10.0 ENVIRONMENTAL EFFECTS OF ACCIDENTS & MALFUNCTIONS

This section provides a summary of the potential malfunctions and accidents that could occur at the Project facilities, the potential effect of these incidents on the environment, and mitigation measures that will be implemented as part of the Project design. The following potential scenarios were assessed:

- hydrocarbon and hazardous material spills;
- LNG releases;
- forest fires;
- discharge of sediment to environment;
- discharges from ships;
- grounding of ships; and
- risk of accidents during decommissioning.

These scenarios have been identified by CEAA as the most relevant potential malfunctions and accidents that may occur for Project components presented in this CSR. As a first step in their assessment, the VECs identified in Section 2.5.2.3 were reviewed for each of the above scenarios to identify those VECs that may be affected by one or more malfunction or accident scenarios. Those VECs for which such an interaction was considered plausible (Table10.0-1) were carried forward for a detailed assessment (Sections 10.1 to 10.3). The assessment of malfunctions and accidents addresses all three phases of the Project, i.e., the construction phase, operation phase and decommissioning phase.

During the construction phase, the potential for malfunctions and accidents related to the proposed Project components are similar to any other large construction site. They can occur as a result of the use of machinery and equipment, and in particular, the storage of fuels and lubricants and refuelling procedures.

During the operations phase, malfunctions specifically related to the transport, handling and storage of LNG and the transport of natural gas by pipeline may occur. This is in addition to conventional accidents related to operating and maintaining process equipment (i.e., working on energized systems, welding, and cutting, working at height or in confined spaces). Accidents may also occur as a result of increased marine vessel and vehicular traffic required to transport LNG to the jetty or petrochemical plant supplies to and products from the marginal wharf.

10.1 LNG TERMINAL, MARINE TRANSFER PIPELINES, LNG STORAGE TANKS AND THE REGASIFICATION FACILITIES

Accidents and malfunctions that could occur at the LNG Terminal, marine transfer pipelines, LNG storage tanks, and Regasification facilities include all of the identified scenarios:

- hydrocarbon and hazardous material spills;
- LNG releases;
- forest fires;

TABLE 10.0-1 Interactions Between Accidents & Malfunctions and ECCs

ECC	LNG Terminal, Marine Transfer Pipelines, LNG Storage Tanks & Regasification Facilities						Marginal Wharf						Project Related Shipping Within 25 km of Country Island		
	Hydrocarbon & Hazardous Material Spills	Accidental Forest Fires	Discharge of Sediment to Marine Environment	Discharges From Ships	Grounding of Ships	Risk of Accidents & Malfunctions During Decommissioning	Hydrocarbon & Hazardous Material Spills	Accidental Forest Fires	Discharge of Sediment to Marine Environment	Discharges From Ships	Grounding of Ships	Risk of Accidents & Malfunctions During Decommissioning	Hydrocarbon & Hazardous Material Spills	Discharges From Ships	Grounding of Ships
Hydrology															
Freshwater Quality/Quantity	√	√				√									
Groundwater Quality/Quantity	√					√									
Marine Water Quality	√		√	√	√	√	√		√	√	√	√	√	√	√
Soil/Sediment Quality	√					√	√					√	√		
Air Quality	√	√				√	√					√	√		
Climate Conditions															
Vegetation (terrestrial & marine)	√	√		√		√	√				√	√	√		√
Species At Risk	√	√		√	√	√	√				√	√	√		√
Fish & Fish Habitat (marine & fresh)	√	√	√	√		√	√		√	√	√	√	√	√	√
Marine Mammals	√		√	√		√	√		√	√	√	√	√	√	
Wildlife & Habitat	√	√				√									
Migratory Birds & Habitat	√	√		√	√	√	√			√	√		√		√
Wetlands															
Lighting Conditions															
Atmospheric & Underwater Acoustic Environment															
Physical & Cultural Heritage[1]															
Current Use of Lands & Resources for Traditional Purposes – Aboriginal Persons	√	√				√	√					√			

ECC	LNG Terminal, Marine Transfer Pipelines, LNG Storage Tanks & Regasification Facilities						Marginal Wharf						Project Related Shipping Within 25 km of Country Island		
	Hydrocarbon & Hazardous Material Spills	Accidental Forest Fires	Discharge of Sediment to Marine Environment	Discharges From Ships	Grounding of Ships	Risk of Accidents & Malfunctions During Decommissioning	Hydrocarbon & Hazardous Material Spills	Accidental Forest Fires	Discharge of Sediment to Marine Environment	Discharges From Ships	Grounding of Ships	Risk of Accidents & Malfunctions During Decommissioning	Hydrocarbon & Hazardous Material Spills	Discharges From Ships	Grounding of Ships
Archaeological, Paleontological or Architectural Significance[1]	√	√	√												
Navigation	√				√	√	√				√	√	√		√
Marine Safety & Security	√				√	√	√				√	√	√		√
Human Health & Safety	√	√		√		√	√					√	√		
Fisheries	√		√	√	√	√	√		√	√	√	√	√	√	√
Aquaculture	√		√	√	√	√	√		√	√	√	√	√	√	√
Tourism	√					√	√					√	√		

Notes:
1 Sites will be identified and protected from Project impacts.

- discharge of sediment to environment;
- discharges from ships;
- grounding of ships; and
- risk of accidents during decommissioning.

The following text briefly discusses the circumstances of each scenario and evaluates the likely environmental effects on potentially affected VECs. Mitigation and management measures are identified and taken into consideration in the final determination of the significance of the effect.

10.1.1 Hydrocarbon and Hazardous Material Spills

10.1.1.1 Spills of Hydrocarbons (excluding LNG) and Hazardous Materials

The potential for spills of hydrocarbons and hazardous materials exists for all phases of the Project. During the construction and commissioning phases, the potential for spills is limited to materials used in site preparation, and fabrication and installation of the facilities and equipment. For example, gasoline, diesel fuel, propane, grease, motor oil, and hydraulic fluids are all needed for heavy equipment required for site preparation. Construction of the facilities will also require hazardous materials such as acetylene, oxygen and other compressed gases, form oil, paints, epoxies, concrete additives, glycol/methanol, cleaners, and solvents.

The probability of spills and the effects of spills, in the event that they occur, will be reduced by a number of design, mitigation, and contingency planning measures (see Sections 10.1.1.4 and 10.1.1.5). These include for example:

- The implementation of hazardous materials management processes and procedures. The handling of fuel and other hazardous materials will comply with the *Transportation of Dangerous Goods Act.*
- Bulk storage of all fuel products, concrete additives and other hazardous materials in aboveground, self-dyked tanks or drums with secondary containment.
- Maintenance of a complete inventory of all fuels and hazardous materials.
- Handling of fuels and other hazardous materials only by persons who will be trained and qualified in handling these materials.
- Implementation of WHMIS to ensure proper handling and storage is achieved.

During the operations phase, the potential for spills relates to most of the materials identified for the construction phase and will be managed similarly. The hazardous material unique to the operations phase is LNG, which is discussed separately in the following section.

10.1.1.2 LNG Releases

The potential for LNG releases is only applicable during the operation phase of the Project. LNG is comprised of methane, with fractional amounts of ethane and propane. It is odourless, colourless, non-corrosive, and non-toxic. Release of cryogenic LNG due to spills, leaks, or

intentional draining can expose facility personnel to several hazards. These hazards include oxygen deficiency, freezing injuries, fire hazards, and air-gas mixtures.
LNG releases can occur:

- from various components of the process;
- during unloading of LNG from vessels;
- from the site pipelines;
- from marine vessel accidents;
- from accumulation of gas in a confined space; and
- as a result of sabotage or terrorist attacks.

LNG Properties and Behaviour

LNG spills do not pose an explosion risk unless the spill occurs in an uncontrolled confined space. Natural gas has a relatively low reactivity and low burning speed. Because of its narrow flammability range (i.e. 5 – 15 volume % in air), unconfined clouds of natural gas generated by an outdoor leak of LNG spill present little danger of explosion. Natural gas is lighter than air and quickly mixes into the surrounding air, forming an air-gas mixture that is below its Lower Flammable Limit. If ignition from an external ignition source should occur, burning will take place only along the air/gas interface where the mixture is above the Lower Flammable Limit. Flame speeds in unconfined natural gas clouds (about 4 to 10 m/s) are far below those that would produce dangerous overpressure or an explosive event. A flash or detonation is considered very unlikely.

Natural gas presents the greatest safety risk when gas leaks or LNG spills occur in confined areas. Confinement, such as an enclosed compressor building, can allow flammable vapour to accumulate and increases the possibility of ignition and the risk of localized damage. Once ignited, pressure will build in the enclosed area; however, flame speeds decelerate rapidly beyond the boundaries of the confinement and limit the extent of potential damage and injuries. The risk of explosion in a confined space is minimized by providing good ventilation in structures that contain or possibly contain natural gas. Ventilation allows the naturally rising natural gas to escape and dilute below its flammability range. Gas-detection equipment will enable operator control to prevent fires and explosions. (For other design, mitigation and contingency planning measures refer to Sections 10.1.1.4 and 10.1.1.5).

LNG boils when the released liquids contact warmer surfaces such as concrete or soil. The rate of boiling is rapid initially but decreases as the surfaces in contact with the liquid cools. The gas evolved mixes with the surrounding air to form three types of mixtures:

1. Near the surface of the liquid, the mixture of gas and air will be too rich in hydrocarbons to burn.
2. A distance away from the liquid surface, the mixture of gas and air will be too dilute in hydrocarbons to burn.

3. Between these two non-flammable mixtures, there is a flammable air-gas mixture. The flammable range of natural gas in air is approximately 5 to 15% by volume. Ignition of this mixture will result in a flame, which travels to the source of the gas.

LNG vapours will be heavier than air at temperatures of -107°C or below and will tend to spread out laterally along the ground rather than rise vertically. As the cloud warms above -107°C, its density becomes less than air and the cloud will rise. Atmospheric water vapour will condense to form a localized white cloud or fog as the air and cold gas mix. The flammable air-gas mixture can exist inside or outside of the visible cloud. The dispersion of the cloud depends on atmospheric and wind conditions as well as the rate at which the vapour is released or generated. Gas, at concentrations above its Lower Flammable Limit, can exist for a considerable distance from its source.

Natural gas produced from LNG is odourless. Odourizer is typically only added just inside battery limits of the regasification process on the natural gas send-out pipeline. For this reason, fixed and portable combustible gas detection equipment is provided within the natural gas and LNG process and handling areas.

10.1.1.3 Potential Environmental Concerns of Spills of Hydrocarbons, LNG, and hazardous Materials

Accidental Spills of Hydrocarbons, LNG, and hazardous Materials could result in potential adverse environmental effects on numerous VECs (see Interaction Matrix Table 10.0-1). These interactions are briefly discussed below.

Effects on Freshwater Quality/Quantity

Spills of hydrocarbons, LNG, and hazardous materials to the freshwater environment have the potential to result in freshwater habitat loss, avoidance of habitat, and direct mortality of freshwater species. Spills of other hazardous materials, including fuels, lubricants, solvents and concrete, may temporarily degrade water quality and subsequently affect fish, through mortality, avoidance of habitat, and disruption of feeding and migration patterns.

The likelihood of impacts will be reduced through the designation of fuel storage and refuelling areas at locations at least 30 m from watercourses and fish habitat and through the development of emergency spill response measures. Given the potential environmental effects from release of LNG, hydrocarbons, or other hazardous material into fresh or marine waters, combined with proposed mitigation and contingency plans (Sections 10.1.1.4 and 10.1.1.5), the potential for environmental effects from a spill is considered unlikely.

Effects on Groundwater Quality/Quantity

The accidental spill of a hazardous liquid during construction or operation could render the groundwater resource unusable for a long period if the spill was sufficiently large. A release of hazardous materials may result from leaks from construction equipment, accidents involving fuel or other hazardous material storage or transport, or from leaks from facilities and pipelines. The likelihood of a large hazardous material spill, however, is considered low due to environmental protection procedures to be applied in the EPP, and the implementation of the design and operational safeguards discussed in Section 10.1.1.4 and the contingency and emergency response procedures described in Section 10.1.1.5. In addition, there are no wells downgradient of the LNG facilities. Given the proposed mitigation and the low risk for impact, the environmental effect of a hazardous material spill on groundwater is considered not significant.

Effects on Marine Water Quality/Quantity

The accidental release of a hazardous liquid into the marine environment could result from an accident involving tankers and other marine vessels at the terminal, or an event involving offloading at the terminal. Hazardous materials may include oil, fuels, lubricants, and LNG. Although there is no industry history of a substantial release of LNG into the marine environment (Section 10.1.1.4), the expected behaviour of an LNG spill on water is described in Section 10.1.1.2. An LNG spill would not affect marine water quality, as the material is not persistent or toxic. Boiling and cryogenic effects are physical effects and are short-term in duration. Spills of other petroleum products would degrade marine water quality. Effects on marine water quality have the potential to result in impacts to fish, marine mammals, fisheries and aquaculture, which are addressed separately subsequent sections.

Effects on Soil/Sediment Quality

Spilled contaminants can accumulate in soils and sediments and be mobilized into groundwater and surface waters slowly over time affecting water quality and fish and fish habitat. The likelihood of a large hazardous material spill, however, is low due to environmental protection procedures established in the EPP, and the implementation of numerous design and operational safeguards (Section 10.1.1.4) and the contingency and emergency response procedures (Section 10.1.1.5). The potential for adverse effects is considered not significant.

Effects on Air Quality

Spills of hydrocarbons, LNG, and hazardous materials have the potential to result in temporary effects on air quality, manifesting as odours, cloud of vapourized LNG, or fire if an ignition source is present. The effect of such events on human health and safety is addressed separately, below.

The effects of process upset events may include minor emissions of PM and combustion gases from equipment and small fugitive releases of natural gas from valves and flanges. Given the mitigation and effect management measures that will be incorporated with the design, operation and management of the Project (Section 10.1.1.4; see also Sections 2.2.4.1 and 2.2.4.2) these types of emissions are expected to be nominal and the environmental effects minimal, i.e., not significant.

Effects on Vegetation

Hazardous material spills may, depending on the toxicity of the substance, cause direct or indirect mortality of vegetation, by oiling plant surfaces or contaminating plant surfaces, water, or soil or in the case of LNG, possible freezing effects. Impacts to vegetation would be limited to areas in direct contact with spilled material and direct impacts on vegetation are unlikely as the spills would most likely occur and be contained in developed areas of the site. Given the proposed mitigation and the risk for impact, the environmental effect of a hazardous material spill on vegetation is considered not significant.

Effects on Species at Risk

Hazardous material spills may, depending on the toxicity of the substance, cause direct or indirect mortality of species at risk, by contaminating water, soil, or food sources. Chemicals may be directly absorbed through dermal contact or ingested. The only species at risk known to occur in the area is the roseate tern, which nest on Country Island, approximately 10 km from the facility. Given the distance from the facility, the risk for effect on the terns from a hazardous material spill or release of LNG at the terminal is considered unlikely. However, although unlikely, the loss of a single species at risk would be considered significant. Nonetheless, with spill prevention measures to be implemented (Section 10.2.1.2) the potential for large scale and frequent accidents is expected to be low. Furthermore, in the unlikely event of a spill, emergency response planning (Section 10.2.1.3) will considerably reduce the potential effect on avian species at risk, including the roseate tern. Given the proposed mitigation measures and the low risk for impact, the environmental effect of a hazardous material spill on species at risk is considered not significant.

Effects on Fish and Fish Habitat

A spill of LNG has the potential to effect biota present at the air/water interface and in intertidal habitat (if a spill reaches shore) during the cryogenic stage (as described under 10.1.1.2 LNG Properties and Behaviour, above). As effects decrease with water depth, and LNG is not persistent and is not toxic to marine biota, an LNG spill is not predicted to have a significant effect on marine fish or fish habitat. An LNG spill is considered to have significantly less severe environmental effects to fish and fish habitat than a spill of hazardous materials such as fuel, oil, and lubricants.

A spill of hazardous materials such as fuels and lubricants into or near a watercourse or the marine environment could temporarily degrade water quality and have subsequent effects on freshwater and marine fish and habitat. Contaminants can also accumulate in sediments and subsequently be mobilized over time, also affecting fish. The effects of a major spill at or near a watercourse could extend downstream, depending on material quantity and toxicity. Fish mortality could occur at all life stages in the affected area. Other effects could include avoidance of the habitat, and disruption of feeding and migration patterns. The magnitude of an effect of a spill is dependant on a number of variables; however, considering mitigation including spill prevention (Section 10.2.1.2) and emergency response planning (Section 10.2.1.3) to be in place, the potential for large scale and frequent accidents is expected to be low. The potential effects to fish and fish habitat from a hazardous material spill are therefore determined to be not significant.

Effects on Marine Mammals

A spill of LNG has the potential to affect marine biota present at the air/water interface and in intertidal habitat (if a spill reaches shore) during the cryogenic stage (as described under LNG Behaviour, above). As effects decrease with water depth, and LNG is not persistent and is not toxic to marine biota, an LNG spill is not predicted to have a significant effect on marine mammals present at depth. An LNG spill could result in asphyxiation (oxygen deficiency) of marine mammals present at the air/water interface in the area of the spill. An LNG spill is considered to have significantly less severe environmental effects on marine mammals than a spill of hazardous materials such as fuel, oil, and lubricants.

A spill of hazardous materials such as fuels and lubricants into the marine environment could temporarily degrade water quality and have subsequent effects on marine mammals. Animal oiling and mortality could occur at all life stages in the affected area. Other effects could include avoidance of the habitat, and disruption of feeding and migration patterns. Marine waters around the facility are not considered to support significant habitat for, or numbers of, marine mammals. The magnitude of an effect of a spill is highly variable depending on its nature; however, considering mitigation measures that will be in place, the low probability of an accident, and the nature of the potential environmental effects, the potential effects to marine mammals from a hazardous material spill are predicted to be not significant.

Effects on Wildlife and Habitat

Hazardous material spills may, depending on the toxicity of the substance, cause direct or indirect mortality of wildlife, by contaminating water, soil, or food sources. Wildlife that may come into direct contact with LNG may be affected by freezing effects. Chemicals may be directly absorbed through dermal contact or ingested. The highest potential of hazardous material or LNG spill potentially affecting wildlife and habitat is associated with developed areas of the Project. Given the proposed mitigation and the low risk for impact, the environmental effect of a hazardous material spill on wildlife and habitat is considered not significant.

Effects on Migratory Birds and Habitat

An LNG release to the marine environment could result in direct bird mortality. As LNG is a cryogenic liquid at -161°C, the extreme low temperature could result in severe freezing on contact if birds remained on the water within the affected zone. This effect would last until the LNG evaporated, generally less than 10 minutes.

The water is unlikely to freeze. Rather, as LNG floats on the water surface (with a density of 45% of the density of freshwater), the water would warm the LNG, causing it to vapourize, forming a spreading cloud. Cryogenic effects are limited to direct contact with the LNG and not the cold LNG vapour. This would create elevated methane levels at the air/water interface that could lead to asphyxiation of birds in the immediate vicinity of the pooled LNG. If an ignition source is present and the LNG vapour burns, bird mortality will result from thermal radiation. There is no explosion risk in open air.

The persistence of environmental effects to marine birds would be less (shorter duration) from an LNG spill than spills of other hydrocarbons or hazardous materials. Hydrocarbon spills could result in oiling of birds and habitat. Depending on the toxicity of the substance, hazardous material spills may result in bird mortality through contamination of water, soil, and/or food sources. Chemicals may be absorbed by birds through dermal contact with contaminated soils or water, or through ingestion of contaminated food sources. The effect on birds from an LNG spill are considered not significant if the spill is contained, and significant (but unlikely) if the spill is not contained.

Effects on Current Use of Lands and Resources for Traditional Purposes by Aboriginal Persons

An accidental LNG or other hazardous material spill has the potential to affect use of lands and resources in and around the facility by Aboriginals. For a description of the type of impacts, refer to the effects discussions for wildlife and fish. Some of the areas traditionally used by Aboriginals for hunting and fishing occur within the LNG site; however, with the development of the lands for the Project the lands will not be accessible for use. For the most part, the land areas with potential to be effected by a spill are of limited significance. A spill into Stormont Bay and surrounding areas, however, could impact traditional Aboriginals fisheries. Given the proposed mitigation including design and operational safeguards and contingency planning (Sections 10.1.1.4 and 10.1.1.5) and the risk for impact (as addressed above under wildlife and fisheries), the environmental effect of a hazardous material spill on the use of lands and resources by Aboriginal persons is considered not significant.

Effects on Archaeological, Paleontological or Architectural Resources

A spill of hydrocarbon or hazardous material that requires clean-up may involve ground disturbance, with potential to affect unidentified archaeological, paleontological, or architectural resources. Areas known to have such resources will be avoided as much as possible. Spills will be infrequent and minor due to the environmental protection precautions required to be undertaken by Contractors and operations staff. Further, it is anticipated that spills requiring clean-up would likely occur and be contained within areas where equipment and vehicles are parked and used where ground disturbance has already occurred. These areas will be assessed for archaeological and paleontological resources prior to construction. The overall effect on unidentified archaeological, paleontological, or architectural resources therefore, has been determined not significant.

Effects on Navigation

Marine vessel accidents could result in temporary loss of access to or alteration of navigation routes as a result of the establishment of exclusion zones around spills. As discussed in Section 10.1.1.4 below, the LNG shipping industry has an excellent safety record. The probability of accidental interactions between LNG facility vessels and public vessels is considered low due to the public vessel advisories or exclusion zones to be established around moving tankers, the terminal's operating procedures and worker training, which will serve to ensure that public watercraft are not in the vicinity of facility tankers when they are manoeuvring in the area. Further, a catastrophic failure of an LNG tanker is considered highly unlikely given tanker design and the marine safety record to date. Therefore, potential accidents of a magnitude to potentially affect marine vessel navigation in Stormont Bay are considered highly unlikely to occur and have been determined not significant.

Effects on Human Health and Safety

At the two-vessel proposed output scenario (2 bcf/d vs 1 bcf/d) assuming a lower end of tanker capacity of 160,000 m^3, one LNG tanker will arrive at the LNG Terminal every 3.5 to 1.8 days. This will result in a total of 105 to 210 LNG tankers per year. This number can be marginally reduced if larger capacity LNG tankers (250,000 m^3) are made available. (5.4 to 2.7 days).

A spill of hazardous materials or LNG could affect both the general public and workers at the LNG facility. An LNG release to the marine environment has the potential to result in direct impacts on humans. As LNG is a cryogenic liquid at -161°C, the extreme low temperature could result in severe freezing on contact if a person remained on the water within the affected zone. This effect would last until the LNG evaporated, generally less than 10 minutes. The extent of the affected zone and timeframe for evaporation will be quantified as part a QRA currently being undertaken for the Project.

When LNG comes into contact with water, the water is unlikely to freeze. Rather, as LNG floats on the water surface (with a density of 45% of the density of freshwater), the water would warm the LNG, causing it to vapourize, forming a spreading cloud. Cryogenic effects are limited to direct contact with the LNG and not the cold LNG vapour. This would create elevated methane levels at the air/water interface that could lead to asphyxiation of persons in the immediate vicinity of the pooled LNG. If an ignition source is present and the LNG vapour burns, mortality will result from thermal radiation. As noted above, the extent of the affected zone will be quantified as part of the QRA. There is no explosion risk in open air.

LNG releases in confined spaces may create oxygen deficient or explosive atmospheres, posing a safety risk to workers.

Accidents related to LNG handling and processing and the transport of natural gas will, for the most part, be addressed by safe operating practices and other measures identified below to reduce the probability and severity of LNG releases (Sections 10.1.1.4 and 10.1.1.5). Additionally, recognizing the proximity of workers to any accidents and the role workers may play in response to accidents and malfunctions, worker safety will also be addressed by the implementation of the Worker Health and Safety Plan, Worker Health and Safety Procedures, and proper training in plant operations and the proper handling and processing of LNG (see Sections 10.1.1.5, 2.2.4.1, and 2.2.4.2).

The use of pipelines to transport natural gas is considered safe. Injuries reported for National Energy Board-regulated pipelines for employees and contractors totalled less than 1 injury in the year 2000 and less than 2 in the year 2001 for every 200 000 hours worked (the equivalent of 100 full time workers) (Jacques Whitford, 2004). Assuming a worst case accident frequency of 2 injuries for every 100 full time workers, and 5 full time workers assigned to operate and maintain the facility's natural gas pipeline, an accident frequency of 0.1 injury per year, or 1 injury every 10 years, is predicted (Jacques Whitford, 2004). Although this is a low rate of injury, further measures, such as the Worker Health and Safety Plan and Safe Operating Procedures, will be employed to reduce it further.

While the likelihood of an LNG release of substantial size is extremely low, given facility design and operational requirements (Sections 10.1.1.4 and 10.1.1.5), as well as the safety record of the LNG industry, the potential effects to human health and safety from a catastrophic spill of LNG are considered significant, although not likely to occur.

Effects on Fisheries

A spill of hydrocarbons or hazardous materials may result in temporary closure of herring, mackerel, lobster, and rock crab fishing grounds in Isaac's Harbour, Country Harbour, and/or Stormont Bay; closure of specific fisheries due to species contamination; or damage to/destruction of fishing gear from oiling or other contamination. Planned mitigation will reduce the potential for accidental events, and spill response and contingency plans (Section 10.1.1.4) will mitigate effects.

An LNG spill will not contaminate fishery resources as LNG is not toxic to aquatic organisms below the water surface. Consequently, an LNG spill is not likely to affect bottom fisheries such as lobster, scallop, and groundfish. There is, however, potential for very short-term effects to commercial fishing activity and fishing gear on the water surface due to both cryogenic and thermal radiation effects.

The persistence of environmental effects to commercial fisheries would be less severe (shorter duration) from an LNG spill than spills of other hydrocarbons or hazardous materials. Establishment of a dynamic exclusion zone for tankers traveling in shipping lanes and from the end of the shipping lane to the jetty would restrict any authorized vessel from coming into proximity with a moving tanker, reducing the potential for collision and spills. The extent and conditions of this tanker exclusion zone will be determined by the Proponent with the Atlantic Pilotage Authority, Canadian Coast Guard, TC, DFO and local fishers.

Overall, the effects of a spill of hydrocarbons or hazardous materials are considered to not be significant.

Effects on Aquaculture

A spill of hydrocarbons or hazardous materials may result in temporary closure of aquaculture sites in operation in Country Harbour, due to species contamination, or damage to/destruction of aquaculture gear and infrastructure from oiling or other contamination. Planned mitigation will reduce the potential for accidental events, and spill response and contingency plans will mitigate effects.

An LNG spill will not contaminate aquaculture resources as LNG is not toxic to aquatic organisms below the water surface. There is, however, potential for short-term effects to aquaculture activity and gear on the water surface due to both cryogenic and thermal radiation effects. Given the distance between the LNG Terminal and the aquaculture sites cryogenic and thermal radiation effects are not considered likely.

Effects on Tourism

Accidents and malfunctions at the LNG Terminal are not expected to result in effects on tourism as these events will have only short-term impacts on local tourist traffic.
Marine vessel accidents could result in temporary impacts on access to or from Stormont Bay as a result of the establishment of short term exclusion zones around spills. As discussed in Section 10.1.1.4, the LNG shipping industry has an excellent safety record. The probability of accidental interactions between LNG facility vessels and public vessels is considered low due to the public vessel advisories or exclusion zones to be established around moving tankers, the terminal's operating procedures and worker training, which will serve to ensure that public watercraft are not in the vicinity of facility tankers when they are manoeuvring in the area. Further, a catastrophic failure of an LNG tanker is considered highly unlikely given tanker design and marine safety record to date. Therefore, potential accidents of a magnitude to potentially affect marine vessel navigation in Stormont Bay are considered highly unlikely to occur.

10.1.1.4 Design and Operational Safeguards

The LNG industry has a long and excellent safety record, due to strict industrial safety standards applied worldwide. Busy ports around the world have LNG facilities that have operated for up to 40 years without an incident impacting the public.

LNG Industry Safety Record

Since commercial LNG transport began in 1959, LNG has been safely transported, stored, and delivered to densely populated cities in the US, Europe, and Japan. LNG has an excellent safety record with more than 33,000 carrier voyages covering 60 million miles around the globe without a major accident over a 45-year history.

Ocean-going tanker transportation of LNG has a long record of safe operation. Few accidents have occurred since the first converted freighter delivered a Lake Charles, Louisiana cargo of LNG to the UK in January 1959, none involving a fatality or major release of LNG. The outstanding LNG shipping safety record is attributable to continuously improving tanker technology, tanker safety equipment, comprehensive safety procedures, training, equipment maintenance, and effective government regulation and oversight.

LNG ships are well-built, robust vessels with a double-hull designed and built to withstand the low-energy impacts common during harbour and docking operations. They are a common sight throughout much of the world.

LNG carrier safety equipment includes sophisticated radar and positioning systems that alert the crew to other traffic and hazards around the ship. A number of distress systems and beacons will automatically send out signals if the ship is in difficulty. The cargo system safety features include an extensive instrumentation package that safely shuts down the system if it starts to operate out of predetermined parameters. Ships are also equipped with gas and fire detection systems.

LNG Terminals have been operating for over 40 years without a serious public safety incident. An incident resulting in loss of life occurred in Cleveland, Ohio in 1944. At this time, knowledge of storage of LNG, or of the low temperature performance of materials, was not as advanced as today. Improper materials used in a single unprotected containment system failed and resulted in spilled LNG. Current design of containment systems utilizes low temperature nickel steel and a secondary containment vessel.

Other incidents attributed to LNG are:

- A construction accident on Staten Island in 1973 where the construction crew was working inside an (empty, warm) LNG tank. Although often referred to as an LNG accident this was, strictly speaking, a construction accident.
- Failure of an electrical seal on an LNG pump in 1979 permitted gas (not LNG) to enter an enclosed electrical switchgear building. A spark caused the building to explode. As a result of this incident, the electrical code has been revised for the design of electrical seals used with all flammable fluids under pressure.

- The recent incident at Skikda in Algeria in 2004 is naturally causing some concern due to the loss of life. The cause of this incident was likely due to a steam boiler explosion. It should be noted that even the resulting fire did not damage storage tanks that are somewhat similar to those that would be utilized at the LNG facility. Furthermore, it should be noted that the Skikda facility is a liquefaction plant, which is completely different compared to the LNG import terminal.

The design of the LNG facility takes into account mitigative measures that would protect humans and the environment in the event of an accident or malfunction. Details about the mitigative features of the facility are outlined in the following and Sections 2.0 and 5.0. A brief overview of the mitigative measures is presented in this section. However it is noted that during the design of the facility, extensive safety studies, for instance Hazard and Operability Analysis (HAZOP), and a QRA, will be performed to achieve a high site and public safety level.

Detection and Response Equipment

Flame Detectors

Infrared and combined infrared/ultraviolet flame detectors will be located at the LNG storage tank roof area, regasification area, and jetty head. An alarm signal from any detector within a fire zone will initiate visual and audible alarms. Signals from detectors in a fire zone will initiate shutdown actions and the firewater and dry chemical systems.

Flammable Gas Detection System

Flammable gas detectors will be employed in the tank zone, regasification area, jetty head, and ventilation air intakes. An alarm signal from the detector within a fire zone will initiate visual and audible alarms. Similar to the flame detectors, the detectors in a fire zone will trigger shutdown actions as well as shutting down the building ventilation system.

Cold Detectors

Temperature probe type cold detectors will be installed in LNG collection trays, drainage channels, or basins to detect an LNG spill.

Heat Detectors

Heat detectors consisting of pneumatically pressurized fusible plastic tubing will be used to provide linear heat detection on and around LNG tank roof areas. Signals from one tube rupturing will initiate visual and audible alarms and start the fire pumps.

Terminal Alarm System

The terminal alarms will be generated by the Emergency Shut Down (ESD) system and consist of warning sirens located in the LNG tanks area, process area, jetty head, and buildings. The alarm system alerts personnel either at the jetty, in the process/tankage area and the buildings in these areas. Once activated, the alarm tone will be supplemented by a speech broadcast over the handheld radio system, giving type and location of incident.

Fire Protection

Fire protection will consist of fixed protection systems which comprise high expansion foam systems, gaseous extinguishing systems, dry chemical systems, hydrants, and monitors, in areas where it is most likely for a fire to occur. These systems will be supplemented by fire extinguishers.

Water deluge systems are not appropriate for extinguishing LNG fires. The application of water on an LNG liquid surface will increase the vapour formation rate thus increasing the burning rate. However, firewater monitors shall be used for exposure protection.

Extinguishment of an LNG fire shall be by dry chemical. High expansion foam will be used for controlling sump fires. Dry chemical shall be used for snuffing LNG tank relief valve tail pipes.

Water curtains will be provided between the jetty head and the tanker to protect the hull of the tanker from fire, cold liquid, or gas. The water curtains will be initiated automatically on confirmed fire detection.

The LNG tank area, the regasification area, and the jetty head will have remote/manually operated oscillating monitors, with design flow rate of 2850 L/min, connected to the fire ring main.

Two remote controlled tower water monitors of each 4000 L/min will be strategically placed to protect the most vulnerable areas of the Jetty Head. They will be able to reach the ship's manifold and offer protection to the Unloading Arm area.

LNG retention sumps or basins will have high expansion foam generators to enable remote manually operated blanketing of any LNG spillage collected in the sump/basin. In the event of ignition, the high expansion foam will reduce the flame size and hence the radiation rate. The LNG retention sumps/basins collect spillage from the curbed areas and spillage trays located around and under significant LNG leakage sources. If necessary, foam retention fences or screens shall be erected around LNG retention sumps/basins to prevent wind destroying the foam blanket.

Both the jetty head impoundment sump and the regasification impoundment sump will have a high expansion foam system (200 L/min).

Firewater hydrants will be provided throughout the regasification area and jetty and will be located not less than 15m from the protected risk. Hoses and hose cabinets shall be provided adjacent to the hydrants.

The jetty head will be protected by 6 double outlet fire hydrants. One hydrant at the jetty head will be equipped with an International Shore to Ship Connection.

The regasification area will be protected by 8 double outlet fire hydrants. Hydrants will be spaced not more than 30m apart in the regasification area.

Fixed dry chemical extinguishing systems will be provided for extinguishing the tail pipe vents from the relief valves on the LNG storage tanks should they ignite. The system operates automatically on confirmed fire detection and includes a main and reserve supply.

Two dry chemical hose reel systems will be provided at the jetty head. These will enable a pool fire in the spill containment areas or other fires to be approached from two directions for fire fighting purposes.

At the Terminal

Prevention and mitigation of hydrocarbon (LNG) and hazardous material spills at the LNG Terminal will be accomplished by the following means:

- inherent safe vessel design;
- the use of competent crews;
- operational procedures and training;
- security plans and procedures; and
- effective emergency planning and preparedness.

Vessel Design and Selection

LNG tankers are ocean-going vessels, double-hulled and specifically designed and insulated to prevent leakage or rupture. Tankers equipped with double hulls have reduced oil spills from groundings by 90 percent and from collisions by 29 percent (DNV (Det Norske Veritas), 1990). Double-hulled tankers have also been shown to reduce the size of spills when they occur. The vessel's LNG containment system is located within the inner hull and maintained at atmospheric pressure and -161°C. LNG tankers are relatively new vessels worldwide with approximately 20 percent of the world tanker fleet less than 5 years old (Jacques Whitford, 2004).

LNG tankers are certified by the International Association of Classification Societies, which provides compliance certification as well as technical support, research and development. Tankers selected to transport LNG and unload to the facility will meet or exceed international standards. The Proponent will require that vessels meet stated standards by using an auditing system such as the Ship Inspection Report Programme (SIRE), a safety initiative introduced by the OCIMF. The SIRE Programme is a tanker risk assessment tool, a large database of up-to-date information about tankers. SIRE serves a dual purpose - it has focused tanker industry awareness on the importance of meeting satisfactory tanker quality and ship safety standards, and it provides documentation of vessel condition. Since its introduction, the SIRE Programme has received industry-wide acceptance and participation by both OCIMF Members, Programme recipients and by ship Operators. The program is a vetting system, allowing prospective charterers to better ascertain whether chartered vessels are well managed and maintained. Additionally, inspection reports, which are maintained on the database for 2 years will be provided to regulators to demonstrate that tankers used to transport LNG to the terminal meet standards.

Mitigation of accidents and malfunctions is taken into consideration in the design of the components of transfer piping from LNG carriers to storage tank headers. Section 2.2 provides details on the proposed design of the following components of this system:

- LNG marine carrier unloading and transfer system design; and
- transfer piping system.

Mitigative features of the LNG Marine Carrier Unloading and Transfer System Design include the following:

- installation of Powered Emergency Release Couplers at the loading arms; and
- during unloading of the LNG carrier the ESD system of the LNG carrier and the LNG import terminal will be coupled.

Crew Training and Communication

Tanker crews will be required to undergo a high standard of training. Training contributes significantly to minimizing spills; 75 to 90% of significant incidents are attributed to human error. Additionally, communication with and between the crew during an emergency can reduce risk. Consequently, tanker officers will be orally proficient in both English and the predominant language of the crew.

The Proponent will require that vessel crews meet stated standards by using an auditing system such as OCIMF's SIRE. Notably, SIRE's Vessel Particulars Questionnaire for Bulk Oil/Chemical Carriers and Gas Carriers (1997) includes information on vessel crews, including minimum and actual manning, nationality, crew employer, manning agent name and contact information, crew continuity, and crew training information. The questionnaire is intended to be completed by the ship's operator and then be made available to inspecting parties, including prospective charterers, terminal operators, and regulators. The reports, which are maintained on the OCIMF database for 2 years will be provided to regulators to demonstrate that the crews of tankers used to transport LNG to the terminal meet standards.

Vessel Movement and Operations

Vessel movement and communications among vessels is coordinated by the Canadian Coast Guard. A number of measures will be applied towards accidents involving marine vessels. Adherence to proper procedures, as defined in the Marine Terminal Manual, and the use of exclusion zones or public vessel advisories will serve to keep public vessels and marine craft at a proper distance from LNG tankers as they are manoeuvring in the harbour.

Marine/navigational safety issues will be addressed via the TERMPOL Review Process under direction of TC Marine Safety. TC is mandated to be part of the technical review committee for the EA to serve this purpose. TC will use the tools in the TERMPOL Review Process to objectively appraise operational ship safety, route safety, and management and environmental concerns associated with the location, construction, and subsequent operation of a marine terminal system for the bulk handling of LNG and other deleterious cargoes identified by TC.

As part of the risk management process identified in the TERMPOL Review Process, establishing safe conditions for the port transit of LNG will be of major importance and will be a direct responsibility of the port authority along with input from Keltic and the various ship operators. A Vessel Traffic System, as specified by the IMO (Resolution A.578-14) for marine traffic management will be implemented in order to prevent close encounters between LNG carriers and other marine traffic. Necessary subordinate specifications concerning traffic management will be developed according to the risk identified in each particular situation.

Other conditions for establishing safe operations in port will include adequate navigation marks and lights in accordance with NWPA, limited ship movement in conditions of poor visibility, and a high standard of pilotage service all of which will contribute to minimizing the risk of marine transport anomalies. The quality of pilotage service is of particular importance. As part of terminal planning Keltic with the facilitation of American Petroleum Association will establish a fixed pilot boarding area at a safe distance offshore beyond which specific sized vessels will not be allowed to continue without a pilot in place.

As part of the operations study within the port design process, navigational risks management will be reviewed and developed based upon the following factors:

- number and types of ships and other craft using the port;
- projected accident scenarios;
- navigational distances and difficulty through the port and jetty approach;
- the maximum draft of the ships;
- tidal conditions (tidal ranges and tidal currents);
- the nature of the sea-bed;
- meteorological conditions (wind, waves, sea-ice and visibility); and
- proximity of the terminal to populated areas and industrial sites.

Marine Security

Maritime security plans and established operational procedures will be in place that complies with new IMO security requirements, the Government of Canada's National Security Policy and the requirements of the *Marine Transportation Security Act* as it relates to ports and port facilities.

Under the approved security plan the Project's security program will include:

- surveillance equipment, including cameras and closed-circuit TV systems;
- improvements to dockside and perimeter security and access control, such as fencing, gates, signage, and lighting;
- command, control, and communications equipment, such as portable and vessel-to-shore radios; and
- infrastructure security protective measures, such as security guards and arrangements with local police departments.

Following the planned port facility security assessment/risk analysis, a security plan will be developed in agreement with the current IMOs Security Code requirement. As required under the *Marine Transportation Security Act* (Section 303 (c)), Keltic will designate in writing the name of the Marine Facility Security Officer to prepare the Port Facility Security Plan. This plan will outline the operational and physical security measures the port facility should take to meet the various required security levels. This plan will also include the appropriate control inspections and additional control measures for evaluating incoming vessel security information.

Introduction to Quantitative Risk Assessment (QRA)

In addition to the facilities being engineered and constructed in strict accordance with regulatory requirements, a QRA is a valuable tool for determining the risk of the use, handling, transport, and storage of dangerous substances. A QRA is used to demonstrate the risk caused by the activity and to provide regulators with relevant information to enable decisions on the acceptability of risk related to the Project.

Predictive modelling and analysis was conducted as part of the Project planning and conceptual design. This analysis provided necessary details associated with siting the facilities relative to surrounding land uses and the spacing of infrastructure within the facility. In addition to this preliminary analysis, a more detailed QRA is required as part of the review process associated with the Nova Scotia Utility and Public Review Board Permit to Construct process and as part of the federal TERMPOL process under the direction of TC. The QRA is being conducted for these parallel processes as part of the permitting process associated with the operations of the facilities. The QRA is currently in parallel with the conceptual design of the facility and will be reviewed with provincial and federal agencies.

QRA has evolved into a state-of-the-art process for evaluating the safety of facilities having the potential for major hazards. A QRA must first establish what the risk is (Risk Analysis), and then evaluate this risk by comparison to risk acceptability criteria. In risk management, the QRA forms a basis for decision-making principally related to:

- acceptability of a proposed new facility;
- land-use planning for the region surrounding a facility; and
- requirements for additional mitigation within a facility.

QRAs can consider risks to (i) the public near a facility, (ii) workers at a facility, and (iii) the operator of a facility – in terms of financial risk. These are the so-called risk receptors. The scope of a QRA must identify which risk receptors are to be considered. This is of particular importance for the proposed facility since it is located in a remote location. Risk assessments for public risk can consider risk to an individual and to society as a whole within the region near the proposed facility and near the transport routes. The Major Industrial Accident Council of Canada (MIACC) process, described below, although focusing on individual risk, considers both. This approach has been recommended to local regulatory agencies for this Project.

However, in other jurisdictions, principally Europe, a more rigorous quantification of societal risk via so-called F-N curves is required. The QRA will identify how risk is to be measured.

The Major Industrial Accident Council of Canada (MIACC) Process for Canada

The MIACC risk-based approach was initially developed for land use planning in the vicinity of hazardous installations. It is equally applicable to the siting of proposed new hazardous installations. Although it is based on an individual risk calculation that produces a risk-separation distance curve, the interpretation for land-use planning has elements of societal risk. A risk analysis combines these consequences with their likelihood, or frequency, of occurrence.

Quite simply: Risk = Frequency × Consequences.

In a risk analysis, a number of accident scenarios are identified (i.e. release of a gas under stable atmospheric conditions and low wind speed). The frequency and consequences are quantified separately and multiplied to determine the risk. This process is undertaken for all accident scenarios that are identified, and the risks summed to obtain the total risk. The total risk is typically shown as iso-risk lines around the hazard source, with risk decreasing with increasing separation distance.

Figure 10.1-1 shows a generic risk curve and MIACCs risk acceptability criteria. These guidelines for acceptable levels of risk are as follows:

- From the risk source to the 1 in 10,000 (10^{-4}) annual chance of fatality risk contour the risk to the public is deemed unacceptable and no other land uses except the source facility.
- In the area between the 1 in 10,000 to 1 in 100,000 (10^{-4} to 10^{-5}) annual chance of fatality risk contours, land uses involving continuous access and the presence of limited numbers of people that can be readily evacuated, can be allowed. For example: open spaces (golf courses, parks), warehouses, and manufacturing plants.
- In the area between the 1 in 100,000 to 1 in 1,000,000 (10^{-5} to 10^{-6}) annual chance of fatality risk contours, uses involving a slightly higher population density, but still having continuous access and easy evacuation, i.e. commercial uses, low-density residential areas, offices.
- Beyond the 1 in 1,000,000 (10_{-6}) annual chance of fatality risk contour the risk is deemed acceptable and there are no land use restrictions.

These criteria are similar to those used in other jurisdictions (i.e. Europe) for major hazard installations and in other industries (North American nuclear industry). MIACC never defined “low density residential” or “high density residential.” For the purposes of this risk assessment, these are assumed to be as follows:

- Low Density Residential: < 5 dwellings per hectare (rural region); and
- High Density Residential: > 5 dwellings per hectare (small town; urban region).

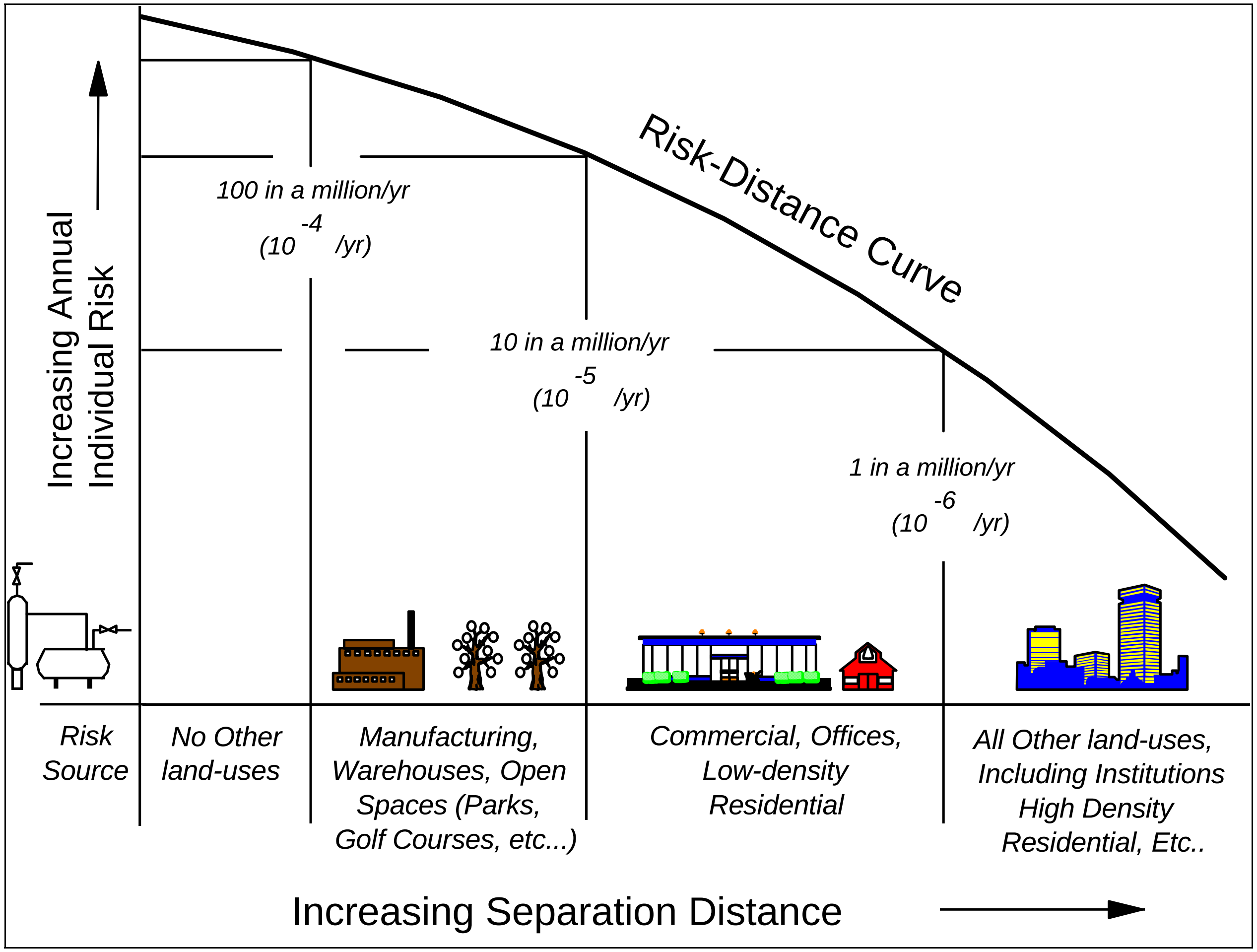

Figure 10.1-1
KELTIC PETROCHEMICALS INC.
Major Accidents in Europe and North America
Major Industrial Accident Council of Canada Land-Use Risk Acceptability Criteria
JUNE 2007

In addition to the approaches and methodologies provided by the Major Industrial Accident Council of Canada Process for Canada (MIACC), the Council for Reducing Major Industrial Accidents/Conseil pour la reduction des accidents industriels majeurs ("CRAIM"), the internationally accepted Dutch Purple Book (CPR 18; Guidelines for Quantitative Risk Assessments) will be utilized accordingly in the identification and modeling of potential accident scenarios.

Liquefied Natural Gas ("LNG") is listed in Schedule 1 of the Environmental Emergency Regulations under the CEPA. The Environmental Emergency Regulations set out specific requirements for the preparation of environmental emergency plans and reporting of accidental releases of listed substances. The CRAIM document and the CSA Emergency Planning for Industry (third edition of CAN/CSA–Z731-03) are both identified as pertinent references in the Implementation Guidelines for Part 8 of the Canadian Environmental Protection Act, 1999 – Environmental Emergency Plans. The CRAIM document also provides recognized guidance in conducting consequence analyses and in considering worst-probable-case-scenarios and alternative-case-scenarios that are required in the Environmental Emergency Plans.

Emergency Planning and Preparedness

In the unlikely event of a spill occurring at the terminal or from a vessel, emergency response plans will be in place to ensure that the size of the spill and potential for effects of the spill are minimized. Details are provided in the following section.

At the LNG Facilities

Prevention and mitigation of hydrocarbon (LNG) and hazardous material spills at the LNG facilities will be accomplished by the following means:

- inherent safe design;
- the use of competent staff;
- operational procedures and training;
- security plans and procedures; and
- effective emergency planning and preparedness (addressed in the following section).

Facility Design

On-site safety measures include leak alarms, emergency shutdown systems, and spill containment. The LNG tanks are of the "full containment" type and designed to fully contain any spills or leaks occurring at the inner tank. The LNG Storage Tanks will be designed to take into consideration mitigative measures related to accidents and malfunctions. In the unlikely event that a failure occurs in the 9% nickel steel inner tank, the outer concrete tank will be capable of containing the full tank contents. Facility design will include adequate ventilation systems to prevent the build up of natural gas in confined spaces. Additionally, gas and temperature monitors will allow early detection of LNG releases, reducing the likelihood of natural gas accumulation in the facility.

Staff Training

All employees and contractors will be trained in operational procedures and environmental emergency response procedures to ensure safe operation of tanker unloading and facility operation. Operating procedures, including confined space entry protocols, and operator training will be implemented to ensure that works are able to identify and take appropriate safe actions in response to LNG releases in confined areas.

Facility Operation

Further hazard analysis of the design will provide for additional level of assurance that the potential for spills or unintentional releases of natural gas is minimized. Operational procedures will be prepared to ensure the transport, handling and process systems are operated within the design parameters. Chemical storage and handling will be done in accordance with the manufacturers' recommendations and federal and provincial regulations, where applicable. Accidental spills will be prevented and mitigated through the implementation of the EPP, the EMP, the Worker Health and Safety Plan, and the Terminal Operations Manual. Procedures and restrictions, including for example, restrictions on smoking and burning, will minimize the possibility and magnitude of adverse effects of a natural gas-related accident, malfunction, or upset condition. Prevention and mitigation of all hydrocarbon spills will be accomplished through adherence to the EPP and Spill Contingency Plan.

Emergency Planning and Preparedness

Contingency planning, personnel training, procedures, restrictions on smoking and burning, emergency response planning and other initiatives will minimize the possibility and magnitude of adverse effects of a natural gas-related accident, malfunction, or upset condition. In the unlikely event of a spill occurring at any of the LNG facilities, emergency response plans will be in place to ensure that the size of the spill and potential for effects of the spill are minimized. Emergency medical facilities will be provided at the central administration complex with first aid stations at each of the main facilities and within the process areas and marine facilities as required. Details are provided in the following section.

10.1.1.5 Contingency and Emergency Response Procedures

Emergency response and contingency planning will take precedence in the development of facility process control measures. Emergency planning will consider dealing with the largest incident that can reasonably be foreseen, but detailed plans will concentrate on events that are most probable as identified through the QRA program.

These activities will be developed with close consultation with port users, ship's agencies, municipal authorities, police, fire, and medical service providers. As a means to minimize, contain, and control potential releases of environmental contaminants, a site specific Emergency Response and Contingency Plan will be developed based on the CAN/CSA Z731-03 standard. The plan will be communicated to all relevant parties that may be involved in responding to each specific emergency to ensure they all understand their appropriate response. All personnel will be appropriately trained in the applications of first response measures and emergency communication requirements.

The plan will include a description of biological and human-use resources that could be impacted in the case of an accident. It will also include an inventory of oil and chemical products and associated storage locations for both Project construction and operational phases. In the event of a spill, or other type of emergency, the incident reporting system outlined in the plan, including notification and alerting procedures, will be adhered to.

Included in the plan will be a list of response organizations and clarification of the roles of each organization. Critical procedures for mobilizing emergency services, triggering mutual aid arrangements, personnel evacuation, casualty handling, and external announcements will be set out in the plan. The plan will also specify the critical actions to be taken to minimize the impact of an accident (marine or land based) in its immediate aftermath, to secure the affected area, and to protect the individuals involved and the surrounding area of the accident. The severity of an emergency may range from an incident, which can be dealt with by local personnel, to one for which effective response and containment requires assistance from the community's emergency services. The plan will identify which is the responsible party in order that immediate decision making processes can be effective and appropriate to the emergency being managed. The plan will also give clear directions for the mobilization of emergency services support, with clear guidance as to how, when, and what to communicate.

A traffic management plan will be established under the umbrella of the EPC Contractor's Health & Safety and Security Program. This program will be developed to ensure personnel and asset safeguard against deliberate or unintentional anomalies.

To minimize, contain, and control any potential releases of hazardous materials, a site-specific Spill Management Plan will be developed. This plan will outline procedures for responding to spills and releases, including a list of spill response equipment that will be stored on-site at all times in the case of emergency events. All staff will be appropriately trained in the handling, storage, and disposal of hazardous materials (i.e. WHMIS, Transportation of Dangerous Goods (TDG)).

In addition, the ESD procedures, fire fighting equipment, leak/fire detection systems and other preventive and repressive measures, which could prevent any loss of containment, will be evaluated during the design of the terminal and safety studies. All preventive and repressive measures will be designed according to the appropriate codes and standards.

During the engineering and construction phases of the LNG facility, failure scenarios will be defined for each component. Technical and organizational measures will be identified to minimize the effects in case of failure. Examples of some of the preventative and repressive measures that will likely be employed at the facility are listed below:

- Malfunctions during LNG unloading:
    - In the event of slipping off of the unloading arms, the carrier's unloading pumps will immediately be shut down automatically.
    - In the event of slipping off of the vapour return line, the carrier's unloading pumps will immediately be shut down automatically.

- Malfunctions of LNG storage:
    - In the event the pressure is too high in the LNG storage tanks, initially vapours will be directed to the flare. In the event the pressure further increases, vapour will be released via a pressure relief valve.
    - In the event of failure of the boil off gas compressors, boil off gas will be flared.
- Malfunctions of the booster pumps and SCVs:
    - In the event of failure of the booster pumps or SCVs, available spare capacity will be put in operation. If this is insufficient, the in tank pumps will be turned down, resulting in a decrease of the send-out capacity. Increased emissions are avoided.
- Malfunctions of nitrogen production:
    - In the event of failure of the air compressors, the ASU will operate at part load or will be completely shut down. This will not result in increased emissions.
    - In the event of failure of other compressors, expansion cooling can only take place partly or not at all. As a result, the ASU will operate at part load, or will be completely shut down. This will not result in increased emissions.
- Pipe Fracture
    - Pipe fracture may occur throughout the LNG facility. Periodical pipe inspections will be undertaken to identify and register possible pipe fractures.
    - Leak detection systems will be installed at strategic locations.
    - In the event of a pipe fracture, the fracture location will be isolated according to the ESD procedure.

10.1.1.6 Conclusion

Environmental effects from hydrocarbon and hazardous materials spills are not likely to be significant considering the measures to be taken in the design, construction, and operation of the facility described above.

10.1.2 Accidental Forest Fires

Project-related forest fires could be caused by a liquid hydrocarbon spill fire, or any other Project-related accident involving fire.

10.1.2.1 Potential Environmental Concerns

Accidental forest fires could result in potential adverse environmental effects on numerous VECs (see Interaction Matrix Table 10.0-1). These interactions are briefly discussed below.

<u>Effects on Freshwater Quality/Quantity</u>

Forest fire can degrade water quality in watercourses, resulting in effects to fish and fish habitat, including fish mortality. The extent of fire damage, type of fire, and time of year will affect the severity and duration of environmental effects from fire. The physical environmental effects are reversible, but it would take a number of years for the environment to recover. Fire damage could result in increased erosion in the watershed, leading to increased sediment loads in watercourses for a number of years, which would affect fish and fish habitat. Changes in freshwater flow could also result in changes to groundwater patterns and groundwater contribution to baseflow, as a result of changes to evaporation and infiltration rates. Re-establishment of riparian and other vegetative communities in the watershed over time would reverse the impacts.

A fire break of cleared land will be developed and maintained between the facility and surrounding forest to minimize the potential for forest fires caused by on-site accidents. This, together with all other design and operational safeguards and contingency planning measures designed to minimize the forest fire risks, is expected to make Project-related forest fires an extremely unlikely event. The environmental effects have been determined not significant.

Effects on Soil/Sediment Quality

As mentioned above, forest fires could result in increased erosion in the watershed, leading to increased sediment loads in watercourses for a number of years, which would affect fish and fish habitat.

Rehabilitation of the disturbed area may include:

- replacement of subsoil and topsoil with soil recovered at the site or with suitable fill from another area; and
- addition of soil amendments as required to optimize and restore soil nutrient levels, organic matter and soil acidity, and to optimize physical properties of the topsoil; and re-grading and reseeding the disturbed area to minimize soil erosion.

Overall the effects of forest fires on soils and sediment quality are considered temporary and reversible and have been determined not significant.

Effects on Air Quality

Fires have the potential to result in temporary effects on air quality, from odours and PM. The effect of thermal radiation on human health and safety is addressed separately, below. While the likelihood of a fire is extremely low, given facility design and operational requirements and the safety record of the LNG industry, the potential effects to air quality from a fire are predicted to be significant in the short-term, but reversible.

Effects on Vegetation

Forest fires can have long lasting effects on the vegetation. Depending on the severity of the fire, it can destroy the entire forest community and convert the area for years to come into open herbaceous shrub vegetation. This would affect the wildlife and bird populations in the area. The potential destruction of riparian woodland vegetation along watercourses may affect fish and fish habitat. The extent of fire damage, type of fire, and time of year will affect the severity and duration of environmental effects from fire. Fire damage could also result in increased erosion in the watershed, leading to increased sediment loads in watercourses for a number of years, which would also affect fish and fish habitat. Re-establishment of riparian and other vegetative communities in the watershed over time would reverse the impacts. Mitigation measures to prevent, contain, and reverse the effects of forest fires are available and effective. Overall, the effects of Project-related forest fires on vegetation are considered not significant.

Effects on Species at Risk

Forest fires have the potential to affect one species at risk, horsetail (*Equisetum variegatum*), which was identified on the site near the junction of Sable Road and Highway 316, over 300 m from the facility. Given the distance from the facility, and the observation that horsetail is also widely distributed around Gold Brook Lake, the risk for an irreversible effect on this rare plant from a forest fire is considered low. The effect is considered not significant.

Effects on Fish and Fish Habitat

Forest fire can destroy riparian vegetation along watercourses, resulting in effects to fish and fish habitat, including fish mortality. The extent of fire damage, type of fire, and time of year will affect the severity and duration of environmental effects from fire. The physical environmental effects are reversible, but would take a number of years for the environment to recover. Fire damage could also result in increased erosion in the watershed, leading to increased sediment loads in watercourses for a number of years, which would also affect fish and fish habitat. Changes in freshwater flow could also result in changes to groundwater patterns and groundwater contribution to baseflow, as a result of changes to evaporation and infiltration rates. This could also result in an effect on fish and fish habitat.

Emergency response measures developed for the Project also serve to minimize the extent of accidental fires. Mitigation measures to minimize erosion and to re-establish riparian and other vegetative communities are available and effective. Consequently, the effect of Project-related forest fires on vegetation is considered not significant.

Effects on Wildlife and Habitat

Forest fires could result in direct wildlife mortalities and indirect effects by changing wildlife habitat. The likelihood of forest fires during construction and operation is low considering the design features and safe operating procedures. Emergency response measures also serve to minimize the extent of accidental fires. Consequently, the potential adverse effects associated with forest fires at the facility are considered not significant.

Effects on Migratory Birds and Habitat

Forest fires could result in direct bird mortality and could have indirect impact through a change in available breeding, nesting and foraging habitat. However, as mentioned above under effects on vegetation, mitigation measures to prevent, contain, and reverse the effects of forest fires are available and effective. Consequently, the effects of Project-related forest fires on migratory birds and habitat are considered not significant

Effects on Current Use of Lands and Resources for Traditional Purposes by Aboriginal Persons

An accidental fire has the potential to affect use of lands and resources in and around the facility by Aboriginal persons. For a description of the type of impacts, refer to the effects discussions for wildlife and fish. Some of the areas traditionally used by Aboriginals for hunting and fishing occur within the LNG site but these areas will not be available once construction commences. For the most part, the land areas with potential to be affected by a forest fire are of limited significance. Given the proposed mitigation and the risk for impact (as addressed under wildlife and fisheries), the environmental effect of a fire on the use of lands and resources by Aboriginal persons is considered not significant.

Effects on Archaeological, Paleontological or Architectural Resources

Forest fires have the potential to directly damage heritage resources or indirectly damage inground archaeological, paleontological, or architectural resources as a result of increased erosion from the removal of vegetation and application of water during fire fighting. The potential for a forest fire resulting from an accident at the LNG facility is considered low, due to facility safety mechanisms and features. Following a fire, any areas with known or potential archaeological, paleontological, or architectural resources will be stabilized to prevent erosion. The overall effect on unidentified archaeological, paleontological, or architectural resources therefore, has been determined not significant.

Effects on Human Health and Safety

The immediate concern for a forest fire would be for human health and safety. Local air quality conditions associated with the fire and the flames have the potential to kill humans and wildlife in the area. The major emissions would be smoke (PM) and CO_2 but would also include CO, NO_x, SO_2, VOCs, and PAHs (polycyclic aromatic hydrocarbons). A large fire could create PM levels greater than the ambient air quality standard over distances greater than 10 km but such situations would be of short duration.

While the likelihood of a fire is extremely low, given facility design and operational requirements, as well as the safety record of the LNG industry, the potential effects to human health and safety from a fire are considered significant, although not likely to occur.

10.1.2.2 Design and Operational Safeguards

The potential for fire during construction and operation will be mitigated through controlling or prohibiting burning, equipment maintenance (i.e., power saw mufflers and vehicle exhaust systems), vegetation management (i.e., vegetation clearing along the pipeline), and facility design and operational protocols intended to reduce the potential for releases of hazardous materials (Sections 10.1.1.4 and 10.1.1.5). The probability of facility operation causing a forest fire is low. A fire break of cleared land will be developed and maintained between the facility and surrounding forest.

10.1.2.3 Contingency and Emergency Response Procedures

Fire fighting capability includes fire detection and emergency response plans. The central administration complex will have a fully equipped fire station. The operation of the fire station will be coordinated with the local community volunteer fire departments. Local fire fighting response will be available at each of the main process areas. For unanticipated large fires and/or fires in isolated areas, assistance will be requested from appropriate government departments.

10.1.2.4 Conclusion

Environmental effects from forest fires are not likely to be significant considering the measures described in the preceding sections to be taken in the design, construction, and operation of the facility.

10.1.3 Discharge of Sediment to Marine Environment

This malfunction and accident scenario involves the failure of erosion and sediment control structures due to precipitation events and the subsequent discharge of sediments to the marine environment.

10.1.3.1 Potential Environmental Concerns

Failure of erosion and sediment control structures could result in the release of a large quantity of sediment-laden runoff to marine waters with potential adverse environmental effects (see Interaction Matrix Table 10.0-1):

- marine water quality;
- fish and fish habitat;
- marine mammals;
- fisheries; and
- aquaculture.

The interactions between the malfunction/accident scenario and these VECs are briefly discussed below.

<u>Effects on Marine Water Quality/Quantity</u>

The potential effects on marine water quality as a result of discharge of sediment to the marine environment have been described in Section 5.1.4. Environmental effects were considered not significant based on the availability of effective mitigation and monitoring measures.

<u>Effects on Fish and Fish Habitat</u>

The potential effects on fish and fish habitat as a result of discharge of sediment have been described in Section 5.1.10 Environmental effects were considered not significant based on the availability of effective mitigation and monitoring measures.

Effects on Marine Mammals

The potential effects on marine mammals would be similar in nature to the effects described for fish and fish habitat above, i.e. not significant.

Effects on Fisheries

The potential effects on fisheries as a result of discharge of sediment have been described in Section 5.1.23 and have been determined not significant.

Effects on Aquaculture

The potential effects on aquaculture as a result of discharge of sediment have been described in Section 5.1.24 and have been determined not significant.

10.1.3.2 Design and Operational Safeguards

The design of the LNG Terminal will include measures to control and treat storm-water run-off to minimize the discharge of sediments during the construction and operation of the facility as described in previously. Erosion and sediment control measures will be implemented and maintained according to the EPP and will be monitored by an environmental inspector, particularly after a heavy precipitation event or snow melt.

10.1.3.3 Contingency and Emergency Response Procedures

Contingency measures to respond to a malfunction of erosion and sediment controls will be provided as part of the Project's Contingency Response Plan (Sections 10.2.1.3 and 10.2.3.3).

10.1.3.4 Conclusion

Environmental effects from discharges of sediment to the marine environment are expected to be small scale, short term, and reversible. Effects will be minimized by the implementation of mitigation measures as described previously and through Contingency Response Planning. Overall, the effects have been determined not significant

10.1.4 Discharges from Ships

Accidental discharges from ships, including bilge water, have the potential for environmental impacts. Bilge water is the water that is collected inside the bottom of a ship's hull (the bilge). Bilge water can be found aboard every vessel, but its composition is unique because the bilge wells receive fluids from many parts of the ship, such as leaks from the engine components and in the cooling system or washdown operations. Bilge water can contain water, oil, dispersants, detergents, solvents, chemicals, and particles. It may also contain exotic, invasive species, depending on previous ports of call. If this water is released at the terminal or to the marine environment, it can impact water quality.

10.1.4.1 Potential Environmental Concerns

Discharges from ships are considered to potentially affect the following VECs (see Interaction Matrix Table10.0-1):

- marine water quality;
- vegetation (marine);
- species at risk (marine);
- fish and fish habitat;
- marine mammals;
- migratory birds and habitat;
- human health and safety;
- fisheries; and
- aquaculture.

The potential effects as a result of discharge of hazardous materials and hydrocarbons have been addressed in Section 10.1 and have been determined not significant for all of the above VECs. The effects of invasive species are addressed here. While ballast water from large vessels is considered a significant source of introductions of harmful invasive aquatic species, bilge water (especially as larvae, eggs or cysts in the case of algae) is also a source of alien species. Invasive species introduced in this manner can include a diversity of living, non-native aquatic organisms. For the LNG Terminal, ballast water will be taken on in Stormont Bay following off-loading. Discharge of ballast on incoming vessels is not anticipated and if required will be done outside the limits of Stormont Bay in accordance with TC protocols.

Not all introduced organisms will survive in their new surroundings, but some are extremely hardy, have no natural predators in their new environment, and can multiply profusely. The infamous European zebra mussel's introduction into the North American Great Lakes, and its subsequent spread to rivers, has jeopardized commercial and recreational fisheries, and caused expensive infrastructure problems. The introduction of invasive or exotic species can result in habitat modification, which then can potentially affect numerous species associated with particular habitats. Other impacts include competition, predation, disease, and hybridization.

Five species of seaweeds and approximately 12 species of invertebrates have invaded the marine vegetation of Atlantic Canada’s rocky shorelines, salt marshes and seagrass meadows since the early 19^{th} century (NRCan, 2007). Many originated primarily from Europe. Invasive species that arrived in the 20^{th} century originated from the Indo-Pacific region. Some of the invasive or exotic species have had major, sometimes devastating, effects on native communities and on the harvest of commercial species. Large tracts of the sublittoral zone of the lower Gulf of St. Lawrence are now occupied by the European seaweeds *Fucus serratus* and *Furcellaria lumbricalis*. *Furcellaria lumbricalis* have become so abundant that they are now harvested in Canada. The Common periwinkle from Europe (*Littorina littorea*) invaded both soft sediment and rocky shores of Atlantic Canada and now plays a major role in structuring both salt marsh and rocky intertidal communities in eastern North America. A more recent invader, which has become abundant, is green crab, (*Carcinus maenas*). High green crab densities in other parts of the world have had major effects on marine communities. In the last decade of the 20^{th} century, a European bryozoan, *Membranipora membranacea*, reached Nova Scotia and caused mass die-offs of native kelps. This process facilitated establishment and spread of the alien green seaweed *Codium fragile sp. tomentosoides*.

Marine Water Quality

The discharges from ships can affect the quality of the marine water in the vicinity of the vessel. The primary concern is with respect to the release of hazardous materials and hydrocarbons. As mentioned above, this has been addressed in Section 10.1 and has been determined not significant. The introduction of alien species does not affect the water quality but is of concern for marine organisms and is addressed below.

Effects on Vegetation (Marine), Species at Risk (Marine), Fish and Fish Habitat, Marine Mammals, Migratory Birds and Habitat

Effects on marine vegetation, fish, vertebrate and benthic species from introduced invasive species, can alter the entire ecosystem, indirectly affecting fish including species at risk, marine mammals, and migratory water birds that rely on those environmental components as a food source, or habitat.

The likelihood of any such effects to occur because of the LNG tankers is considered low. The LNG tankers will carry minimal ballast arriving in Stormont Bay and will take on ballast following unloading; therefore no discharge of ballast water in Stormont Bay is anticipated. Bilge water discharges will be avoided based on specific environmental management and operational procedures for vessels docking at the LNG Terminal. Accidental releases are considered limited to small volumes and rare occurrences.

Human Health and Safety

The concerns with respect to effects of ship discharges on Human Health and Safety relate primarily to the potential impacts on water quality as a result of accidental releases of hazardous materials and hydrocarbons to the marine environment. These have been addressed in Section 10.1 and have been determined not significant.

Effects on Fisheries and Aquaculture

Effects of invasive organisms on commercially harvested fish and habitat, as discussed above, have the potential to affect fisheries.

Some invasive organisms can become toxic, posing threats to other species and aquaculture stocks. On Prince Edward Island, clubbed tunicates have caused substantial problems at commercial shellfish sites. Since 1998, the dense masses of tunicates have proliferated, growing on lines and other aquaculture gear, smothering and killing the molluscs. More than one million pounds of tunicates are removed from the island each year, yet they continue to come back. Similarly, the multinucleate sphere X (MSX) virus has impacted commercial and Aboriginal oyster fisheries in the Bras D'Or Lakes.

The likelihood of any such effects to occur because of the LNG tankers is considered low. The LNG tankers will not carry and therefore will not discharge any ballast water. Bilge water discharges will be avoided based on specific environmental management and operational procedures for vessels docking at the LNG Terminal (Section 10.1.4.2 and 10.1.4.3). Accidental releases are considered limited to small volumes and rare occurrences. The effects are expected to be not significant.

10.1.4.2 Design and Operational Safeguards

To prevent the accidental discharge of oil or oily water, crews will be required to seal the engine room bilge overside discharge valve(s). Bilge water will be routinely monitored for oil and treated in the ships oil/water separator prior to discharge if found to be contaminated. Regular visual monitoring will be conducted around all vessels while in port to identify accidental discharges. Keltic will adhere to the *Canada Shipping Act* and regulations.

10.1.4.3 Contingency and Emergency Response Procedures

All accidental overside discharges are to be reported immediately to the Terminal operator. If the discharges contain oil or other deleterious substances, the vessel must immediately notify the Terminal operator and the vessel must immediately activate its Oil Pollution Emergency Plan. This plan is a requirement of the *Canada Shipping Act*. The Oil Pollution Emergency Plan must identify the person authorized to implement the plan and also confirm the vessel has an arrangement with a Canadian Coast Guard certified response organization. In the event of a spill, the vessel must immediately notify the Terminal operator which in turn notifies the Canadian Coast Guard.

10.1.4.4 Conclusion

Environmental effects from accidental discharges of hazardous materials and hydrocarbons through accidental release of ship bilge water to the marine environment are expected to be short term and reversible. Effects from the introduction of invasive species through bilge water discharges are more difficult to predict and potentially have significant long-term impacts. The likelihood of such effects to occur because of the LNG tankers is considered low. The LNG tankers will not carry and therefore will not discharge any ballast water. Bilge water discharges will be avoided based on specific environmental management and operational procedures for vessels docking at the LNG Terminal (Section 10.1.4.2 and 10.1.4.3). Accidental releases are considered limited to small volumes and rare occurrences. The effects, although difficult to predict, are expected to be not significant.

10.1.5 Grounding of Ships

The grounding of ships may result from a ship crossing an area of insufficient water depth (i.e., less than 15 m) due to a navigational error, malfunctioning of navigation equipment, or drifting into shallow water following engine malfunction. As there is sufficient depth available for LNG tankers in the vicinity of the facility and the concern with grounding is more closely related to areas on the approach to Stormont Bay, the assessment of the environmental effects of grounding addressed in Section 10.3 are also applicable to the LNG facility.

10.1.6 Risk of Accidents and Malfunctions during Decommissioning

Accidents and malfunctions during decommissioning are considered all included in the malfunction and accident scenarios assessed in the preceding sections. No other scenarios specific to the decommissioning phase have been identified. The environmental effects, mitigation measures, contingency and emergency response procedures described above equally apply to accidents and malfunctions that may occur during decommissioning.

10.2 MARGINAL WHARF

Accidents and malfunctions with potential to occur at the marginal wharf include the following:

- hydrocarbon and hazardous material spills;
- discharge of sediment to environment;
- discharges from ships;
- grounding of ships; and
- risk of accidents and malfunctions during decommissioning.

Forest fires are not a considered a possibility at the marginal wharf, as the area surrounding marginal wharf will be cleared and developed.

10.2.1 Hydrocarbon and Hazardous Material Spills

In support of the product output from the petrochemical facility, marine traffic for this facility will include the transshipment of feedstocks, product components, and byproducts. These shipments will increase traffic levels by an estimated 200 additional vessels entering the port per year. This means a yearly traffic flow into Stormont Bay of 300 to 400 LNG and product carriers. This number does not include the movement of harbour tug, offshore and inshore fisheries vessels or vessels of less than 100 m length.

The potential for spills of hydrocarbons and hazardous materials exists for all phases of the Project. During the construction and commissioning phases, the potential for spills is limited to materials used in site preparation, and fabrication and installation of the facilities and equipment. For example, gasoline, diesel fuel, propane, grease, motor oil, and hydraulic fluids are all needed for heavy equipment required for site preparation. Construction of the facilities will also require hazardous materials such as acetylene, oxygen and other compressed gases, form oil, paints, epoxies, concrete additives, glycol/methanol, cleaners, and solvents.

The probability of spills and the effects of spills, in the event that they occur, will be reduced by the implementation of hazardous materials management processes and procedures. The handling of fuel and other hazardous materials will comply with the *Transportation of Dangerous Goods Act*. All bulk storage of fuel products, concrete additives and other hazardous materials will be stored in aboveground, self-dyked tanks or drums with secondary containment. A complete inventory of all fuels and hazardous materials will be maintained and fuels and other hazardous materials will only be handled by persons who will be trained and qualified in handling these materials. The Project will also implement WHMIS to ensure proper handling and storage is achieved.

10.2.1.1 Potential Environmental Concerns

Potential environmental concerns associated with malfunctions and accidents related to the marine components of the LNG facility (Section 10.1) are also applicable to the marginal wharf with the exception of environmental effects related to LNG releases.

10.2.1.2 Design and Operational Safeguards

Design and operational safeguards associated with malfunctions and accidents related to the marine components of the LNG facility (Section 10.1.1.4) are also applicable to the marginal wharf.

10.2.1.3 Contingency and Emergency Response Procedures

Contingency and emergency response procedures associated with malfunctions and accidents related to the marine components of the LNG facility (Section 10.1.1.5) are also applicable to the marginal wharf.

10.2.1.4 Conclusion

Based on the foregoing, environmental effects from hydrocarbon and hazardous materials spills are not likely to be significant considering the measures described in the preceding sections to be taken in the design, construction, and operation of the facility.

10.2.2 Discharge of Sediment to Marine Environment

The potential exists for failure of erosion and sediment control structures due to precipitation events.

Potential environmental concerns, mitigative measures, and conclusions associated with discharges to the marine environment described for the LNG facility are also applicable to the marginal wharf with the exception of environmental effects related to LNG releases.

10.2.3 Discharges from Ships

As mentioned above, these shipments to and from the marginal wharf will increase traffic levels by an estimated 200 additional vessels entering the port per year. This means a yearly traffic flow into Stormont Bay of 300 to 400 LNG and product carriers. This number does not include the movement of harbour tug, offshore and inshore fisheries vessels or vessels of less than 100 m length.

The general environmental concern is identical with that discussed for the LNG Terminal and relates to the potential for environmental impacts from discharges to the marine environment of bilge water, which has the potential to release hydrocarbon contaminants and/or invasive/exotic species (see Section 10.1.4). The concern with respect to the potential introduction of release of invasive/exotic species is somewhat elevated at the marginal wharf. Most of the vessels docking at the marginal wharf will arrive with ballast water, which will be discharged in accordance with the *Ballast Water Control and Management Regulations* prior to arriving in Stormont Bay.

10.2.3.1 Potential Environmental Concerns

Potential environmental concerns associated with the introduction of alien invasive species and marine water quality, fish and fish habitat, marine mammals, migratory birds and habitat, fisheries and aquaculture as a result of accidental discharges from ships, presented in Section 10.1.4 (as related to the marine components of the LNG facility) are also applicable to the marginal wharf.

10.2.3.2 Design and Operational Safeguards

Design and operational safeguards associated with accidental discharges of hydrocarbon contaminants from ships related to the marine components of the LNG facility (Section 10.1.4.2) are also applicable to the marginal wharf.

The introduction of invasive species to the marine environment through release of ballast water at or near the marginal wharf is a potential scenario but is considered unlikely. Ballast exchanges are mandated by the IMO ballast water guidelines and the Canadian Ballast Water Control and Management Regulations under the *Canada Shipping Act*.

The Canadian Ballast Water Control and Management Regulations require the vessel operator to exchange ballast water at sea:

- In accordance with the regulations, vessel operators must carry a ballast water management plan on board. The plan must specify such aspects as:
    - ballast water management processes to be used and procedures to be followed;
    - procedures to be followed for co-ordinating ballast water management with Canadian authorities;
    - detailed description of the on-board ballast water system and the system's design specifications;
    - on-board responsible officer; and
    - ballast water reporting form and reporting requirements.
- The implementation of the ballast water management plan is the responsibility of the vessel operator.
- In accordance with the Canadian Ballast Water Control and Management Regulations, if exceptional circumstances (equipment failure, weather/ safety considerations) prevent a proper ballast water exchange, TC is to be notified as soon as possible by the vessel. The Minister of Transport determines, in consultation with the master of the ship, mitigation measures prior to the discharge / exchange of ballast water in Canadian waters. This will involve considerations of the nature of the ballast water, the likelihood of introduction of harmful aquatic organisms, safety and environmental conditions, and may result in decisions such as ballast water retention, discharge at sea in an alternate exchange zone, treatment prior to discharge etc.

Compliance with the regulations is monitored as part of TCs routine ship inspections. Keltic will monitor the proper implementation of ballast water exchange practices by requesting, that the vessel operator provides Keltic with a copy of the completed ballast water reporting form for each voyage to the marginal wharf.

10.2.3.3 Contingency and Emergency Response Procedures

Contingency and emergency response procedures associated with accidental discharges from ships related to the marine components of the LNG facility (Section 10.1.4.3) are also applicable to the marginal wharf.

10.2.3.4 Conclusion

Environmental effects from accidental discharges of hazardous materials and hydrocarbons through accidental release of ship bilge water to the marine environment are expected to be short term and reversible. Bilge water discharges will be avoided and effects of accidental releases minimized based on specific environmental management and operational procedures for vessels docking at the LNG Terminal (Sections 10.1.4.2 and 10.1.4.3).

The likelihood of effects from the introduction of invasive species through ballast water discharges is considered low. The ballast water exchange is regulated by the Canadian Ballast Water Control and Management Regulations under the *Canada Shipping Act*. These regulations ensure that ballast water is exchanged in the open sea in order to minimize the risk of introducing alien species.

Overall, the effects of accidental discharges from ships are considered not significant.

10.2.4 Grounding of Ships

The grounding of ships may result from a ship crossing an area of insufficient water depth (i.e., less than 15 m) due to a navigational error, malfunctioning of navigation equipment, or drifting into shallow water following engine malfunction. As there is sufficient depth available for cargo vessels in the vicinity of the facility and the concern with grounding is more closely related to areas on the approach to Stormont Bay, the assessment of the environmental effects of grounding addressed in Section 10.3.3 are also applicable to the marginal wharf.

10.2.5 Risk of Accidents and Malfunctions During Decommissioning

Accidents and malfunctions during decommissioning are considered all included in the malfunction and accident scenarios assessed in the preceding sections. No other scenarios specific to the decommissioning of the marginal wharf have been identified. The environmental effects, mitigation measures, contingency and emergency response procedures described above equally apply to accidents and malfunctions that may occur during decommissioning.

10.3 PROJECT RELATED SHIPPING WITHIN 25 KM OF COUNTRY ISLAND

Accidental events and malfunctions may occur in shipping within 25 km of Country Island including the potential for grounding on shoals; and collisions involving tankers, cargo vessels and other marine vessels. These specific scenarios assessed include:

- hydrocarbon and hazardous material spills;
- discharges from ships; and
- grounding of ships.

The interactions between these scenarios and potentially affected VECs (Interaction Matrix, Table 10.0-1) are briefly discussed below.

10.3.1 Hydrocarbon and Hazardous Material Spills

The potential for spills of hydrocarbons and hazardous materials identified for both the construction and operational phases of the LNG Terminal and the marginal wharf equally apply to the spills resulting from shipping accidents (grounding or collision). They may involve release of bilge water, LNG tank ruptures, or spills of Marine Diesel Oil (MDO) (MDO- Petroleum Distillate Fuel).

10.3.1.1 Potential Environmental Concerns

Potential environmental concerns for the marine environment associated with malfunctions and accidents related to the marine components of the LNG facility (see relevant subsections in Sections 10.1 and 10.2) are also applicable to Project related shipping, with the exception of potential effects to migratory birds, which are located in closer proximity to shipping lanes than to the terminal.

Effects on Species at Risk

Hazardous material spills may, depending on the toxicity of the substance, cause direct or indirect mortality of species at risk by contaminating water, soil, or food sources. Chemicals may be directly absorbed through dermal contact or ingested. The only species at risk known to occur in the area is the roseate tern, which nest on Country Island, approximately 5 km from the proposed shipping lane. Given this distance, the risk for effect on the terns from a hazardous material spill is considered low. Given the proposed mitigation (Sections 10.3.1.2 and 10.3.1.3) and the low probability for impact, the environmental effect of a hazardous material spill on species at risk is considered not significant.

10.3.1.2 Design and Operational Safeguards

Design and operational safeguards associated with malfunctions and accidents related to the marine components of the LNG facility (Section 10.2.1.2) are also applicable to shipping. Additionally, the following measures will be employed for shipping operations:

Project related shipping will comply with the outcomes of the TERMPOL review process which will detail anticipated Project shipping, shipping protocols and communications for the Project, pilotage requirements, and emergency response requirements.

Some examples of the operational safeguards include:

- the marginal wharf and LNG Terminal will be a compulsory pilotage area; and
- ships will not be allowed to approach, dock, or remain at the facility if sea conditions do not allow safe operation.

Navigation aids and piloting service will assist with shipping operations in foggy conditions.

In severe wave conditions environmental effects will be mitigated by:

- the LNG storage facility will be located and designed to appropriate wave run-up conditions;
- the LNG Terminal and marginal wharf will be designed to with stand storm/wave/wind events and LNG ships are designed to be seaworthy in all types of weather; and
- ships will not dock and, if docked, will depart if waves exceed design criteria.

Operational procedures will include a monitoring program for the rare possibility of icebergs.

10.3.1.3 Contingency and Emergency Response Procedures

Contingency and emergency response procedures associated with malfunctions and accidents related to the marine components of the LNG facility (Section 10.1.1.5) are also applicable to Project shipping.

10.3.1.4 Conclusion

Based on the foregoing, environmental effects from hydrocarbon and hazardous materials spills are not likely to be significant considering the measures described in the preceding sections to be taken in the design and operation of Project shipping.

10.3.2 Discharges from Ships

Accidental discharges from ships with the potential for environmental impacts include bilge water, which has the potential to release hydrocarbon contaminants and/or invasive/exotic species to the marine environment. Potential exists for environmental effects from the discharge of bilge water from vessels. Bilge water can contain water, oil, dispersants, detergents, solvents, chemicals, particles and exotic, invasive species, depending on previous ports of call. If this water is released to the marine environment, it can impact water quality.

10.3.2.1 Potential Environmental Concerns

Potential environmental concerns associated with marine water quality, fish and fish habitat, marine mammals, fisheries, and aquaculture as a result of accidental discharges from ships, presented in Sections 10.1.1.3, 10.1.2.1, 10.1.3.1, and 10.1.4.1 (as related to the marine components of the LNG facility) are also applicable to Project shipping.

10.3.2.2 Design and Operational Safeguards

Design and operational safeguards associated with accidental discharges of hydrocarbon contaminants from ships related to the marine components of the LNG facility (Section 10.1.4.2) are also applicable to the shipping within 25 km of Country Island.

The introduction of invasive species to the marine environment through release of ballast water at or near the island is a potential scenario but is considered unlikely. Ballast exchanges are mandated by the IMO ballast water guidelines and the Canadian Ballast Water Control and Management Regulations under the *Canada Shipping Act*.

The Canadian Ballast Water Control and Management Regulations require the vessel operator to exchange ballast water at sea. Specific stipulations have been described in 10.2.3.2 and equally apply for the shipping within 25 km of Country Island.

10.3.2.3 Contingency and Emergency Response Procedures

Contingency and emergency response procedures associated with accidental discharges from ships related to the marine components of the LNG facility are also applicable to Project shipping.

10.3.2.4 Conclusion

Environmental effects from accidental discharges of hazardous materials and hydrocarbons through accidental release of ship bilge water to the marine environment are expected to be short term and reversible. Bilge water discharges will be avoided and effects of accidental releases minimized based on specific environmental management and operational procedures for vessels docking at the LNG Terminal and marginal wharf (Sections 10.1.4.2 and 10.1.4.3).

The likelihood of effects from the introduction of invasive species through ballast water discharges is considered low. The ballast water exchange is regulated by the Canadian Ballast Water Control and Management Regulations under the *Canada Shipping Act*. These regulations ensure that ballast water is exchanged in the open sea in order to minimize the risk of introducing alien species.

Overall, the effects of accidental discharges from ships are considered not significant.

10.3.3 Grounding of Ships

The grounding of ships may result from a ship crossing an area of insufficient water depth (i.e., less than 15 m) due to a navigational error, malfunctioning of navigation equipment, or drifting into shallow water following engine malfunction. This possibility has been raised as a concern by both regulatory agencies and the public as there are a number of shoals to the south of Country Island and along the western side of the approach to Stormont Bay. Partly as a result of these characteristics, the Project will be under compulsory pilotage from a point outside Stormont Bay. This location will be decided by TC and the Atlantic Pilotage Authority, as recommended by the TERMPOL process.

10.3.3.1 Potential Environmental Concerns

Hazardous material spills resulting from grounding of ships may, depending on the toxicity of the substance, cause direct or indirect mortality of species at risk by contaminating water or food sources. Chemicals may be directly absorbed through dermal contact or ingested. The only species at risk known to occur in the area is the roseate tern, which nest on Country Island.

10.3.3.2 Design and Operational Safeguards

Design and operational safeguards associated with malfunctions and accidents presented for hydrocarbon and hazardous material spills in Section 10.1.1.4 are also applicable to grounding of ships.

10.3.3.3 Contingency and Emergency Response Procedures

Contingency and emergency response procedures associated with malfunctions and accidents presented for hydrocarbon and hazardous material spills in Section 10.1.1.5 are also applicable to grounding of ships.

10.3.3.4 Conclusion

Based on the foregoing, environmental effects from ship groundings are not likely to be significant considering the measures described in the preceding sections to be taken in the design and operation of Project shipping.