed. All staff will be appropriately trained in the handling, storage and disposal of hazardous materials (*e.g.*, WHMIS, TDG). Chemical storage and handling will be done in accordance with the manufacturers' recommendations and federal and provincial regulations, where applicable. On-site safety measures include: leak alarms; emergency shutdown systems; spill containment; and provisions to protect piping from the effects of transient pressure variations.

Additional mitigation measures include:

- ensuring an adequate level of environmental awareness by contractors and workers;
- incorporating specific mitigative measures into contract specifications and providing strict on-site control and inspection;
- maintaining equipment and machinery in good working order and monitoring for leaks of fuel, lubricants and other hazardous substances;
- storing fuels, lubricants and other hazardous substances in designated areas outside of buffer zones established around surface water/wetlands;

- stockpiling potentially hazardous construction materials away from surface water/wetlands; and

- implementation of a Spill Management Plan to address response to accidental spills; this would include immediate clean-up of releases, containment and removal of impacted groundwater and removal and proper disposal of impacted soil.

In consideration of the safety measures and mitigation in place, any discharge to the environment would be minimal. Effects of localized, minor spills on the environment would be reversible and minimal, as any such spills would be rapidly cleaned up in accordance with the Spill Management Plan. Significant effects on Project VECs/VSCs from a hazardous material spill are not likely.

8.3.7 Summary of Malfunctions and Accidental Events Effects Assessment

With the implementation of design prevention, planning and mitigation measures detailed throughout this section, environmental effects on the following VECs/VSCs due to malfunctions and accidental events are rated as not significant:

- Marine Benthic Habitat and Communities;
- Marine Fish and Fish Habitat;
- Marine Mammals;
- Wetlands;
- Freshwater Habitat;
- Groundwater Resources;
- Rare Mammals;
- Rare Herpetiles;
- Community Services and Infrastructure; and
- Marine Transportation.

In the highly unlikely event of a Project related ship collision resulting in a large oil spill, significant adverse effects are predicted for seabirds and fisheries and aquaculture resources, however, this significant effect is not likely to occur. An accidental event at the terminal resulting in a fire spreading to surrounding vegetation could result in a significant adverse effect on rare vegetation (southern twayblade); however, this significant effect is not likely.

Significant adverse effects on air quality (*i.e.*, exceeding regulatory limits) and human health and safety could result due to fires and explosions; however these accidents are unlikely to occur, and would be rapidly controlled by trained first responders (*e.g.*, trained on-site crews and municipal emergency response forces). Any such effects on air quality would be localized and temporary. Significant effects on air quality are therefore unlikely. Emergency response and contingency plans will minimize the threat to human health and safety. Significant effects on human health and safety in the surrounding

communities as a result of fires and explosions are not predicted. A significant reduction in the capacity of local emergency response (fire, medical and police) to provide mandated services is not predicted.

8.4 Cumulative Effects

Subsection 16(1)(a) of the *CEAA* requires that every screening of a project include an assessment of the "cumulative environmental effects that are likely to result from the project in combination with other projects or activities that have been or will be carried out."

As discussed in the Cumulative Effects Assessment Practitioners Guide (CEA Agency 1999), a key component of cumulative effects assessment is the determination of the regional context for VECs/VSCs. The methodology applied to this assessment has considered the regional context for each VEC/VSC to identify potential cumulative effects with other projects and activities and in consideration of the regional distribution of the VEC/VSC.

A critical step in any environmental assessment, is determining what other projects or activities have reached a level of certainty (*i.e.*, "will be carried out") such that they are required to be considered by the *CEAA*.

It is helpful to consider the clarification provided by the Joint Review Panel for the Express Pipeline Project in Alberta. Following an analysis of subsection 16(1)(a) of *CEAA*, the Joint Review Panel determined that certain requirements must be met for the Panel to consider cumulative environmental effects:

- there must be a measurable environmental effect of the project being proposed;
- that environmental effect must be demonstrated to interact cumulatively with the environmental effects from other projects or activities; and
- it must be known that the other projects or activities have been, or will be, carried out and are not hypothetical (NEB and CEA Agency 1996).

Furthermore, the Joint Review Panel indicated that it is an additional requirement that the cumulative environmental effect is *likely* to occur, that is, there must be some *probability*, rather than a mere possibility, that the cumulative environmental effect will occur. These criteria were used to guide the assessment of cumulative environmental effects of the proposed Project.

A key component of cumulative effects assessment is the determination of the regional context for VECs/VSCs (CEA Agency 1999). The methodology applied to this assessment has considered the regional context for each VEC/VSC to identify potential cumulative effects with other projects and activities and in consideration of the regional distribution of the VEC/VSC.

For the purposes of the assessment, it is assumed that the existing status or condition of each VEC/VSC reflects the influence of other past and current projects and activities occurring within or outside of the Project area. It also assumes (unless there is evidence to the contrary, such as predictable down or upward trend in a population) that these existing activities will continue to be carried out in the future and to have similar effects as currently observed. The assessment has therefore integrated the cumulative effects of these ongoing projects and activities. This section focuses on the effects of other future projects and activities, as considered and assessed for each VEC/VSC. The methodology used in assessing cumulative effects for this Project follows current practice and is consistent with *CEAA* and informed by the assessment framework presented in the Cumulative Effects Assessment Practitioners Guide (CEA Agency 1999). The CEA Agency suggests that relevant environmental standards, guidelines, and objectives should be helpful in determining significance of cumulative environmental effects.

In the early stages of the assessment, a cumulative effects scoping exercise was conducted to identify past, present, or likely (*i.e.*, approved) future projects that might interact cumulatively with the Project. Past projects or activities potentially affecting VECs/VSCs have been considered in the description of existing conditions as applicable for each VEC/VSC. These projects include:

- construction and operation of the Canso Causeway;
- development on the Strait of Canso (including multiple marine terminals, and various industrial facilities);
- marine transportation; and
- commercial fisheries.

Likely future projects and activities were identified based on discussions with regulators and the knowledge of the study team and include:

- **Proposed Point Tupper Nova Scotia Power Coal Terminal**. Nova Scotia Power (NSP) and Logistec are developing a project to place a terminal at the NSP site in the Strait of Canso near Peebles Point. At present, coal is delivered to the quarry site at Cape Porcupine, and transported overland to the Nova Scotia Power generating sites at Point Tupper and Trenton. The facility is proposed to be located approximately 8 km northwest of the proposed LNG terminal, at the NSP Point Tupper Generating Station on the Strait of Canso. This project will consist of a marine terminal and a land-based coal storage/transfer facility (NSPI 2003). Construction is expected to begin in 2004, with start of operation in March 2005 (NSPI 2003). The environmental assessment for the project has been completed by NSDEL and DFO.

- **Maritimes and Northeast Pipeline (M&NP) (future tie-in)**. It is anticipated that M&NP will build a buried natural gas pipeline lateral from the LNG facility to transport the regasified LNG to the M&NP mainline pipeline and onto markets served by that pipeline system. It is anticipated that the pipeline will be no larger than 36" diameter, buried in a trench and built to technical and environmental management standards approved for the existing pipeline system. The precise location and routing of the future pipeline (after tie in at the LNG facility) is currently not known though it is assumed to follow existing rights-of-way to the Point Tupper area where it will cross the Strait of Canso parallel to the existing Point Tupper natural gas lateral and NGL pipelines. The nearest point is located approximately 2.9 km from the proposed LNG facility.

The VECs/VSCs selected for effects assessment through the scoping process described in Section 7.0 are also considered appropriate and inclusive for the consideration of potential cumulative effects. Past and current projects and activities to be assessed for potential cumulative effects are evaluated in the context of the Project impact assessment for the VECs and VSCs in Sections 8.1 and 8.2. The future projects to be assessed including potential cumulative interactions and relevant VECs and VSCs are summarized in Table 8.27. The spatial boundaries for the assessment of cumulative effects with respect to the coal terminal are generally limited to the Strait of Canso area (including airshed). The spatial boundaries for the M&NP pipeline tie-in focus on those areas close to the tie-in where spatial overlap of effects could possibly occur, as well as pipeline crossing of the Strait.

8.4.1 Air Quality

Air emissions from the NSP terminal are not known but are expected to include dust and vehicle emissions during construction and operation which could interact with dust and operational emissions from the LNG facility. In particular, these air emissions could interact cumulatively within the airshed to create increased levels of suspended particulate matter. Levels of suspended particulates will be regulated for both facilities and air monitoring will be used as requested by NSDEL to ensure compliance. The existing levels of suspended particulates in the region are well within levels as established by Environment Canada and the cumulative contributions will not be expected to reduce regional air quality to unacceptable levels. There is also potential for the construction of the M&NP pipeline to create temporary, localized cumulative interactions (*e.g.*, dust, vehicle emissions) with dust and vehicle emissions from construction of the LNG Terminal (if the construction near the Terminal overlaps temporally). These air emissions will be temporary, localized and reversible. In summary, significant adverse cumulative effects on air quality are not likely. ANEI will participate in future airshed management programs (*e.g.*, regional monitoring) as required by NSDEL to promote the management of cumulative air quality effects on a regional basis.

Table 8.27 Likely Future Projects and Activities with Potential Cumulative Interactions with the Proposed Bear Head LNG Terminal

Project/Activity	Status	Potential Cumulative Interaction	VECs/VSCs Potentially Affected by Cumulative Effects
Environmental Components			
Proposed Point Tupper NSP Coal Terminal	Planned future project	Project emissions (dust and air pollution) may combine with emissions from the construction and operation of the proposed coal terminal. Construction and operation of marine facilities for both projects will interact with the marine environment (benthic habitat, fish and fish habitat, marine mammals). Increase in Project vessels increases the potential for interaction with marine mammals. Potential cumulative effects on birds due to noise and lights.	• Air Quality • Marine Benthic Habitat and Communities • Marine Fish and Fish Habitat • Marine Mammals • Birds
M&NP Pipeline (future tie-in)	Planned future project	Project emissions (dust and air pollution) may combine with equipment emissions from pipeline/custody transfer station and construction and operation. Potential cumulative effects on marine and freshwater environment from erosion and siltation. Potential cumulative effects on wetlands and other habitats. Potential cumulative effects on birds and other wildlife due to habitat loss, noise and lights.	• Air Quality • Marine Benthic Habitat and Communities • Marine Fish and Fish Habitat • Wetlands • Freshwater Habitat • Rare Mammals • Birds • Rare Vegetation • Rare Herpetiles
Socio-economic Components			
Proposed Point Tupper NSP Coal Terminal	Planned future project	Potential cumulative effects on navigation safety with increase in shipping traffic. Potential cumulative effects on fisheries and aquaculture (exclusion of vessels, effects on fisheries habitat and fished populations). Potential for cumulative effects on human health and safety due to additional air emissions, and on community services and infrastructure due to increased demand on emergency, health and social services. Potential cumulative effects on economic activity (increased). The existing municipal Planning Strategy will continue to guide future land development in the vicinity of the Project that is compatible with heavy industry.	• Marine Transportation • Fisheries and Aquaculture • Community Service and Infrastructure • Economic Development • Land Use
M&NP Pipeline (future tie-in)	Planned future project	Potential cumulative effects on navigation safety with increase in vessel traffic during construction (pipeline crossing). Potential cumulative effects on community services and infrastructure due to increased demand on emergency, health and social services. Potential cumulative effects on economic activity (increased). The existing municipal Planning Strategy will continue to guide future land development in the vicinity of the Project that is compatible with heavy industry.	• First Nations Land and Resource Use • Community Services and Infrastructure • Economic Development • Marine Transportation • Land Use

8.4.2 Marine Benthos and Marine Fish and Fish Habitat

The net loss of benthic habitat and associated communities, and potential effect on marine fish and fish habitat could potentially interact cumulatively with the effects on these VECs associated with the proposed Point Tupper Coal Terminal project and a potential M&NP pipeline across the Strait of Canso. Potential cumulative interactions include net benthic and fish habitat loss and habitat degradation due to contamination or sedimentation.

Spatial overlap between the projects with regard to fish and fish habitat and benthos is unlikely in the case of the coal terminal since it is approximately 8 km from the Project site; temporal overlap is also unlikely. The location for a potential pipeline crossing the Strait is unknown but it is assumed at this time that spatial overlap is also unlikely. The small marine footprint of this Project (*e.g.,* piled jetty structure) minimizes the potential cumulative effects of this Project on marine benthic habitat and communities, and marine fish and fish habitat.

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), adherence to applicable regulations, guidelines and conditions of permit. Minimal habitat loss is predicted for this Project and vertical habitat (pilings) created will offset the loss. Benthic disturbance will be temporary and reversible. It is assumed that the other projects that could act cumulatively (*e.g.,* coal terminal) will be held to similar environmental standards which may include fish habitat compensation, and adherence to applicable regulations, guidelines and conditions of permit. The overall cumulative effect of these projects and activities on marine benthic habitat and communities, and marine fish and fish habitat is predicted to be not significant.

8.4.3 Marine Mammals

The potential effects of jetty construction on marine mammals relate primarily to generation of underwater noise through pile driving. The noise resulting from the proposed LNG project could potentially interact cumulatively with marine noise associated with construction of the coal terminal and pipeline crossing the Strait of Canso on marine mammals as they pass through the Strait.

Another consideration, in terms of cumulative environmental effects on marine mammals, is potential collisions with vessels. Vessels used in jetty construction will likely not be an issue of concern considering slow vessel speed and the high probability that marine mammals will avoid the general area during jetty construction.

It is uncertain if there will be a temporal overlap of marine construction activities involving the pipeline. Construction on the coal terminal is scheduled to begin in the spring of 2004, therefore temporal overlap with construction of the two terminals is unlikely. It is likely that there will be ample spatial separation

(8 km between Bear Head and coal terminal) to prevent overlapping noise effects on mammals in the Strait.

With the implementation of mitigation measures (*e.g.*, standard vessel operating procedures and halting pile driving if a mammal is observed within 500 m of the construction area) and proper planning, and in consideration of the temporary and localized nature of Project activities, cumulative effects on marine mammals are predicted to be not significant.

8.4.4 Wetlands

Construction of the M&NP pipeline has the potential to act cumulatively with the Project to result in a net loss of wetland habitat by infilling, as well as potential effects on wetland hydrology. Wetland avoidance was an important consideration in the siting of the LNG facility; only a very small amount of wetland habitat (*i.e.*, 0.3 ha) is likely to be affected. Pipeline construction is not expected to have substantial effects on wetland habitat since wetlands are generally avoided wherever possible in pipeline construction and regulatory approval of the final route. Wetland legislation in Nova Scotia has also reduced the incidence of wetland habitat loss. It is expected that the pipeline construction will be subject to similar environmental standards as the LNG Project, and similar planning (*e.g.*, avoidance of valuable productive wetland habitat) and mitigation measures (*e.g.*, runoff capture methods, silt containment structures) will be employed. This includes the potential for wetland compensation, if warranted, by the Nova Scotia Department of Natural Resources. Overall, the cumulative effects on wetlands are predicted to be not significant.

8.4.5 Freshwater Habitat

Cumulative effects on freshwater habitat are possible between the LNG project and the M&NP pipeline assuming the pipeline will have to cross some watercourses. The LNG project has been sited to avoid watercourses, though erosion and sedimentation, if uncontrolled, could affect freshwater habitat. An EPP and Stormwater Management Plan will control potential sedimentation of, and discharge to, the watercourses on the LNG site. The pipeline watercourse crossings will be carefully designed and managed through standard crossing methods and mitigative practices to avoid damage to watercourses and freshwater fish habitat. Construction of the pipeline is subject to regulation as are the environmental terms and conditions imposed upon watercourse crossings. The environmental assessment for the pipeline and consultations with DFO will identify any particular sensitive habitats and special mitigative measures that may be required. Given the proven effectiveness of erosion and sediment controls and watercourse crossing wetlands for pipelines, no significant adverse cumulative effects are predicted.

8.4.6 Rare Mammals and Rare Herpetiles

Habitat loss for mammals and herpetiles from construction of the LNG terminal would be additive to habitat loss associated with the construction of a natural gas pipeline and coal terminal. The area is absent of rare mammals and sensitive mammal habitat. The cumulative loss of habitat is not expected to be significant for four-toed salamanders. The degree of cumulative habitat fragmentation associated with the three projects will vary depending on the extent of the disturbed areas and their proximity to other disturbed areas. Cumulative effects of habitat loss for rare herpetiles and rare mammals is not likely to be significant.

8.4.7 Birds

The coal terminal and M&NP pipeline have the potential to interact cumulatively with the proposed LNG Terminal to affect birds. There will be an additive loss of bird habitat as well as habitat fragmentation and the creation of habitat edge. Construction activities can be expected to disturb birds found around the margins of these developments. It is assumed that operation of the coal storage terminal will not result in increased ship traffic in the Strait of Canso that could increase disturbance to seabirds and add to potential for collisions between vessels which could result in oil spills. Construction of the pipeline crossing in the Strait, if it coincides with marine construction at the LNG Terminal, could present a minor incremental risk (insignificant) to seabirds from disturbance and spills which is limited in duration and is subject to regulatory approval.

No rare or sensitive terrestrial birds or terrestrial bird habitat are present in or near the proposed LNG Terminal site. The other proposed projects are not expected to affect large areas of terrestrial habitat adjacent to the LNG terminal site. As such, significant adverse cumulative effects on terrestrial birds (*i.e.*, population level) are not predicted.

8.4.8 Rare Vegetation

Rare plant populations found in the LNG Terminal study area have the potential to be adversely affected if the M&NP pipeline were constructed within or in close proximity to the populations. These populations are now known and are avoided by the LNG Project (and will be provided with additional mitigative measures) and are expected to be factored into the regulatory approval of the final route for the gas pipeline. The coal terminal is not expected to have any potential adverse effects on these populations. Previously unknown populations of rare plants could be affected by these projects which could contribute to cumulative effects on rare plants. Rare plant surveys are expected to be part of the environmental assessments for these other projects and it is also expected that mitigative measures will be developed to minimize adverse effects on any rare plant populations that may be encountered during these surveys. No significant cumulative effects on rare vegetation are predicted.

8.4.9 Fisheries and Aquaculture

There is potential for cumulative effects on fisheries and aquaculture related to increases in turbidity in the marine environment during construction activities. Minimal, localized increases in turbidity are predicted during marine construction activities for all three projects. No temporal overlap been Project construction and the coal terminal construction is predicted. Since no schedule has been proposed for construction of the pipeline, there is potential for temporal overlap with the Project construction. Spatial separation of the projects (estimated at 2.9 km) reduces the likelihood of cumulative effects on fisheries and aquaculture. No significant cumulative effects on fisheries and aquaculture are predicted.

8.4.10 Marine Transportation

Transportation Canada Safety Board (TSB) maintains records of specific accidents and incidents occurring in Canadian waters. This reporting requirement is identified in the *Canada Shipping Act* (Millen, pers. comm., 2003). 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 (Table 8.24). Due to the low incidence of accidents involving LNG carriers (refer to Section 8.2.3), the number of accidents and reportable incidents in the Strait of Canso is unlikely to increase.

Construction of the coal terminal is not expected to coincide with the development of the LNG Project. It is unknown whether the movement of the coal facility will increase or decrease the number of vessels transiting the Strait of Canso. It is assumed at present that the needs of the generating facility will not increase.

A cumulative minor increase in vessel traffic is predicted should marine pipeline construction coincide with Project construction. This additional traffic could increase the cumulative risk of vessel collision though this is predicted to be insignificant.

8.4.11 Land Use

Operating within existing administrative and industrial park zoning parameters, the Bear Head Terminal and the NSP Local Terminal will be built on an undeveloped site zoned for port industrial development. These projects will have a positive effect, as the development will “improve” the land and compliment and enhance other existing or planned land uses in keeping with the Municipal Planning Strategy and, in general, with the socio-economic character of the community. Existing controls will reduce the chances for adverse cumulative effects on land use.

8.4.12 Community Services and Infrastructure

The timing of the construction of the M&NP pipeline system tie-in may overlap with that of the Bear Head LNG Terminal project. Given the anticipated project sizes and the locations of the two projects, there could be 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 (*i.e.,* Stora expansion), and with proper communications and planning with local emergency response and other service providers, significant cumulative effect on community services and infrastructure are not anticipated.

8.4.13 Economic Development

All three projects have the potential to have a positive cumulative effect on economic activity in the area. There could be competition for labour and equipment if the pipeline and LNG facility are constructed simultaneously; however with proper planning and communication with local labour organizations and equipment operators, these effects are not expected to be significant.

8.4.14 Summary

Temporal overlap with construction of coal terminal project is not likely, and the substantial spatial separation (8 km) will minimize the potential for cumulative effects with the LNG Project. While the pipeline construction schedule is unknown and may overlap with the LNG Project, the spatial overlap (in terms of potential effects on VECs and VSCs) is likely to be limited to the area in the vicinity of the tie-in. Both the coal terminal and pipeline projects will be subject to regulatory requirements for environmental management as will the LNG project. Significant adverse cumulative effects are therefore unlikely. There will be positive cumulative effects from economic development of these projects. Another positive outcome is that the existing Municipal Planning Strategy will continue to guide future land development in the vicinity that is compatible with heavy industry. The existing controls will reduce the potential for cumulative effects on land use. Implementation of the mitigative measures contained in this screening report and adherence to applicable legislation and guidelines will ensure that significant cumulative environmental effects will be unlikely.

8.5 Effects of the Environment on the Project

The definition of environmental effects under Section 2(1) of the *CEAA* includes “any change to the project that may be caused by the environment”. Potential effects of the environment on the Project are described below.

8.5.1 Extreme Weather

Extreme weather events have the potential to damage the facility and related vessels, resulting in the unintended release of LNG.

Environment Canada data (1951-1980) indicates extreme hourly speeds of 77km/hr with extreme gusts to a maximum of 137 km/hr in the Project area, although it is recognized that these occurrences are rare. Chedabucto Bay is open to easterly gales that bring large waves ashore, however the predominant winds are from the west and northwest. Easterly winds at sea shift to northeast and weaken along the indented coastline due to the effects or friction over land.

Extreme wind can produce high waves, dense blowing sea foam, heavy tumbling of the sea and poor visibility. High winds and heavy seas at reduced temperatures can cause freezing spray conditions. Freezing spray can occur between November and April, however the potential for moderate or greater vessel icing from freezing spray is greatest in February. Safe work aboard a vessel can be impeded by freezing spray. The rate of ice build-up is strongly influenced by the vessel design, speed and direction of travel.

Visibility of one-half nautical mile or less is common for the Chedabucto Bay area in all seasons. Reduced visibility due to fog is likely to occur in late spring and early summer, with a peak fog potential in July. During winter poor visibility occurs less than 10% of the time and is often caused by snow.

All facilities will be fully weather proofed and designed for a full range of climatic conditions including severe rain, wind and waves. The tanks will be designed taking into account the wind loads (both typical and atypical) for the region. Equipment and structures will be designed to withstand the harshest recorded environment for the region. LNG ships are designed to be seaworthy in all types of weather. The LNG ship will not dock and, if docked, will undock and depart should the weather exceed the design criteria. For example, LNG ships do not dock in winds in excess of 25 knots. If extreme winds are predicted, the LNG ship's officers would monitor the weather to avoid being caught in restricted weather during the storm.

The plant will be designed to withstand all climatic elements with a substantial margin of safety. The increased frequency of adverse events is not directly relevant as every event must be accommodated without adverse impact to the safety of the plant systems. Since CSA Z276-01 contains design requirements that take wind and weather factors into account, a significant release of LNG resulting from facility damage due to severe weather is not likely.

The plant will conduct real-time monitoring of weather elements, and will archive these data. The data will be used on a real-time basis for guidance in ship berthing, safety planning, and interpretation of any compliance issues. There are no climatic data gaps that have been identified as being relevant to the Project and insufficiently characterized for the purposes of plant design or environmental assessment.

8.5.2 Sea Ice

Ice cover in the eastern portion of the Strait was virtually eliminated by the construction of the causeway (COA 2003a). In an analysis of ice and local climate (O'Neill 1977), it was concluded that construction of the Causeway has significantly reduced ice coverage generated by low salinity flows through the Strait originating in the Gulf of St. Lawrence; it has little or no detectable effect on climate (COA 2003a). It is unlikely that sea ice will have a significant effect on the Project.

8.5.3 Climate Change and Sea Level Rise

Increasing concentrations of greenhouse gases in the atmosphere are believed to be causing global warming (IPCC 1990; IPCC 1995). Increased temperatures may contribute to an increase in ocean volume (*i.e.*, sea level rise). Although estimates vary, global sea level rise is expected to be +0.5 m by 2100 (Wigley and Raper 1992; IPCC 1995; Forbes *et al.* 1997a). Other atmospheric changes relating to climate change may include increased storm intensity (Emanuel 1987) and other changes relevant to coastal stability such as surface winds, ocean waves storm surges and ice conditions (Forbes *et al* 1997).

Rising sea levels have prevailed in most parts of Atlantic Canada south of the Gulf of St. Lawrence for the past few thousand years. In the Halifax area, relative sea level has risen at least 40 m in the past 10,000 years (Shaw *et al.* 1993; Stea *et al.* 1994).

The design of the structures incorporates an adequate factor of safety to deal with anticipated changes in weather severity during the lifetime of the project, including storms and sea level rise associated with climate change. It is unlikely that climate change due to global warming will have a significant effect on the project.

8.5.4 Seismic Activity

The Strait of Canso lies in a relatively quiet seismic zone in which large magnitude earth quakes are infrequent. The Strait of Canso has been placed within Zone 1 on the current zoning map for Canada. Only little damage may be expected as a result of seismic events in this zone (Socio Economic Systems Inc. 1977).

There have been two small tremors of <3 m on the Richter scale recorded at Chedabucto Bay and at Canso Head, however, there is no history of soil liquefaction or land movement in the area (Whitman Benn and Associates Limited undated).

Tanks will be designed for the seismic rating in the region, as required under CSA Z276-01.

8.5.5 Summary

Project facilities will be designed and installed based on the appropriate environmental design criteria to ensure the safety and integrity of these facilities during severe environmental conditions. All Project facilities will be designed and constructed with the most recent meteorological, climatological, oceanographic and geotechnical data available to the designers. The design will incorporate an adequate factor of safety to deal with anticipated changes in weather severity during the lifetime of the Project, including storms and sea level rise associated with climate change. Monitoring and/or contingency planning will also serve to minimize any adverse effects. Effects of the environment on the Project are therefore predicted to be not significant.