9.0 EFFECTS OF THE ENVIRONMENT ON THE PROJECT

9.1 INTRODUCTION

By the definition of "environmental effect" under CEAA, any change to the project that may be caused by the environment must be considered in the determination of environmental effects. As such, a federal EA is required to consider effects of the environment on the Project in addition to evaluating effects of the Project on the environment.

A significant effect of the environment on the Project would be one that results in:

- substantial delay in Project schedule during construction;
- long-term interruption in service, such as ship-to-shore product transfer at the LNG Terminal or marginal wharf;
- damage to plant and site infrastructure such that public health and safety or the environment is at risk; and
- damage to plant and site infrastructure that would not be technically or economically feasible to repair.

Minor effects of the environment on the Project would be ones that result in short-term delays in construction schedules, frequent short-term disruptions in service, and increased operating or maintenance costs.

The types of natural environmental issues or events that could have an effect on the Project during construction or operation of the plant-site components include the following:

- construction-site or shore-line erosion, seismic activity including tsunamis;
- precipitation, wind and waves;
- sea ice;
- climate change with associated sea level rise; and
- forest fires.

In anticipation of climate change including the effects of extreme weather conditions, the Project will require design parameters that reflect the increased severity and variability currently predicted. Expert advice, including that of EC, will be solicited during the FEED stage to develop appropriate design parameters.

In order to minimize these effects on the Project, mitigative measures will be employed during the design, construction, and operation of Project facilities based on appropriate environmental design criteria to ensure the safety and integrity of all facilities during severe environmental conditions, including high winds, extreme rainfall, and major marine storm surges. The EMP will incorporate these mitigative measures under its umbrella. Specific EPPs will be created addressing key mitigative measures needed during construction, operation and maintenance, and modifications and decommissioning.

Designs will incorporate an adequate factor of safety to deal with possible changes in weather severity during the lifetime of the Project, including storms and sea level rise associated with climate change. Monitoring and/or contingency planning will also serve to minimize potential adverse effects. These mitigative measures are noted in the appropriate section below.

With the implementation of mitigation measures, the environment is not expected to significantly affect the Project. The Project is not expected to experience effects to the extent that there is a long-term interruption in service, a substantial loss of Project schedule, damage to infrastructure which puts public health and safety or the environment at risk, or that there is damage to infrastructure that would not be technically or economically feasible to repair.

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

9.2.1 Erosion

Erosion of the construction site or shoreline may be caused by heavy rainfall events or significant wave action. The potential exists for failure of erosion and sediment control structures due to such precipitation events. Such a failure could result in the release of a large quantity of sediment-laden runoff to receiving watercourses with potential adverse environmental effects on fish and fish habitat. Under the EMP, the erosion and sediment control structures will be regularly monitored, particularly after a heavy precipitation event or snow melt, and remedial action will be taken as necessary.

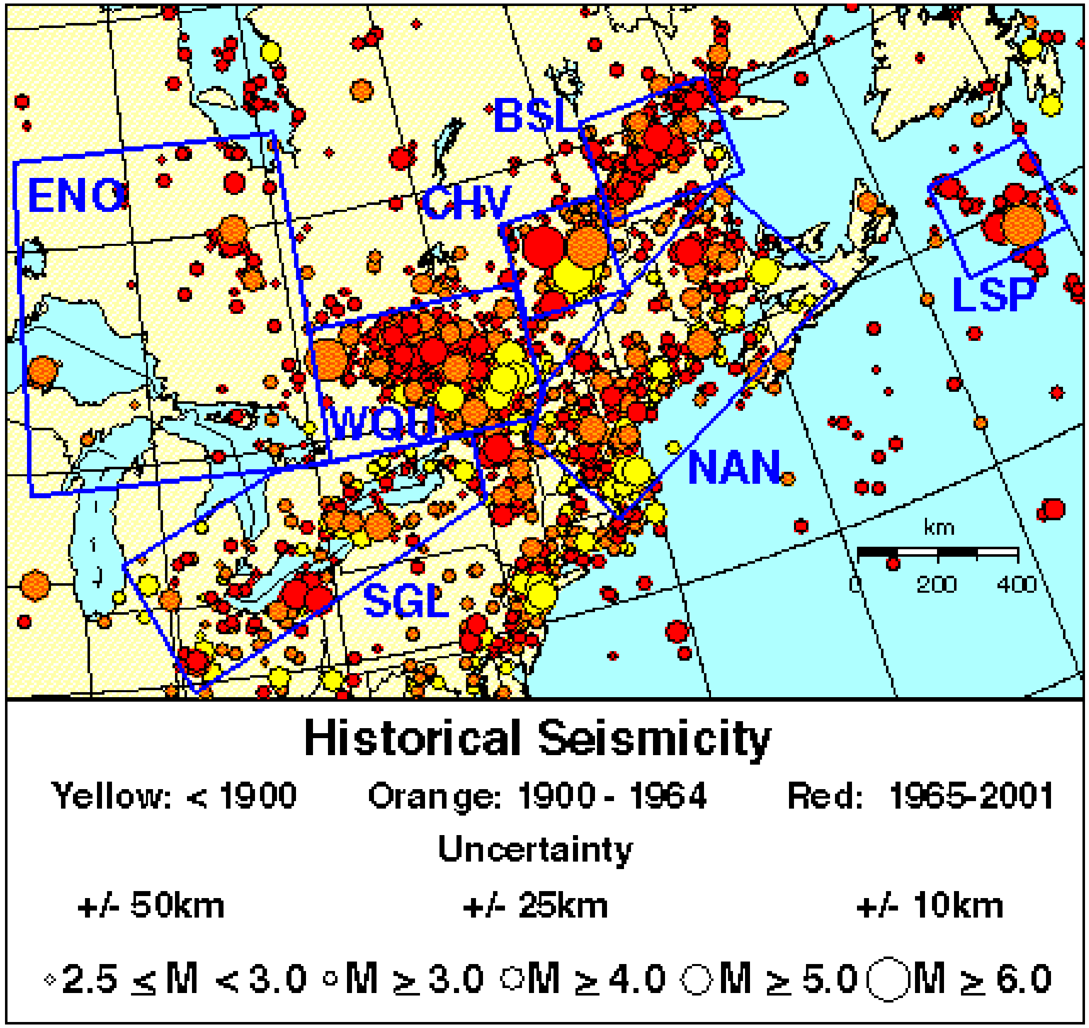
Erosion and shoreline breaches may also wash out soil beneath the pipeline trestle. This will be mitigated by supporting the pipeline on a series of independent foundations. The spacing and dimensions of the foundations will be such that, in the event of a washout along one pipeline segment, sufficient support is provided by the other foundations. In addition, operational plans will specify that no unloading activities will take place during severe weather conditions. Ongoing monitoring of the pipeline pressure will ensure that in case of a rupture, a shut down of the system is triggered.

Considering mitigative measures and the definition of significant effect on the Project as outlined in Section 9.1, the effect of erosion on this Project component is not considered to be significant.

9.2.2 Seismic Events

9.2.2.1 Background

Eastern Canada is located within a stable continental part of the North American Tectonic Plate, and as such has a relatively low rate of earthquake activity. Nevertheless, within Canada's eastern seismic region, large earthquakes have occurred in the past and will inevitably occur in the future. Figure 9.2-1 shows the size and frequency of events and boundaries of the subregions within which earthquakes occur most frequently in Canada's eastern seismic region.



Geological Survey of Canada

FIGURE 9.2-1
KELTIC PETROCHEMICALS INC.
SEISMIC SUB REGIONS
JUNE 2007

The causes of earthquakes in eastern Canada are not well understood: unlike at plate boundary regions where the rate and size of seismic activity is directly correlated with plate interaction, seismic activity seems to be related to the regional stress fields (Ruffman, 1994), with the earthquakes concentrated in regions of crustal weakness (Bent, 1995) at depths varying from surface to 30 km (Geological Survey of Canada, 2003).

Seismic activity under the ocean could cause a tsunami, which would generate an ocean surge ("tidal wave") that may damage coastal structures or cause flooding. There are historical accounts of tsunamis occurring in Atlantic Canada. Much background information is provided in Section 8.13.5.2 of the provincial EA Report (AMEC, 2006). The tsunami that is most relevant to the proposed Project site occurred on November 18, 1929, in which a magnitude 7.2 earthquake occurred along the southern edge of the Grand Banks (epicentre of 44.5°N, 56.3°W) that was felt as far away as New York and Montreal (Geological Survey of Canada, 2005). On land, damage due to earthquake vibrations was limited to Cape Breton Island, where chimneys were overthrown or cracked, and where some highways were blocked by minor landslides. The earthquake triggered a large submarine slump that generated a tsunami that was seen in Cape Breton Island, where it did minor damage; it was physically seen as far southwest as Lunenburg, Nova Scotia, and in Bermuda. It was recorded on tide gauges as far south as Charleston in the US, in the Azores, and across the Atlantic Ocean in Portugal (Ruffman, 2001).

9.2.2.2 Seismic Hazard

The 2005 edition of the NBCC contains significant changes in the provisions for seismic loading and design (Heidebrecht, 2003). The 2005 edition of the NBCC uses a probability of exceedance of 2% in 50 years, and calculates hazard in the form of uniform hazard spectra, which provides a much better period dependent representation of earthquake effects on structures. Keltic has committed to applying a 0.0002 p.a. probabilistic ground motion design criteria.

Table 9.2-1 presents the seismic hazard for various spectral acceleration time periods as given by Adams and Halchuk (2003) for site category C (very dense soil and soft rock, 360 < V30 ≤ 760 m per second (m/s)), and seismic hazard with appropriate ground motion amplification factors as defined by Liam Finn and Wightman (2003) applied for site categories B (rock, 760 < V30 ≤ 1,500 m/s) and A (hard rock, V30 > 1,500 m/s) for three localities along Nova Scotia's Eastern Shore, compared to three urban areas with low to high levels of seismic hazard, i.e. Toronto, Montreal, and Vancouver (Heidebrecht, 2003).

The seismic hazard at the proposed Project Site would fall somewhere between that for Halifax and Canso, and since all important structures will have foundations built directly onto bedrock, it could be defined as a class A to B site. Even when taking into account the nearby magnitude 7.2 Grand Banks event of 1929, Figure 9.2-1 shows the seismic hazard for the Project Site to be generally low; similar to or less than site class A to B criteria for Toronto for time periods of 0.2 and 0.5 seconds, and only slightly above that for Toronto and significantly less than for Montreal for 1.0 second period events.

TABLE 9.2-1 Seismic Hazard

Site Class	Locality	Spectral Acceleration (0.2)	Spectral Acceleration (0.5)	Spectral Acceleration (1.0)	Spectral Acceleration (2.0)	Peak Ground Acceleration
C	Halifax	0.23	0.13	0.069	0.019	0.12
	Canso	0.24	0.14	0.071	0.020	0.13
	Louisburg	0.22	0.12	0.066	0.018	0.12
	Toronto	0.26	0.13	0.055	0.015	0.17
	Montreal	0.69	0.34	0.140	0.048	0.43
	Vancouver	0.94	0.64	0.330	0.170	0.46
A	Halifax	0.16	0.08	0.035	--	--
	Canso	0.17	0.08	0.036	--	--
	Louisburg	0.15	0.07	0.033	--	--
	Toronto	0.18	0.08	0.028	--	--
	Montreal	0.55	0.22	0.070	--	--
	Vancouver	0.75	0.42	0.165	--	--
B	Halifax	0.18	0.09	0.041	--	--
	Canso	0.19	0.1	0.043	--	--
	Louisburg	0.18	0.08	0.040	--	--
	Toronto	0.21	0.09	0.033	--	--
	Montreal	0.62	0.26	0.084	--	--
	Vancouver	0.94	0.54	0.231	--	--

Note: Spectral Acceleration (g) with Time Periods 0.2, 0.5, 1.0 and 2.0 sec., and Peak Ground Acceleration (g) for Normalized Site Class C and for Site Classes A, B (after Adams and Halchuk, 2003 and Heidebrecht, 2003)

9.2.2.3 Tsunami Hazard

The frequency and severity of tsunamis at the site is uncertain.

Typically, tsunamis are triggered by deep-seated earthquakes. The frequency of tsunamis in Atlantic Canada is uncertain. Ruffman (Heritage Newfoundland, 2003) suggested that earthquakes of the magnitude that triggered the 1929 tsunami are 1 per 1000 years, but could be as low as 1 per 100 years for magnitude 6.0 earthquakes. A magnitude 6.0 earthquake off the east coast would likely not be strong enough to cause a tsunami by itself, but it could cause an underwater landslide that could cause a tsunami.

Campbell et al. (2003) note that large failures occurred during the late glacial period between 20 and 10 kiloannum (ka) and appear to have a recurrence interval on the order of 2000 years. They also suggest that at present the risk of a local large tsunami appears to be low based on the occurrence of only two large failure events during the last 7000 years.

Researchers have only begun to model submarine slump-generated tsunami (Bornhold et al., 2004; Finea et al., 2005) and their possible effect on Atlantic Canada coastlines. Regarding the tsunami that was triggered by the 1929 Grand Banks earthquake, models by Murty et al. (2005a, 2005b) have shown that quarter wave resonance amplification played a major role in amplifying the tsunami in some of the bays and gulfs on the south coast of Newfoundland. Their model suggested that tsunami energy could not propagate towards Nova Scotia, mainly because of extensive sand banks east of Nova Scotia. As FEED progresses, Keltic will review available research on tsunamis and identify additional information that can be incorporated in the design of the facilities and emergency response plans.

At sea, tsunamis travel as a shallow water wave with a small height (generally less than 1 m) and usually go unnoticed. On reaching shallow water, speed diminishes but the energy in the wave remains constant, and so wave height must increase.

The foundations for the LNG tanks have been sited +15 m above sea level which gives a large margin of confidence against any tsunami wave. Historical data dating back to 1774 shows tsunamis affecting Canada's Atlantic coast have been limited to no more than three occurrences which only impacted Newfoundland's coast with a maximum 15 m water height (National Geophysical Data Centre). The sheltered on-shore facilities of the Project complex are not expected to be vulnerable to a major LNG release caused by a tsunami.

Presently, there are tsunami warning systems in the Pacific Ocean and in the Gulf Coast. To date, none are located in the Atlantic Ocean; however, one is planned near Canadian shores that will reportedly involve all Atlantic Provinces (Murty et al, 2005a). With the USA government's commitment to enhance the tsunami early warning and detection system by 2007, it is expected that sufficient advance warning will be communicated to marine vessels servicing the Keltic complex to provide them adequate disengagement time to return to the safety of the open sea before a tsunami makes landfall.

9.2.2.4 Mitigation Measures and Residual Effects

In order to minimize these effects on the Project, mitigative measures will be employed during the design and construction of Project facilities. Primarily these mitigative measures are:

- Tanks and other structures on site will be designed for the seismic rating in the region, as required under CSA Z276-01.
- All structures at the site will be built to meet or exceed relevant building codes, including the new design criteria as set out in the 2005 edition of the NBCC.
- Appropriate contingency planning will also address the possibility of structural failure which may result from ground vibration caused by a severe seismic event.
- Foundations for the LNG tanks have been sited +15 m above sea level, which is the maximum historical height for tsunamis in the region.
- During the FEED stage, the best available information will be used to estimate possible wave size and run-up in Stormont Bay and at the proposed Project Site. The results of this modeling will be used, as appropriate, in the design of the wharf and plant facilities and in developing emergency response procedures.
- A tsunami warning system is planned for the Atlantic Ocean near Canadian shores, which will provide adequate warning to Project related shipping of approaching tsunamis. Contingency plans developed for the site will include actions to be taken in the event of a tsunami warning.
- In the event of a tsunami/tsunami warning, ship-to-shore transfers would be postponed and ships would be dispatched to harbour anchorage or the open sea.

Considering the mitigative measures and the definition of significant effect on the Project as outlined in Section 9.1, the effect of potential seismic events on this Project component is expected to be significant; however, the likelihood is considered to be extremely low.

9.2.3 Precipitation and Fog

The 1982 to 2002 mean annual total precipitation for the Keltic Study Area was 1438 mm. Although rain may occur in any month of the year, rainfall in the Keltic Study Area is generally the highest during fall. Snow and freezing precipitation can occur between October and May, with the largest amounts falling between December and March. Storm precipitation events in the Keltic Study Area can be severe – the 100, 200 and 500 year 24 hour-duration events estimated to be 152 mm, 162 mm and 175 mm, respectively.

Extreme rain can result in stoppages of outdoor work, particularly during construction phases of the plant site. If unusual wet periods or excessive rain do occur, this can result in Project delays and an associated delay in completion and could result in additional capital cost. Erosion and sedimentation are addressed in Section 9.2.1.

Extreme snowfall can affect winter construction or contribute to unusual flooding during snow-melt. It has the potential to increase structural loadings on facility and temporary buildings. Exceptional early snowfall could delay construction and result in additional work for snow clearing and removal. This could increase construction costs. Early snow cover can minimize or prevent ground freezing and this may also affect winter construction intended at improving work progress and accessibility.

Dense inland fog is more prevalent in late spring and early summer. Chilled air above southerly-flowing ocean currents mixing with warm, moisture-laden air moving from the Gulf Stream can generate bands of thick, cool fog off the coast. Dense fog originating inland may reduce visibility and can interfere with the operation of vehicles on the highway. With onshore winds, fog banks can move far inland. Fog can interfere with the docking of vessels at the LNG Terminal.

The EMP will include mitigative measures for minimizing these effects of high precipitation during Project construction and operation. Project components will be designed to withstand the forces of storms, with associated precipitation, storm surge, waves and associated sea spray, as well as snowfall loading on structures. The design parameters with respect to extreme weather, including precipitation, will be determined in consultation with specialists, including EC, during the FEED stage; also the terminal's operating manual will be accessible for all operators. Measures associated with erosion are addressed in Section 9.2.1. Modern navigation aids and piloting service will minimize the effects of fog on docking and berthing at the LNG Terminal.

Considering mitigative measures and the definition of significant effect on the Project as outlined in Section 9.1, the effect of precipitation on this Project component is not considered to be significant.

9.2.4 Wind

Winds blow predominantly from the south or southwest during summer and from the northwest during winter, although severe storms, including summer hurricanes and winter "nor'easters" may generate strong winds from the northeast. High winds can also increase structural loading on large or tall structures. High winds for the Project are defined as steady wind speeds of 65 km/h, or gusts of 90 km/h (EC, 2007) with extreme winds as one-hour wind speeds of 122 km/h or 3 second gust speeds over 196 km/h for a 100-year return period (Seaconsult Marine Research Ltd., 1985). Wind borne sea spray can lead to long-term corrosion on exposed oxidizing metal surfaces and structures.

High winds could have an effect on the transfer of product to/from ships. High winds and heavy seas at reduced temperatures can cause freezing spray conditions. Freezing spray can occur between November and April; however the potential for moderate or greater vessel icing from freezing spray is greatest in February. Safe work aboard a vessel can be impeded by freezing spray, as could some work tasks at the LNG Terminal.

Due consideration to wind will be given to components design. All facilities will be fully weather proofed and designed for a full range of climatic conditions including severe wind. The design parameters with respect to wind will be determined in consultation with specialists, including EC, during the FEED stage. Regular inspection for damage due to wind will occur during construction and operation of the facility.

Also in the event of an extreme weather event, ships will not be allowed to dock or remain at the facility if sea conditions do not allow safe operation.

LNG vessels have the potential to experience severe weather conditions. High winds, dense fog, rain, or snow could potentially affect the transfer operations at the LNG Marine Terminal. If sea conditions did not allow safe operation, LNG vessels would not be allowed to dock or remain but would be dispatched to harbour anchorage.

LNG vessels will enter Stormont Bay under pilotage. The LNG vessel will be directed and moored to the LNG Marine Terminal aided by tugs. Supply ships will enter Stormont Bay and will dock against the Marginal Wharf.

The marginal wharf and LNG Marine Terminal will be designed to withstand extreme storm/wave/wind events. The design parameters with respect to waves will be determined based on the Seaconsult Marine Research Limited report in consultation with specialists, including EC, during the FEED stage. There is anchorage available in Stormont Bay if conditions are not appropriate for docking. The captain or the pilot of the ship will make decisions with respect to safe navigation at sea and when transfer activities must be postponed due to rough seas. Port communication systems will be in place to ensure procedure coordination between the captain of the vessel and LNG Terminal and marginal wharf operators.

The KDP has initiated the TERMPOL process; which is intended to result in the operation of the facilities in a manner that will protect the public and ensure environmental safety and security. Through this process the potential risks associated with accidents will be identified and plans developed to mitigate these risks. A marine risk assessment is currently underway and is incorporating the wind, wave, and storm surge events from existing information available for Stormont Bay. As part of the assessment, Keltic will also seek the advice of EC and NRCan with respect to anticipated sea-level rise and the impact on storm surge heights. Therefore, no significant impacts on marine safety and security in the Study Area are expected.

If extreme weather is anticipated or occurs during a transfer the activities will be postponed, and ships will be dispatched to harbour anchorage.

Considering mitigative measures and the definition of significant effect on the Project as outlined in Section 9.1, the effect of wind on this Project component is not considered to be significant.

9.2.5 Waves

Extreme wind can produce high waves, dense blowing sea foam, heavy tumbling of the sea, and poor visibility. Run-up waves can be produced from wind blowing over the surface of water. Maximum wave height is primarily a function of wind strength, wind duration, and length of exposed water (fetch). Substantial run-up waves can occur during extreme storm events, such as during tropical storms, hurricanes, and “nor’easters.”

Stormont Bay is open to the ocean and to easterly gales that can bring large waves ashore. The predominant winds are from the Northwest and Southwest, and easterly winds at sea generally shift to northeast, thus reducing wave force within Stormont Bay. Storm surges for this Project are defined as an increase of at least 0.6 m above the normal astronomical high tide (EC, 2007). Seaconsult Marine Research Ltd. (1985) reports that a 1 in 100 year event would equate to a surge of 0.6 metres in Country Harbour. Extreme weather events can lead to storm surges of 1.5 m as was shown in the Halifax Harbour after the passing of Hurricane Juan in 2003 (Bowyer, 2003).

The LNG storage facility will be located and designed in consideration of potential wave run-up conditions. The LNG Terminal will be designed to withstand extreme storm/wave/wind events. The design parameters and detailed information with respect to waves will be determined in consultation with specialists, including EC, during the FEED and subsequent modeling stage. This modeling will include an assessment of the potential coastal impacts to Stormont Bay as a result of the Marginal wharf and LNG Marine Terminal structures. This study will specifically assess how ocean waves, river, and tidal currents may be altered by the proposed Marginal wharf and LNG Marine Terminal structures and how in turn those impacts may alter the coastal processes and physical environment of Stormont Bay (Vancouver Port Authority, 2006). The height of storm surge that can be expected in Stormont Bay ranges from .44 m to .65 m (Seaconsult Marine Research Limited, 1985), however, recent events such as Hurricane Juan indicate that the storm surges can exceed 1 m.

There is anchorage available in Stormont Bay if conditions are not appropriate for docking. The captain of the ship or when in the pilotage area, pilots will decide if navigation to / docking at the terminal is safe navigation and when transfer activities must be postponed due to rough seas. Appropriate communication systems will be in place to ensure procedure coordination between the captain of the vessel and shore-based personnel.

Considering mitigative measures and the definition of significant effect on the Project as outlined in Section 9.1, the effect of precipitation on this Project component is not considered to be significant.

9.2.6 Ice

Sea ice forms along Nova Scotia's Atlantic coast during January, February, and March, peaking in late February and March. Sea ice formed in the Gulf of St. Lawrence can also drift through the Cabot Strait onto the Scotian Shelf and pile up along the coast when winds are from the north and east. Ice accumulations occur mainly between the second week of February and the second week of May.

In the coastal area around Country Harbour, the frequency of occurrence of ice could be up to 33% during the first week of March and between 1% and 15% in February and the rest of March. In addition, ice is expected to form locally in January and February. The 30-year median of the predominant ice type is new or grey-white ice (less than 0.3 m thick) in February, grey ice (less than 0.15 m thick) during the 1st week of March, and first year ice (up to 0.7 m thick) for the rest of March (ExxonMobil, 2006).

When carried away to sea by winds and currents, the coastal ice cover melts and does not hinder navigation. The likelihood of Gulf of St. Lawrence ice occurring at the development sites is relatively low; however it is believed that a much larger proportion than 1% comes from the Gulf, especially in February and March. Sea ice, both local and from the Gulf of St. Lawrence, are considered to be potentially significant environmental factors affecting navigation and design of coastal structures. The Canadian Coast Guard Icebreaking Program would be able to support LNG marine vessels and facilities by assisting commercial vessels to voyage efficiently and safely through or around ice covered waters. With the support of the Canadian Coast Guard Icebreaking Program, most Canadian ports are open for business year-round (DFO, 2004).

Icebergs originate from glaciers in Greenland and drift with the Labrador Current and typically decay on the Grand Banks of Newfoundland. According to a few local residents, icebergs have never been seen in the Keltic Study Area. Only one iceberg has been reported in the Keltic Study Area in the last 60 years (ExxonMobil, 2006), and the probability of future iceberg occurrences is low.

The formation of ice in the shallow coastal waters must be taken into account when designing the LNG Terminal facility. Operational procedures will include a monitoring program for the presence of area ice, both local and from the Gulf of St. Lawrence, as well as the rare possibility of ice bergs in the Keltic Study Area.

Considering mitigative measures and the definition of significant effect on the Project as outlined in Section 9.1, the effect of icing on this Project component is not considered to be significant.

9.2.7 Climate Change

Global climate change has emerged as a long-term environmental challenge of global significance. Emissions of GHGs are ascribed to contribute to global warming in addition to the natural warming the earth has been subject to since its advance out of the pleistocene ice age starting about 10,000 years ago. In addition to general global temperature increases, climate change projections for the Project Area include increased precipitation, sea level rise due to thermal expansion and melting of glacial ice and overall changes in the frequency and severity of storms. Many of the aspects of climate change are covered individually in this section with the exception of sea level rise and crustal subsidence.

The extremes and variability of all of these factors, especially with the influence of climate change, require consideration in the FEED stage and subsequent construction and operation of the facility.

9.2.7.1 Background

Table 9.2-2 summarizes the climate criteria changes provided by the Canadian Institute for Climate Studies (CICS) (2006) scenario projection model as a result of global warming through to the 2080s due to natural and anthropogenic causes.

TABLE 9.2-2 CICS Scenario Projection Model Results for Nova Scotia through to the 2080s

Climate Parameter	Units of Change	Mean Annual	Winter	Spring	Summer	Fall
temperature	ºC	+4	+5	+3.5	+4.3	+3
precipitation	%	+3	+5	-4	+7	+5
Max. temperature	ºC	+4	+3.5	+4	+4	+3.5
Min. temperature	ºC	+4.2	+6.2	+4	+3.2	+3
Solar radiation	Watts per m^2 (W/m^2)	0	+1	+1	-6	0
Wind speed	%	+5	0	+14	0	+3
evaporation	mm per day (mm/d)	+0.2	-0.2	+0.7	+0.25	+0.2
Soil moisture capacity fraction	%	0	0	0	0	-0.05
Mean sea level pressure	Hectopascal (hPa)	+0.4	0	+1.3	-1	-0.2
Snow water content	Kg/m^2	0	0	0	0	0
Sea ice	Kg/m^2	0	0	0	0	0
Derived vapour pressure	hPa	+3.4	+2.2	+2.2	+4	+3.5
Derived relative humidity	%	0	0	-1	+1.5	+0.5
Derived diurnal temp. change	ºC	-0.5	-2.5	0	-0.5	0
Surface temperature	ºC	+4	+5.2	+3.8	+4	+3.5

Note: This data was based upon default model CGCM2 A21 SRES.

Global warming within this time period is expected to result in:

- a reduction in northern hemisphere snow cover and extent of sea-ice;
- global sea level rise of up to 59 cm as a result of the above;
- global changes in the frequency and intensity of extreme climate events in the north Atlantic;

- more frequent heat waves and fewer cold waves and frost days; and
- increased incidents of coastal flooding, accelerated coastal erosion and possible increased saltwater intrusion into groundwater resources.

This is just one of many climate change models. As an input to the FEED, Keltic will seek out other climate change models for consideration. CICS has expertise on techniques for evaluating other model results and considering their applicability to the future case. EC will also be contacted for advice at this stage.

9.2.7.2 Effects of Climate Change

The effects of climate change on the Project are not considered to be particularly relevant during the construction phase due to the time frame associated with climate change relative to the proposed time frame for Project construction. During Project operation, the changes noted above are expected to have an effect over time on various (sensitive) components of the natural ecosystem. An increase in extreme marine related events (including increased storm intensity, winds, ocean waves, and storm surges) could result in an increased number of operation disruptions at the LNG Terminal facilities.

It is possible that extreme events could increase the likelihood of accidents or malfunctions if structures were not designed to withstand frequent storms, which could lead to environmental impacts on marine fish, marine mammals, birds, surface water, etc. Structures will be properly designed, and appropriate mitigation measures in place to deal with the increased likelihood of such malfunctions or accidents.

Sea level rise is an important consideration for coastal projects. For example, tidal records for the Halifax region show that the mean tide level has risen approximately 0.36 m per century, or at least 40 m in the past 10,000 years (Shaw et al., 1993; Stea et al., 1994).

In 2007, IPCC's The Fourth Assessment Report IPCC projected that by 2100, global warming will lead to a sea level rise of approximately 0.2 to 0.6 m. This rise will mostly be due to warming of the oceans and glacial cap melting. This would be in addition to the 0.36 m per century already being experienced, thus a potential rise in sea level between 0.45 m and 1.25 m may occur at the site during the next century. In addition to sea-level rise caused by climate change, land is subsiding in the Maritimes by about 0.2 m per century (EC, 2004a). The LNG Terminal will not be affected by sea-level rise and crustal subsidence as allowances for sea-level rise and crustal subsidence will be incorporated in the design.

9.2.7.3 Mitigative Measures and Residual Effects

The LNG Terminal will be sited and designed to be able to withstand possible rises in sea elevations and crustal subsidence which may result from climate change. At the FEED stage, the Proponent will review various climate change models (including those of CICS) and solicit EC for advice on their applicability in order to select appropriate design parameters.

Considering mitigative measures and the definition of significant effect on the Project as outlined in Section 9.1, the effect of climate change on this Project component as currently understood is not considered to be significant.

9.2.8 Forest Fires

Two thirds of all forest fires in Canada are caused by people, the third is caused by lightning (Canadian Forest Service, 2006). However, a fire could be caused by a liquid hydrocarbon spill, another accident involving fire, carelessness, or by natural causes. The immediate concern would be for human health and safety.

The Keltic Project is registered under a number of NFPA codes, standards, and regulations associated with the prevention and protection against fire. Mitigative measures include:

- NFPA codes will be in place on Project Site: Portable fire extinguishers, Standard for installation of centrifugal fire pumps, Installation of private fire service mains, Flammable and combustible liquids code, Standard for the Installation and use of Stationary Combustion Engines and Gas Turbines, National Fuel Gas code, National Fire Alarm code, Lightning Protection code, Standard for the Installation, Maintenance and use of Public Fire service communication systems.
- Area will be clear of slash, litter, building materials, and gear for access and safety purposes.
- Mobile fire-fighting equipment will be provided by a central fire station as part of common user facilities.
- Latest technology in fire sensing will be incorporated in the facility design and will respond to appropriate fire-control centres as needed:
    - all process and storage areas will be serviced by underground pipelines and hydrants as well as strategically placed special fire-fighting equipment; and
    - operators at all process units will be located in individual control centres and will be trained as first responders for fire-fighting.

In the event a forest fire occurs, all valves will be shut off to isolate sections of the LNG facilities. Project personnel will follow proper mitigation procedures and use NFPA equipment to contain and extinguish local fires as quickly as possible until fire fighting response crews arrive. The LNG facilities will maintain safe working areas free of access debris, litter, and extraneous building materials which may catch fire.

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. The existing heli-pad in the Industrial Park will be re-established at the central administration complex.

Considering mitigative measures and the definition of significant effect on the Project as outlined in Section 9.1, the effect of forest fires on this Project component is not considered to be significant.

9.3 MARGINAL WHARF

9.3.1 Erosion

The location of the marginal wharf rests on the northeast side of Stormont Bay, where wave erosion is likely to occur. Due to the coastal location of the marginal wharf, waves are one of the most widely recognized indicators of storm events and a natural hazard for shoreline erosion (Shaw, 2001). The marginal wharf will be constructed from pre-cast concrete caissons, placed on a granular stone mattress then positioned on the seabed. The marginal wharf is located in a sheltered location where rigorous waves traveling at high speeds would be less predominant; therefore, the magnitude of shoreline erosion would most likely be minimal. Erosion could potentially be caused by heavy rainfall events, large storms, significant wave action, and sea level rise. Wind and ice erosion is more severe during winter months and could potentially cause damage to the marginal wharf over the long-term.

An assessment of the stability of the slope/shoreline will be undertaken, to facilitate proper design of sediment control structures, such as erosion control blankets and armour stone. Silt curtains and booms will be used during construction to minimize siltation in the marine environment caused by shoreline erosion. Armour stone will be placed along the shoreline to ensure long term protection from wave erosion. Erosion control structures will be monitored regularly, especially after storm events, heavy precipitation, or snow melt, and corrective action will be taken as necessary. Details, including blanket thickness and the size of armour will be determined during the FEED stage.

Considering mitigative measures and the definition of significant effect on the Project as outlined in Section 9.1, the effect of erosion on this Project component is not considered to be significant.

9.3.2 Seismic Events

As described in Section 9.2.2 above, the Project location lies within a stable continental region of the North American Tectonic Plate, within Canada's eastern seismic region, large earthquakes have occurred in the past and will inevitably occur in the future. The frequency and magnitude of seismic effects (including tsunamis) at the Project location are expected to be low. However, the marginal wharf will serve as the port facility for loading and unloading large quantities of petrochemical by-products, process feed stocks and as a transport and containment vessel dockage facility; therefore, the wharf will be designed for the seismic rating in the region, as required under CSA Z276-01. In addition, all structures at the site will be built to meet or exceed the new design criteria as set out in the 2005 edition of the NBCC. Appropriate contingency planning will also address the possibility of structural failure which may result from an extreme seismic event.

In order to minimize these effects on the Project, mitigative measures will be employed during the design and construction phase. Primarily these mitigative measures are:

- The marginal wharf will be designed for the seismic rating in the region, as required under CSA Z276-01.
- All structures at the site will be built to meet or exceed relevant building codes, including the new design criteria as set out in the 2005 edition of the NBCC.

- Appropriate contingency planning will also address the possibility of structural failure which may result from a severe seismic event.
- During the FEED stage, the best available information will be used to estimate possible wave size and run-up in Stormont Bay and at the proposed Project Site. The results of this modeling will be used, as appropriate, in the design of the wharf and plant facilities and in developing emergency response procedures.
- A tsunami warning system is planned for the Atlantic Ocean near Canadian shores, which will provide adequate warning to Project related shipping of approaching tsunamis.
- In the event of a tsunami / tsunami warning, ship-to-shore transfers would be postponed and ships would be dispatched to harbour anchorage or the open sea.
- Prepare and regularly update disaster plans. Address both response and recovery issues.

Considering the mitigative measures and the definition of significant effect on the Project as outlined in Section 9.1, the effect of potential seismic events on this Project component is expected to be significant; however, the likelihood is considered to be extremely low.

9.3.3 Precipitation and Fog

The Atlantic Ocean influences climate surrounding the Keltic Study Area, causing consistent precipitation, thick fog, and sea ice annually. The marginal wharf extends into Stormont Bay and further the Atlantic Ocean to the southeast, where effects from extreme rainfall could result in stoppages of outdoor work on the marginal wharf facility. The marginal wharf is required for receipt and shipment of products and by-products and will also receive supplies and equipment during construction of the entire complex. The wharf is a highly important element of the Project; however heavy rain, fog, freezing rain, hail, ice, and snow can interfere with the operation of the marginal wharf and LNG marine terminal. Slippery conditions and limited visibility may cause concern when service crafts (tugs, pilot, vessel, etc) require docking on the north and western side of the marine facility, along with the roll-off dock for unloading of equipment and materials from ships during construction

Precipitation is common year-round in Nova Scotia, however rainfall is slightly greater in late fall and early winter because of the more frequent and intense storm activity. Storm precipitation events in the Keltic Study Area can be severe, quite possibly causing the marginal wharf to be slippery, icy, and unsafe during construction phases and operation. Snow and freezing precipitation can occur between October and May, with the largest amounts falling between December and March. If unusual wet periods, fog, or excessive rain occur during construction, this could result in Project delays and an associated delay in completion and could result in additional capital cost.

Periods from mid-spring to early summer are typically the foggiest. Bands of thick, cool fog lie off the coast created when chilled air above southerly-flowing ocean currents mixing with warm, moisture-laden air moving from the Gulf Stream. Dense fog originating inland may reduce visibility and can interfere with the operation and navigation of vessels approaching the marine facilities. With onshore winds, fog banks can move far inland. Fog can interfere with the docking of vessels at the marginal wharf.

The EMP will include mitigative measures for minimizing the effects of high precipitation during Project construction and operation. Project components will be designed to withstand the forces of storms, with associated precipitation, storm surge, waves and associated sea spray, as well as snowfall loading on structures. The design parameters with respect to extreme weather, including precipitation, will be determined in consultation with specialists, including NRCan and EC, during the FEED stage. Measures associated with erosion are addressed in Section 9.3.1 above. Modern navigation aids and piloting service will minimize the effects of fog on docking and berthing at the marginal wharf.

Considering mitigative measures and the definition of significant effect on the Project as outlined in Section 9.1, the effect of precipitation on this Project component is not considered to be significant.

9.3.4 Wind

A variety of weather conditions from hurricane–force winds to heavy precipitation can pass rapidly through areas of Nova Scotia or suspend over a region for days. Nova Scotia frequently experiences storms which pass close to the Atlantic coast, producing highly changeable and often stormy weather. According to Atlantic Climate Centre, "the wind at any given location is often quite different from the wind conditions which prevail even a short distance away. The variation between wind direction and speed results from the characteristics of natural and manmade obstructions, topography, and surface cover." Winds blow predominantly from the south or southwest during summer with an average speed of about 10 to 15 km/h. In the coldest months the predominant direction is from the west and northwest with an average speed of 22 km/h (EC, 2005a). Severe storms, including summer hurricanes and winter "nor'easters", may generate strong winds from the northeast.

Extreme weather events have the potential to delay construction and create damage to the marginal wharf and the following marine structures: supports along the southeast side of the LNG pipeline and vapour return pipeline, along with the containment structure, warehouse facility, and roll-off dock for unloading. The purpose and design of the marginal wharf structure extends off the shoreline into Stormont Bay to receive and ship products therefore it has greater exposure to wind and extreme weather events than in-shore facilities. Marginal wharf construction materials, such as concrete caissons and a granular mattress have been chosen appropriately to suit and withstand a variety of weather conditions.

Extreme weather events may include high wind speeds, heavy rainfall or snowfall, hail, lightning, and fog. High wind speeds are an important element and indicator of storms and cause rough waters, waves, and surges. High winds and heavy seas at reduced temperatures can cause freezing spray condition between November and April. In winter months, sea spray will freeze, creating unsafe conditions on the marginal wharf which could lead to work stoppage.

To minimize effects on the marginal wharf, extra precaution will be taken during high wind storms to reduce damage during transfer of product to/from ships. The EMP will specify regular inspection for damage or unsafe working conditions due to wind during construction and operation. Due consideration to wind will be given to component design; ensuring all structures on the marginal wharf facility are extremely secure, and provide the greatest possible protection to operators from dangerous high wind/freezing spray conditions.

Considering mitigative measures and the definition of significant effect on the Project as outlined in Section 9.1 the effect of wind on this Project component is not considered to be significant.

9.3.5 Waves

The coastal location of Stormont Bay is open to the ocean and to easterly gales that can bring large waves ashore. However, winds travel mainly from the Northwest and Southwest, and easterly winds at sea generally shift to northeast, thus reducing wave force within Stormont Bay. Ocean waves are one of the most widely recognized indicators of storm activity and constitute a significant natural hazard for shoreline erosion and infrastructure damage in coastal settings (Shaw, 2001). The marginal wharf, situated at the mouth of Isaac's Harbour will be exposed to waves impinging on shore and crashing upon the wharf structure. Large buoys or tires will be placed along sides of the marginal wharf to protect all service craft from damage caused by wave motion. LNG vessel navigation and docking procedures for the Keltic facility as well as other necessary marine operational manuals will be developed through the TERMPOL process, through consultation with Canadian Coast Guard, TC, and the Atlantic Pilotage Authority.

In the event of a winter storm; a variety of weather conditions from freezing spray, high gusting winds, heavy storm surges, choppy waves, sea foam, rain, fog, and poor visibility could cause docking and navigation problems for vessels. Winds associated with nor'easter winter storms can create peak wave heights as high as 14 m. If extreme wave conditions are anticipated or occur, ships will not be allowed to dock or remain at the facility if sea conditions do not allow safe operation. If extreme weather occurs during a transfer the activities will be postponed, and ships will be dispatched to harbour anchorage.

The marginal wharf will be designed to withstand extreme storm/wave/wind events. The design parameters with respect to waves will be determined in consultation with specialists, including EC, during the FEED stage. There is anchorage available in Stormont Bay if conditions are not appropriate for docking. The captain of the ship will make decisions with respect to safe navigation at sea and when transfer activities must be postponed due to rough seas. Appropriate communication systems will be in place to ensure procedure coordination between the captain of the vessel and marginal wharf operators.

Considering mitigative measures and the definition of significant effect on the Project as outlined in Section 9.1, the effect of waves on this Project component is not considered to be significant.

9.3.6 Ice

As described in Section 9.2.6 above, ice accumulations occur mainly between the second week of February and the second week of May. Sea ice, both local and from the Gulf of St. Lawrence, is considered to be potentially significant environmental factors affecting navigation and design of coastal structures. The formation of ice in the shallow coastal waters must be taken into account when designing the marginal wharf. Operational procedures will include a monitoring program for the presence of area ice, both local and from the Gulf of St. Lawrence, as well as the rare possibility of ice bergs in the Keltic Study Area.

Impacts of sea ice are important to note, in the event that thick sea ice formation is prevalent surrounding the marginal wharf. Ice ride-up could occur, causing corrosion and weathering on the marginal wharf structure. De-icing the marginal wharf could require a fairly large amount of time during winter conditions, to ensure safe surfaces for operators. However, a large amount of sea ice forming in Stormont Bay is improbable as it rests in a protected location.

The bitter Atlantic winter weather can bring harsh challenges for ships navigating on the east coast of Canada. The Icebreaking Program would be able to support LNG marine vessels and facilities by assisting commercial vessels to voyage efficiently and safely through or around ice covered waters. With the support of the Canadian Coast Guard Icebreaking Program, most Canadian ports are open for business year-round (DFO, 2004).

Considering mitigative measures and the definition of significant effect on the Project as outlined in Section 9.1, the effect of icing on this Project component is not considered to be significant.

9.3.7 Climate Change

The United Nations Framework Convention on Climate Change defines climate change as: "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is, in addition to natural climate variability, observed over comparable time periods." Cumulative effects of climate change have implications toward the world's oceans, changes in sea level, threatening the loss of fish habitat and species, flooding of property, shoreline erosion, contamination of coastal water supplies, and a reduced visibility of ports. Higher sea levels could increase coastal erosion and damage from storm surges, and present problems for coastal infrastructure. The extremes and variability of factors listed above require consideration in the FEED stage and subsequent construction and operation of the Keltic Project.

9.3.7.1 Effects of Climate Change

The effects of climate change on the Project are not considered to be particularly relevant during the construction phase due to the time frame associated with climate change relative to the proposed time frame for Project construction. An increase in extreme storm intensity, winds, ocean waves, and storm surges could result in an increased number of operation disruptions at the marginal wharf.

Sea level rise is an important consideration for coastal Projects. As described in Section 9.2.7.2 above, a potential rise in sea level between 0.45 m and 1.25 m may occur at the site during the next century; which could impact operations and design requirements.

The marginal wharf will be sited and designed to be able to withstand possible rises in sea elevations which may result from climate change. At the FEED stage, the Proponent will review various climate change models (including those of CICS) and solicit EC for advice on their applicability in order to select appropriate design parameters.

Considering mitigative measures and the definition of significant effect on the Project as outlined in Section 9.1, the effect of climate change on this Project component as currently understood is not considered to be significant.

9.3.8 Forest Fires

A forest fire could be caused by a liquid hydrocarbon spill, another accident involving fire, carelessness, or by natural causes. The marginal wharf is not directly surrounded by forested areas; however fire can easily spread from on-shore toward marine facilities. The immediate concern for a fire would be for human health and safety.

The Keltic Project is registered under a number of NFPA codes, standards, and regulations associated with the prevention and protection against fire. Mitigative measures include:

- NFPA codes will be in place on Project Site: Portable fire extinguishers, Standard for installation of centrifugal fire pumps. Installation of private fire service mains, Flammable and combustible liquids code, Standard for the Installation and use of Stationary Combustion Engines and Gas Turbines, National Fuel Gas code, National Fire Alarm code, Lightning Protection code, Standard for the Installation, Maintenance and use of Public Fire service communication systems.
- Area will be clear of slash, litter, building materials, and gear for access and safety purposes.
- Mobile fire-fighting equipment will be provided by a central fire station as part of common user facilities.
- Latest technology in fire sensing will be incorporated in the facility designs and will respond to appropriate fire-control centres as needed:
  - all process and storage areas will be serviced by underground pipelines and hydrants as well as strategically placed special fire-fighting equipment; and
  - operators at all process units will be located in individual control centres and will be trained as first responders for fire-fighting.

In the event a forest fire occurs, all valves will be shut off to isolate sections of the LNG transfer pipeline heading toward the LNG storage tanks. Marginal wharf operators will follow proper mitigation procedure and use NFPA equipment to contain and extinguish the fire as quickly as possible until local fire station response arrives. The marginal wharf will maintain a safe working facility with no access debris, litter, and extraneous building materials lying on deck to catch fire.

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. The existing heli-pad in the Industrial Park will be re-established at the central administration complex.

Considering mitigative measures and the definition of significant effect on the Project as outlined in Section 9.1, the effect of forest fires on this Project component is not considered to be significant.

9.4 PROJECT RELATED SHIPPING WITHIN 25 KM OF COUNTRY ISLAND

Effects of the environment on Project related shipping has included the area within 25 km of Country Island in order to ensure consideration of any potential effects in the context of the presence of a roseate tern colony on the Island. This population was listed by COSEWIC as threatened in Canada in 1986 and as endangered in the USA in 1987 (United States Fish and Wildlife Service, 1987).

During operations of the Keltic facility, the movement of large ships close to Country Island is restricted because of the presence of seabirds. No ships will approach within 200 m of the island (as per the Roseate Tern Recovery Plan), unless in an emergency situation. The final location of the shipping lanes will be determined through consultation with TC and follow TC Marine Safety's Development of Routing Standards (TP 1802 E) http://www.tc.gc.ca/marinesafety/tp/TP1802/menu.htm. Under normal circumstances, Project related shipping can avoid significant impacts on seabirds given the relatively infrequent passage of ships through the area. The following sections will consider if effects of the environment on the Project could alter this condition.

9.4.1 Seismic Events

The potential for seismic events in the Keltic Project Area has been described in Section 9.2.2 above. It is possible that ships could experience the effects of tsunamis while at sea, however, tsunamis travel in open water as a shallow water wave with a small height (generally less than 1 m) and usually go unnoticed.

On reaching shallow water, tsunami wave height increases. Therefore, it is possible that tsunamis could affect shipping operations at the LNG Terminal or marginal wharf. A tsunami warning system is planned near Canadian shores that will reportedly involve all Atlantic Provinces (Murty et al, 2005a). It is expected that sufficient advance warning will be communicated to marine vessels servicing the Keltic complex to allow adequate disengagement time to return to the safety of the open sea before a tsunami makes landfall. It is possible that tsunami events could cause short-term delays and minor route alterations in shipping activities but not in any way that would affect the roseate tern colony or other environmental components.

9.4.2 Precipitation and Fog

Local precipitation and fog conditions have been described in Section 9.2.3 above. Extreme weather including heavy precipitation or dense fog banks can interfere with vessel navigation or increase the likelihood of accidental events.

The EMP will include mitigative measures for minimizing the effects of high precipitation during Project construction and operation. Navigation aids and piloting service will minimize the effects of fog on navigation and safety in the shipping lanes. Appropriate communication systems will be in place to ensure procedure coordination between the captain of the vessel and shore-based personnel.

9.4.3 Wind

Stormont Bay receives strong winds, especially in the colder months, blowing most frequently from the west or northwest as the cold arctic air approaches (NSMNH, 1996a and b). This could have great impacts on shipping as a vessel might stray off-course. Country Island hosts one of the few breeding populations of roseate terns. Ships are not permitted within 200 m of the island (as per the Roseate Tern Recovery Plan), unless in an emergency situation. Tern colonies are particularly vulnerable to disturbance. The birds startle easily, flying up from their nests, and leaving their chicks and eggs vulnerable to gulls, crows, and other predators, or to hypothermia.

Many times high wind events are compounded by low visibility. This could make navigation at sea and the avoidance of sensitive areas difficult. During high winds, a ship could be blown off-course bringing it close enough to Country Island to disturb the sensitive population of roseate terns. In addition, terns may become disoriented themselves and risk flying into the lights of ships passing nearby.

Shipping lanes will be established in consultation with TC in accordance with TP 1802 Routing Standards and the CWS to keep ships away from the island and its population of endangered roseate terns. Modern navigation aids and piloting service will minimize the effects of extreme weather on navigation in the shipping lanes. Therefore, the effects of wind on vessel navigation are not expected to be significant, i.e., are not expected to have significant consequential effects on the Country Island roseate tern colony.

9.4.4 Waves

The Atlantic Ocean has some of the world's busiest shipping lanes; however LNG shipping transport is extremely regulated through strict international standards set out by the IMO. In the event extreme winds create high waves, surrounding Country Island, LNG shipping tankers would take precautions.

The size and capacity of LNG shipping vessels will be able to withstand stormy conditions, with high winds and run-up waves; however proper anchoring systems and mitigation procedures must be in place. TC, working through the TERMPOL process and with appropriate agencies, advocates increased international measures aimed at providing navigational aids, and pilots in emergency situations. When combined with mitigation for effects from other types of extreme weather, waves are not expected to cause significant effects on navigation that could have significant consequential effects on the Country Island roseate tern colony.

9.4.5 Ice

The Nova Scotia current is a smaller coastal movement of cool water from the Gulf of St. Lawrence along the Scotian Shelf to the Gulf of Maine (Draper, 2002). Sea ice forms along Nova Scotia's coast during January, February, and March. More specifically, the frequency of ice Stormont Bay receives could be up to 33% during the first week of March and between 1% and 15% in February and the rest of March. It is important to consider that a large proportion of sea ice comes from the Gulf of St. Lawrence, especially in February and March, along with local ice forming in January and February. The 30-year median of the predominant ice type is new or grey-white ice (less than 0.3 m thick) in February, grey ice (less than 0.15 m thick) during the 1st week of March, and first year ice (up to 0.7 m thick) for the rest of March (ExxonMobil, 2006) .

Sea ice has not been predicted to obstruct navigation of shipping vessels near Country Island. The coastal ice cover melts when it's carried away to sea by winds and currents. The likelihood of Gulf of St. Lawrence ice occurring at development sites is very low. However, formation of ice in shallow coastal waters, surrounding Country Island must be taken into account. The LNG shipping tankers 700 m available turning radius increases the potential for collisions between fixed objects, such as Country Island. Risk reduction and mitigation include control of ships by tug escort into Stormont Bay and where there is an increased mobility in sea ice conditions by contacting Canadian Coast Guard Officials.

While it is possible that icing could cause short-term delays and minor route alterations in shipping activities, no additional significant impacts on navigation are anticipated that could cause significant consequential effects on the Country Island roseate tern colony or other environmental components.

9.4.6 Climate Change

The potential effects of climate change in the Keltic Project Area have been described in Section 9.2.7 above. The only potential effect of climate change on Project related shipping would be an increase in the frequency or severity of extreme weather events or changes in sea ice conditions. As described in the preceding sections, these factors could cause short-term delays or minor alterations in shipping activities but would not cause significant consequential affects on the Country Island roseate tern colony or other environmental components.