

---

## 22.0 EFFECTS OF THE ENVIRONMENT ON THE PROJECT

Section 2(1) of *CEAA* defines effects of the environment as “*any change to the project that may be caused by the environment...whether any such change or effect occurs within or outside Canada*”. Typically, potential effects of the environment on any project are a function of project or infrastructure design and the risks of natural hazards and influences of nature. These effects may result from physical conditions, land forms, and general site characteristics which may act on the Project such that Project components, schedule and/or costs could be substantively and adversely changed.

In general, environmental conditions that can affect Project Construction, infrastructure or operational performance will be communicated to the Design Team and addressed through engineering design and industry standards. Good engineering design involves the consideration of environmental effects and loadings or stresses (from the environment) on the project. The planning and engineering design for this Project are no exception.

Long term environmental management and Project longevity are inherent considerations in the best management practices of project design and development. As a matter of accepted engineering practice, responsible and viable engineering designs consistently overestimate and account for possible forces of the environment, and thus inherently incorporate several factors of safety to ensure that a project is designed in a safe, reliable, and diligent manner. The very nature of the Project—refining crude oil to produce transportation fuels using a variety of physical, chemical and catalytic processes—requires that the design and construction materials that will be used as part of the Project facilities are able to withstand considerable stresses. Equipment and materials will be used that are able to withstand extremely high temperatures, pressures, corrosive environments, and other factors. By selecting construction materials, designs and practices that accommodate these pressures arising from the process itself, environmental stressors—such as those that could arise as a result of climate change, severe weather, acid rain, and other factors—would more than adequately be addressed by engineering design, materials selection, and engineering foresight.

Mitigation strategies for minimizing the likelihood of a significant effect of the environment on the Project occurring are inherent in the planning process, engineering design codes and standards, construction practices, and monitoring. As such, and in consideration of the best management practices that will be applied throughout the design, Construction, Operation, and Decommissioning and Abandonment of the Project, the effects of the environment on the Project during all phases of the Project will be managed through responsible design and thus have been rated not significant.

---

### 22.1 Environmental Attributes

The environmental attributes that were considered for the potential to have an effect on the Project were determined based on the Final Guidelines and EA Track Report, regulatory consultation, public and stakeholder input, a review of the known past and existing conditions, and knowledge gained through projections of potential future conditions (e.g., potential effects of climate change). Based on the issues and concerns identified, the environmental attributes selected for consideration include:

- Climate conditions, including:
  - Temperature and precipitation;

- Fog;
  - Wind;
  - Severe weather events;
  - Tidal conditions; and
  - Storm surges and waves.
- Climate change (including sea-level rise);
  - Seismic activity;
  - Acid rock drainage;
  - Coastal erosion;
  - Salt spray;
  - Acid rain/acid fog; and
  - Forest fires resulting from causes other than the Project.

Many of these attributes were specifically required to be assessed as part of the Final Guidelines and federal EA Track Report and Scoping Document.

Climate conditions and climate change are presently the focus of much concern globally. *"In the past year, climate change has become among the most publicized issues in Canada and one of the main sources of debate in Canadian politics"* (Koval *et al.* 2008). The Project is located at or near the land/sea interface where extreme weather and sea conditions can occur, and where a substantive change in climate and/or sea level could affect the Project if not mitigated or accounted for in its design and construction. As a result, a more thorough investigation of the effects of climate and climate change on the Project was undertaken as compared to that undertaken for the other environmental attributes listed above, to assess the potential effects of the environment on the Project from this emerging global environmental threat.

---

## 22.2 Selection of Effects

The environmental attributes listed in Section 22.1 have the potential to affect the Project in several ways; for example:

- Reduced visibility and inability to manoeuvre construction equipment and marine vessels safely ;
- Delays in receipt of raw materials and/or feedstocks, or in shipping of products;
- Damage to infrastructure;
- Increased structural loading;
- Corrosion of exposed oxidizing metal surfaces and structures, perhaps weakening structures and potentially leading to malfunctions; and/or
- Loss of electrical power resulting in potential loss of production.

These and other effects of the environment on the Project generally fall into one of two categories. As a result, the effects analysis for Effects of the Environment on the Project is focused on the following effects:

- Delays in Construction and/or Operation; and
- Damage to Infrastructure.

Some of these effects of the environment on the Project, such as a loss of electrical power, can also have effects on the environment—these environmental effects are addressed in Chapter 23.

---

## 22.3 Environmental Assessment Boundaries

---

### 22.3.1 Spatial Boundaries

The spatial boundaries (Assessment Area) for the assessment of the effects of the environment on the Project include all areas where Project-related activities are expected to occur. For the purpose of this EIA/EA, these areas are focused on the Project location and are comprised of the following:

- The refinery location itself, where the refinery and associated process units will be located;
- The preferred linear facilities corridor, within which rail, pipeline, and electrical transmission facilities to the refinery will be located;
- The location of crude oil, finished product, and co-product storage facilities at Black Point;
- The location of the marine terminal including the jetty and barge landing facility; and
- The shipping lanes and adjacent areas in the Bay of Fundy (in relation to potential accidents, malfunctions and unplanned events).

---

### 22.3.2 Temporal Boundaries

The temporal boundaries include Construction, Operation, and Decommissioning and Abandonment of the Project.

As discussed in Section 3.2.6, Decommissioning and Abandonment will not occur for several decades. A Decommissioning and Abandonment Plan will be developed in accordance with the regulations applicable at that time. While environmental attributes listed above may have an effect on Decommissioning and Abandonment, the variability and uncertainty in the projections of such activities require a decommissioning plan to consider the environmental conditions current to that time period. As a result, Decommissioning and Abandonment is not considered further in this assessment, and the effects of the environment on the Project during Decommissioning and Abandonment are rated not significant. That being said, effects of the environment on the Project described for Construction and Operation will persist in Decommissioning and Abandonment. Those that are variable due to long term variation or climate change are difficult to project.

---

## 22.4 Residual Effects Rating Criteria

A significant adverse residual effect of the environment on the Project is one that would result in:

- A substantial loss of the Project schedule (e.g., a delay resulting in the construction period being extended by one season);
- An interruption in service (e.g., supply of raw materials delayed by more than 6 days, such that there would not be enough crude oil in storage to meet production demands, or loss of electricity supply for a few hours);
- Damage to the Project infrastructure resulting in a substantial increase in a health and safety risk to the public or business interruption;

- Damage to the Project infrastructure resulting in repairs that could not be technically or economically implemented; or
- Failed mitigation causing environmental damage that could not be technically or economically corrected or compensated in a feasible manner.

---

## 22.5 Effects Analysis

As discussed in Sections 2.9.2 and 4.1, the Project will be designed, constructed, and operated in compliance with various codes, standards, best practices, acts and regulations that govern the required structural integrity, safety, reliability, and environmental and operating performance of the various Project components to minimize the potential for adverse effects of the environment on the Project. Adherence to these codes, standards, acts and regulations will help to carry out the Project in a manner that minimizes the potential effects of the environment on the Project, including damage to infrastructure that could result from their occurrence.

As outlined in the introduction to this chapter, the Project will be designed in accordance with several best management and engineering design practices. As a factor of safety, and a matter of reliable engineering practice, the design and materials chosen for construction of the Project will be selected so that the Project will withstand extreme environmental stressors that are associated with the petroleum refining process. The nature of the refining process (*e.g.*, using high temperatures, elevated pressures, corrosive environments, and other extreme conditions) requires that materials of construction and equipment can withstand these environmental stressors. Accounting for these stressors in the design and construction of the Project will also inherently ensure that the potential effects of the environment on the Project that could occur from various natural and environmental phenomena (*e.g.*, sea level rise and other factors arising from climate change, acid rain, and others) are minimized. The results of this EIA Report and the mitigation identified herein to minimize the potential for significant adverse effects of the environment on the Project will be communicated to the Project design team and its engineers so that they can incorporate measures to address any residual concerns that might not be explicitly accounted for in their engineering design processes.

A sampling of specific codes and standards in the National Building Code of Canada, the Canadian Standard Association (CSA) and the Province of New Brunswick Acts and Regulations that address specific issues related to environmental activities was presented in Table 2.1. To minimize the potential effects of environmental extremes on the Project, the design of structures and equipment will be compliant with the National Building Code of Canada 2005, Volumes 1 and 2 and the User's Guide – NBC 2005 Structural Commentaries Part 4 of Division B. Furthermore, the National Building Code of Canada also lists design requirements specifically for Saint John, New Brunswick. Design requirements address such environmental extremes as:

- Lateral wind loads;
- Storm water drainage, from rain storms and floods;
- Weight of snow and ice, and associated water;
- Lateral earthquake loads;
- Erosion protection of slopes, embankments, ditches and open drains; and
- Waves, storm surge and tidal extremes.

To account for potential weather extremes, engineering specifications of the National Building Code of Canada contain design specific provisions, such as:

- Critical structures, piping, tanks and pressure vessels steel selection to prevent brittle fracture at low ambient conditions;
- Piping designed to prevent overpressure due to volumetric expansion as a result of solar heat gains;
- Electrical grounding of vessels and structures for lightening protection;
- Maximum motor ambient temperature; and
- Winterization and freeze protection.

Compliance with this and other Codes will minimize the likelihood of a significant adverse effect of the environment on the Project. Other mitigation measures implemented as part of the planning process including adherence to engineering design codes and standards, use of good engineering judgment and careful construction practices, care in selection of appropriate construction materials and equipment, careful planning of operation activities (e.g., crude oil deliveries), and the implementation of a proactive monitoring, maintenance and process safety management program will minimize the potential for adverse effects of the environment on the Project to such an extent that they are not significant.

Codes and standards are set in legislation as minimum requirements. They are continuously reviewed as new information becomes available. In addition to complying with codes and standards, the Design Team will adopt a proactive approach to incorporate climate change considerations and adaptation measures into the Project.

An assessment of the effects of the environment on the Project with respect to the various environmental attributes outlined in Section 22.1 is provided in the subsections that follow.

---

### 22.5.1 Effects of Climate on the Project

“Climate” is defined as the statistical average (mean and variability) of weather conditions over a substantial period of time (typically 30 years), accounting for the variability of weather during that period. The relevant parameters used to characterize climate are most often surface variables such as temperature, precipitation, and wind, among others.

“Climate change” is an acknowledged change in climate documented over two or more periods, each with a minimum of 30 years (Catto 2006). The United Nations Framework Convention on Climate Change (UNFCCC), in its Article 1, 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 (IPCC 2007a).

The definition of climate change dictates the context in which the effects of those changes are discussed. While it is appropriate to examine the effects of projected climate change on Operation over the next 50 to 100 years, it is not fitting to consider the effects of climate change projections on Construction which will take place over a relatively short period of time (6 to 8 years) in the near future. In this case, where Construction will occur over the first eight years, it is more appropriate to consider the effects of recent climatological conditions, especially the potential adverse effects of weather variability and weather extremes on Construction.

To assess the environmental effects of climate on the Project, current climate and climate change must both be considered. Current climate conditions are established by compiling relevant historical data

and establishing a climatological background for the Saint John region. Climate change effects projected over the life of the Project are determined through review of climate modelling research to establish the current state of understanding of trends likely in the Saint John region over the next 50 to 100 years. Projections vary among these global and downscaled model results, mainly as a result of varying levels of precision in data used to run climate models and because of variations in the projections of future greenhouse gas (GHG) emission scenarios. A consensus has evolved regarding the climate change-related effects most likely to affect Atlantic Canada, New Brunswick, Saint John and, in turn, the Project (Vasseur and Catto 2008; Reeves 2008).

Numerous climate-related conditions, linked primarily to global warming, have been observed across Atlantic Canada, the entire country and globally. Many believe that these changes to the climate regime will accelerate over the next century, as has been the case with global temperatures over the past two decades (IPCC 2007a). For example, increased temperatures, receding glaciers and melting of permafrost, rising sea levels and coastal flooding, changing precipitation patterns and intensity, as well as increasing drought and lowering water levels are all conditions that are being studied and measured. Of these, several have been projected to affect coastal infrastructure in Atlantic Canada, New Brunswick, Saint John (Vasseur and Catto 2008) and the Project. Those most relevant to Operation over the next 50 to 100 years are:

- Increasing temperatures;
- Changing precipitation patterns;
- Rising sea level; and
- More severe storm surges and flooding.

---

#### 22.5.1.1 Existing Conditions: Climatological Background (1971 to 2000)

The current climate conditions are generally described by the most recent 30 year period for which Environment Canada has developed statistical summaries—generally referred to as climate normals. The most recent period for which climate normals data are available from the Saint John Airport weather station (the closest to the Project) is for 1971 to 2000, and has been chosen as the appropriate period for summarizing current climate conditions for the Project. Current climate condition summaries for sea state, storm surges and other phenomena related to the Bay of Fundy are for approximately the same period, 1970 to 2008.

---

##### 22.5.1.1.1 Temperature and Precipitation

As discussed in Section 6.2.3, Saint John has a rather moderate climate, which tends to have mild winters and cooler temperatures for the spring, summer and fall seasons. This is mostly due to the moist Atlantic air year-round and the cool waters of the Bay of Fundy that never completely freeze (Environment Canada 2004a).

Through the most recent 30-year climate averaging period (1971-2000), the average annual temperature was 5°C. The daily mean temperature for January was -8.1°C. Summers are cool to moderately warm, with a daily mean temperature for July of 17.1°C. From 1971 to 2000, Saint John experienced relatively few annual days with extreme temperatures. On average, there have been 71 and 0.79 annual days with instantaneous maximum temperatures greater than 20°C and 30°C respectively, and 15.2 and 0.23 days a year with instantaneous minimum temperatures less than -20°C and -30°C respectively. Taking humidity into consideration, humidex temperatures are, on

average, greater than 30°C and 35°C for 9.8 and 0.98 days of the year respectively (Environment Canada 2004a; Environment Canada 2004b).

Precipitation in Saint John has been, on average, abundant and well distributed throughout the year, although the late fall and early winter are generally the periods during which the highest precipitation amounts are experienced. From 1971 to 2000, Saint John received an average of 1,390.3 mm of precipitation a year, of which 1,147.9 mm and 256.9 mm were rain and snowfall (as water equivalent), respectively. As with temperature, there were relatively few extreme precipitation events during the period. On average, there have been 45.8 and 13.9 annual days with precipitation greater than 10 mm and 20 mm, respectively, in Saint John. Of these events, rainfall accounts for more than 80% and snowfall less than 20% of the total precipitation. This is consistent with 37.7 and 12.5 days a year with rainfall greater than 10 mm and 25 mm, as well as 7.8 and 0.73 days a year with snowfall greater than 10 cm and 25 cm (Environment Canada 2004b).

---

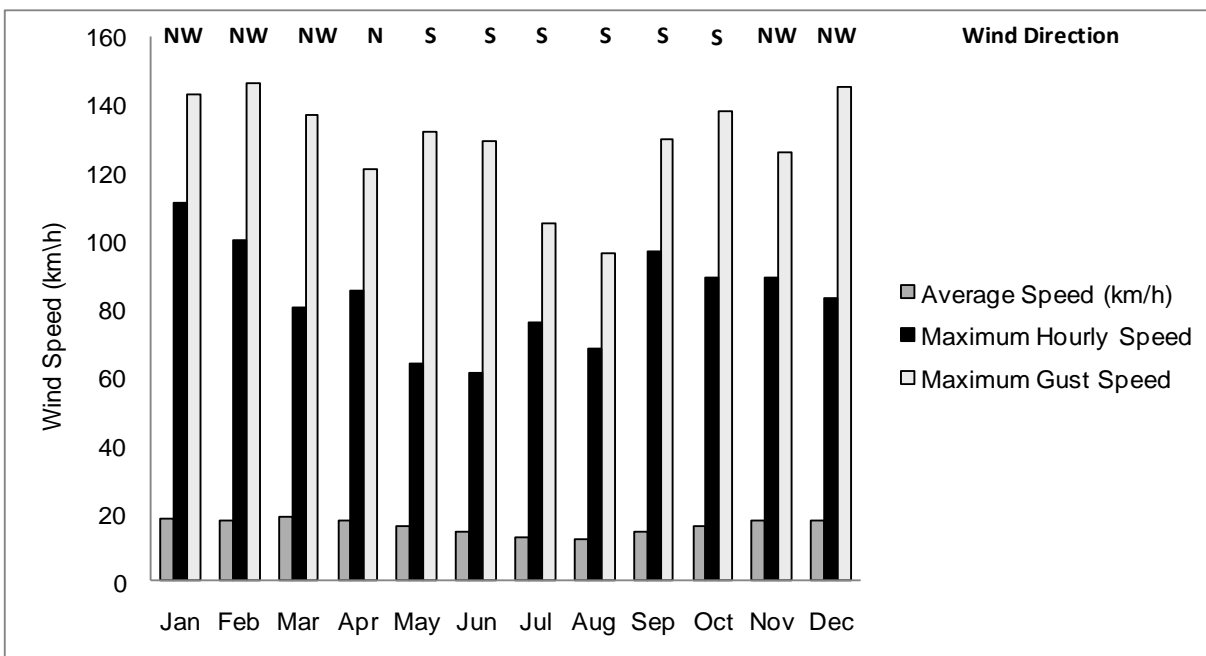
#### 22.5.1.1.2 Fog

Fog is defined as a visible mass of condensed water vapour at ground level, caused when relative humidity of the air reaches 100% at the surface (Ford 2004). “Days with fog” are days when fog occurs and horizontal visibility is less than 1 km (thick fog) and 10 km (fog) (Environment Canada 1990). The area around the Bay of Fundy experiences a considerable number of days with fog (approximately 120 d/a) (Environment Canada 1990), especially during the summer months when the contrast in temperature is greatest between sea surface (Bay of Fundy) and the surrounding air (Environment Canada 2004a). This is consistent with the measured increase in hours of reduced visibility (< 1 km) between May and September (Environment Canada 2004b). At Saint John, fog occurs on more than one quarter of the year, and 36% of the time in July. Fog is more common during the night and early morning, and generally dissipates by 14:00 (Environment Canada 2004a).

---

#### 22.5.1.1.3 Wind and Sea Spray

As outlined in Section 6.2.3, monthly average wind speeds for Saint John measured at the Saint John Airport, range from 12.1 to 18.6 km/h with an annual average wind speed of 16.1 km/h (Figure 22.1). From May to October, the dominant wind direction is from the south, with a shift to winds predominantly from the northwest from November to April (Environment Canada 2004b). Maximum hourly wind speeds, averaged from 1971 to 2000 for each month, range from 61 km/h to 111 km/h; while maximum gusts for the same period range from 96 km/h to 146 km/h. Occurrences of extreme winds are relatively uncommon at Saint John—over the last three decades there has been an average of 21.3 and 6.1 days per year with winds greater than or equal to 52 km/h and 63 km/h respectively (Environment Canada 2004b).



Source: Environment Canada (2004b)

**Figure 22.1 Predominant Monthly Wind Direction, Monthly Mean, Maximum Hourly and Maximum Gust Wind Speeds (1971 to 2000) at Saint John, New Brunswick**

Sea spray, fairly common in the Bay of Fundy, results when high winds carry water droplets suspended in air when waves break over rocks. The effects of sea spray would potentially be felt in the PDA at the marine terminal and the refinery complex located at the cliff headlands on the Bay of Fundy.

22.5.1.1.4 Severe Weather Events

Storms can occur in New Brunswick throughout the year but tend to be more common and severe during the winter. Winter storms generally bring high winds and a combination of snow and rain. Freezing rain has been observed on approximately 12 days a year in New Brunswick, ranging from an average of 34 hours to 59 hours a year at Fredericton and Moncton, respectively. The Groundhog Day storm in February 1976 was an intense winter storm that caused a great deal of damage in southern New Brunswick, particularly to Saint John. In the summer and fall, storm centres often pass across the Bay of Fundy and move northeast through the Strait of Belle Isle. Southern New Brunswick tends to have at least one heavy rainstorm every one to two years (Environment Canada 2004a).

Winter storms are often classical “nor’easters”, where the cyclonic centre passes south of southern New Brunswick, and is then subsequently subject to strong northeast winds and heavy precipitation over one to several days. Thunderstorms, which are more frequent in New Brunswick than the rest of Atlantic Canada, occur on average 10 to 20 times a year. Generally, only one of these is extreme enough to produce hail. Thunderstorms can produce extremes of rain, wind, hail and lightning; however, most of these storms are relatively short-lived.

Tornadoes are rare, but can occur in New Brunswick. Of Canada’s ten worst tornadoes on record, one occurred in eastern New Brunswick at Bouctouche on August 6, 1879 (Environment Canada 2007j). There are no recorded tornadoes in the Saint John area, based on the reported threshold limits of less than 0.5 per year (Natural Resources Canada 2007a).



---

#### 22.5.1.1.5 Tidal Conditions

In their study of conditions at Saint John, about half way along the Bay, Sandwell Engineering Inc. (Chapter 13) reported the tidal reference levels (relative to the chart datum of 0.0 m). These figures provide a mean tidal range of 6.49 m, with the largest tide tidal range of 9.08 m being reported for Saint John Harbour. Saint John is one of the primary ports in the Canadian Hydrographic Service's tidal prediction network.

---

#### 22.5.1.1.6 Storm Surges and Waves

Increasing sea level and more frequent and severe weather has also brought about an increased frequency of storm surges. Storm surges are defined as the elevation of water resulting from meteorological effects on sea level. During the past 15 years, storm surges have resulted in property destruction in all four Atlantic Provinces (Vasseur and Catto 2008). In Atlantic Canada, storm surges have been higher in coastal waters and highest in the Gulf of St. Lawrence, with Saint John at the lower end of the scale having observed a storm surge of 0.6 m every 40 years (Bernier *et al.* 2006). In southeastern New Brunswick, storm surges range from 0.6 m to 2 m in height and surges above 0.6 m in height occur about two to three times per year along the Canadian Atlantic coast (Parkes *et al.* 1997). Typically, surges were found to last for an average of 2.2 hours, and occasionally over 12 hours. At Saint John, where the vertical difference between the average high water level and the extreme high water level is in the order of 2.3 m, the risk from storm surge flooding is much less than in areas with lower tidal amplitude. Two important storm surges that happened close to the occurrence of tidal high water caused considerable damage throughout the Bay of Fundy. The Groundhog Day storm in 1976 caused a surge off the coast of Saint John estimated at 1.6 m, with maximum wave heights (trough to crest) of 12 m with swells as high as 10 m. The famous Saxby Gale of 1869 is estimated to have created a storm surge between 1.2 m and 2.1 m (Parkes *et al.* 1997), with the higher surges occurring in the upper Bay of Fundy between Moncton and Burncoat, Nova Scotia.

Wind speed on a spatial scale of the Bay of Fundy or more is the greatest determining factor for generation of waves in the area of the Marine Terminal and Other Marine-Based Infrastructure.

At Saint John, the headland at Mispic Point is fully exposed to wind and wave action entering the Bay of Fundy from the southwest (at its mouth between Grand Manan Island and Yarmouth, Nova Scotia). Analysis of data from two wave gauges (370 m off Partridge Island and 180 m off the Courtenay Bay breakwater) during the period from November 1959 to February 1960 indicates that waves with periods of 8-9 seconds occurred 19% of the time, and 33% of the waves were higher than 0.3 m (Neu 1960). Two percent were higher than 1.5 m, with 2.7 m the highest in the data set. The longest waves had a period of 13 seconds and occurred for 1% of the time.

Run-up waves are produced from wind blowing over the surface of water. Maximum wave height is primarily a function of wind strength, wind duration and the length of exposed water ("fetch"). Substantial run-up waves usually occur during extreme storm events such as tropical cyclones and nor'easters. At nearby Point Lepreau, waves with a characteristic height of 6.7 m were observed at a wave-rider buoy stationed in 91 m of water. This particular storm was estimated to be a 50-year storm. Evidence of 9 m storm run-up waves was recorded along the New Brunswick coast in 2000 and 2001 (Jacques Whitford 2004).

In Transport Canada's "Wind and Wave Climate Atlas" (MacLaren Plansearch Ltd. 1991), the significant wave height and wave period of a typical storm off Saint John, with a one year return interval, are given as 5.2 m and 13.9 seconds. The required combination of the fetch and likelihood of

wind duration and direction makes it probable that waves with periods much greater than 8 seconds originate outside the Bay of Fundy.

There is potential that a tsunami could occur in the region. Two tsunamigenic events, on November 18, 1755 and November 18, 1929, listed in the eastern Canadian earthquake catalogue of Smith (1962), were reviewed and it was concluded that there was no evidence that either of these two events had caused tsunami effects in the Bay of Fundy. A study of the effects of the November 18, 1929 event in New Brunswick by Burke *et al.* (1987) also did not find mention of tsunami effects in reports from the coastal communities of the province. The recent establishment of the Atlantic Tsunami Warning System, which allows tsunami warnings and improved capacity to predict storm surges (Forbes 2007), will likely be an invaluable tool in predicting extreme storms along the southern coast of New Brunswick.

---

#### 22.5.1.2 Climate Change

The climate as a “natural” phenomenon is extremely complex. Weather observations are perhaps the oldest and most reliable form of environmental monitoring. Typical and extreme weather events are well documented with reasonably good spatial coverage existing in Canada with a combination of fully instrumented, manned or automated, observation stations supplemented by a wider coverage of climatological stations. This monitoring forms the basis for the historic and present day predicted climate conditions and trends.

Predicting future environmental effects of climate change for a specific area using global data sets can be problematic due to generic data and larger scale model outputs which do not take into account local climate. Accurate regional and local projections require the development of specific regional and local climate variables and climate change scenarios (Lines *et al.* 2005). As a result, downscaling techniques have emerged, over the last decade, as an important advancement in climate modelling. Downscaling is used to introduce micro-scale interactions by including local climate variables. Downscaling techniques are particularly important for Atlantic Canada due to the inherent variability associated with this predominantly coastal climate. Statistical downscaling uses global climate model (GCM) projections as well as historical data from weather stations across the region, and studies the relationship between these sets of data. Downscaling produces more detailed predictions for each of these weather stations (Lines *et al.* 2005) and has allowed for a better understanding of future climate scenarios based on precise and accurate historic data sets (D. Burton, personal communication, March, 30, 2008).

Results tend to differ between a Statistical Downscaling Model (SDSM) and Global Climate Model (GCM). According to Lines *et al.* (2005), monthly, seasonal and annual results for SDSM values not only differed from, but were typically higher than, those of the Canadian coupled Global Climate Model version 1 (CGCM1). The overall mean annual maximum temperatures increase projected for Atlantic Canada between years 2020 and 2080 ranged from 1.6 C° to 4.7 C° and 1.1 C° to 3.6 C° for the SDSM and CGCM1 model results, respectively (Lines *et al.* 2005). This is consistent with predicted mean annual maximum temperature for the same time period at Saint John, predicted to range from 1.8 C° to 4.2 C° and 1.1 C° to 3.9 C° for the SDSM and CGCM1 model results, respectively (Lines *et al.* 2005) (Table 22.1).

**Table 22.1 Projected Mean Annual Maximum ( $T_{\max}$ ) and Minimum ( $T_{\min}$ ) Temperature Change and Precipitation Percent Change for both SDSM and CGCM1 Model Results**

Period	$T_{\max}$		$T_{\min}$		% Precipitation	
	SDSM	CGCM1	SDSM	CGCM1	SDSM	CGCM1
2020s	1.8	1.1	1.5	1.6	18	2
2050s	2.9	2.1	2.2	2.9	20	-2
2080s	4.2	3.9	3.8	4.2	21	2

Source: Lines *et al.* 2005.

The Statistical Downscaling Model projections for maximum temperature for 2050 at Saint John are for summer, fall and winter increases (2.9 C° to 4.3 C°), while for the spring, slight cooling is anticipated (-0.6 C°) (Lines *et al.* 2005). By the year 2080, temperatures are projected to increase in all seasons, with greater warming in the summer, fall and winter (4.5 C° to 5.7 C°) than the spring (1.6 C°) (Lines *et al.* 2005). This average temperature change will be gradual over the period and will change precipitation types and patterns.

The warmer fall and winter temperatures could mean later freeze up; wetter, heavier snow; more liquid precipitation occurring later into the fall; and possibly more freezing precipitation during both seasons. With little change in spring temperatures, differences in fresh water ice formation and breakup patterns will likely be slight over the next century. Changes to precipitation patterns due to warmer weather over the fall and winter months, on the other hand, could lead to stronger spring run-off (Natural Resources Canada 2007b). There is less agreement among the global circulation and regional downscaling models regarding changes in precipitation. Annual precipitation increases projected for Atlantic Canada between the years 2020 and 2080 range from 18% to 21% and -2% to 2% for the SDSM and CGCM1 model results, respectively (Lines *et al.* 2005). Precipitation trends are of more interest when taken together with the temperature increases and the seasonality of the predicted changes. Statistical Downscaling Model trends for the years 2020 to 2080 indicate a 8% to 12% and 21% to 35% increase for the winter and summer months, respectively (Lines *et al.* 2005). It is generally considered that the increased precipitation being projected for portions of western Atlantic Canada may be the result of continued landfall of dying hurricanes and tropical storms reaching into this area in the summer and fall months (G. Lines, personal communication, March 5, 2006).

While statistical downscaling model results highlight an increase in summer and fall precipitation, the Canadian Global Climate Model (CGCM1) results range from no change in the 2020s to a reduction in precipitation over the summer season for the years 2050 to 2080 (Lines *et al.* 2005). This is inconsistent with trends projected by Environment Canada (2008h), where global model results highlight a reduction in summer precipitation for the 2080s. This discrepancy in seasonal results highlights the variability inherent in climate modelling, a technical boundary. Due to the increased precision of localized data used in downscaled modelling, relative to global modelling, confidence is considered to be greater in the downscaled results relative to global model results.

Regardless of the differences in the projected temperature and precipitation changes between global climate and statistically downscaled models, there is a consensus in the climatological community concerning the overall anticipated environmental effects of climate change. This is especially true since many of the changes are documented as already occurring. For example, over the next 100 years, Atlantic Canada will likely experience warmer temperatures, more storm events, increasing storm intensity, rising sea level, storm surges, coastal erosion and flooding (Vasseur and Catto 2008).

Severe weather is predicted to be more frequent and more intense over the next 100 years. Many reports indicate the likelihood of growing insurance claims and other measures of the destructive nature of these changes. For instance, in Canada, the insured catastrophe losses totalled \$1.7 billion between 1985 and 1995, and increased to \$6.7 billion since 1995 (Leadbetter *et al.* 2006) both as a result of more developed infrastructure, more frequent severe weather, and a lack of climate adaptation considerations in the construction of new infrastructure.

While advances in modelling science over the last decade have improved confidence in long-term, projections, like all modelling projections, the results and guidance they provide are not meant as absolutes, but rather are intended to allow for preparations, for design considerations, and to facilitate adaptation.

---

#### 22.5.1.2.1 Sea Level Rise and Storm Surges

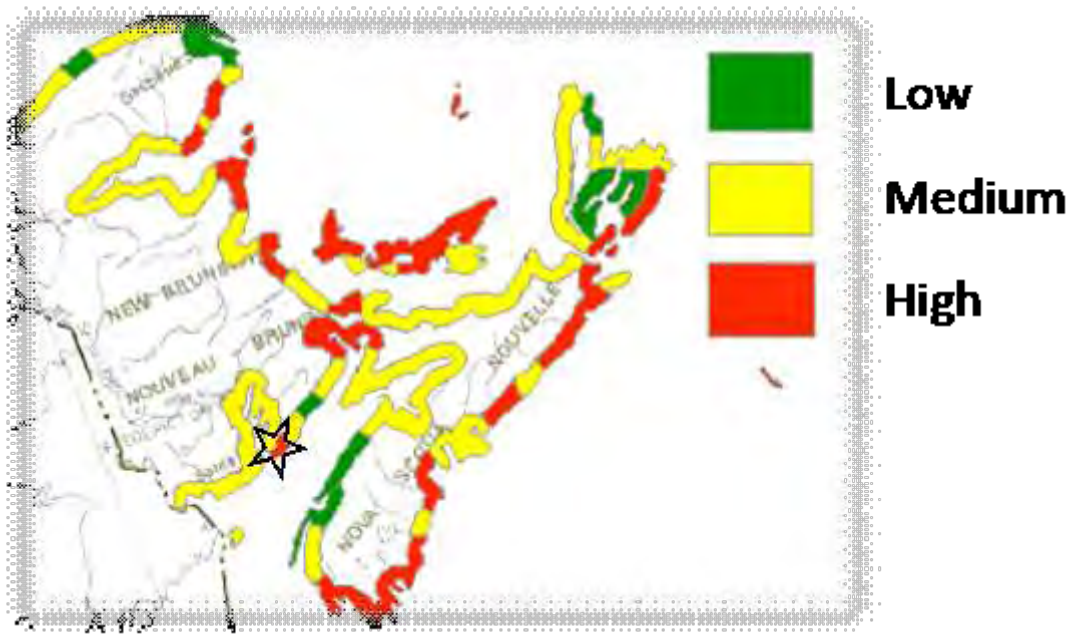
Global sea levels have risen 1.8 mm/a from 1961 to 2003, and 3.1 mm/a between 1993 and 2003 (Bindoff *et al.* 2007). The sea level has been slowly and steadily rising in most of Atlantic Canada for centuries due to crustal subsidence, warming trends, and the melting of polar ice caps (Government of Newfoundland and Labrador 2003). In particular, the sea level has been gradually rising along the southeastern coast of New Brunswick for several thousand years and the changes associated with that rise have become especially evident along the Northumberland Strait over the last several decades (Daigle *et al.* 2006) due to the low coast profile and substantive development near the coast line and on lands near mean sea level.

Most of Atlantic Canada is also experiencing crustal subsidence in coastal areas, thus compounding the rise in sea level (Vasseur and Catto 2008). In the Bay of Fundy, the rate of sea level rise has been even greater than in other areas of Atlantic Canada, about 400 mm in 100 years, largely because the coastal lands have been simultaneously subsiding by about 300 mm during this time (Percy 2001). During the latter phases of the last ice age, the weight of ice over land resulted in a hinge effect that caused coastal areas to rise relative to inland areas in the Bay of Fundy area of New Brunswick. Upon melting of the ice caps, coastal areas are subsiding while inland areas are rising.

Saint John, New Brunswick, is projected to have a moderate to high sensitivity to the impacts of sea level rise, especially induced by climate change (Geological Survey of Canada Bulletin 1998). Sensitivity is defined as the degree to which a coastline may experience physical changes such as flooding, erosion, beach migration, and coastal dune destabilization (Natural Resources Canada 2007c) (Figure 22.2).

Sea levels are expected to continue to rise at a greater rate in the 21<sup>st</sup> Century than was observed between 1961 and 2003 due to more rapid warming and ice cap and glacier melting. By the mid-2090s global sea levels are projected to rise at a rate of approximately 4 mm/a, and reach 0.22 m to 0.44 m above 1990 levels (Bindoff *et al.* 2007). Near Saint John, sea levels are anticipated to rise 0.7 m over the next 100 years (Reeves 2008). When crustal subsidence is coupled with the anticipated sea level rise due to global warming, the Bay of Fundy tidal response is estimated to result in the high water levels in the vicinity of Saint John increasing by about 0.6 m by 2050, 0.8 m by 2085, and 1 m by 2100, plus or minus about 15% (Greenberg *et al.* 2006). These are half or a third of the values suggested by an earlier publication by Godin (1992). It is generally understood that a rise in sea level, coupled with more frequent and severe weather, are likely to bring about storm surges that could flood areas in Atlantic Canada that were once unlikely to flood (Conservation Corps of Newfoundland and

Labrador 2008). However, sea level rise is not expected to permanently flood any part of Saint John due to its steep rocky shorelines (Reeves 2008).



Source: Geological Survey of Canada Bulletin 1998.

**Figure 22.2 Sensitivity of Coastal Areas in the Maritime Provinces to Sea Level Rise**

As the sea level continues to rise, the frequency of higher storm surges will increase (Vasseur and Catto 2008). At the current sea level, storm surges of 3.6 m are anticipated annually in the southern Gulf of St. Lawrence by 2100 (Parkes *et al.* 2006). Over the next 100 years storm surges in excess of 4.0 m are anticipated to occur once every 10 years (Vasseur and Catto 2008). At Saint John, serious storm surges are also anticipated to increase over the same time period (Environment Canada 2006d). Storm surge return periods are forecasted as:

- 1:10 year storm at 4.6 m;
- 1:20 year storm at 4.7 m;
- 1:50 year storm surge at 4.9 m; and
- 1:100 year storm at 5.2 m (Drisdelle 2007).

Climate systems are highly variable, reducing the certainty with which climate projections can be made. While the directions of some climate conditions are nearly certain, there is greater uncertainty in the projected magnitude or extent of the conditions. For example, while it is expected that temperatures will increase over the next 80 years, determining the extent of that temperature increase becomes progressively more difficult. When investing in infrastructure and industries of the future that will be subject to sea level rise and storm surges, precautions must be taken in their design to ensure their long-term viability and sustainability in the face of the projected the environmental effects of climate change.

### 22.5.1.3 Assessment of Effects of Climate on the Project

The environmental attributes of climate, as earlier defined, are important considerations in Construction and Operation. While current climate conditions and weather variability may affect Construction,

projected longer term climate change scenarios may affect Operation. The potential effects that these climate conditions may have on the Project are described and predicted where possible. To address these environmental effects, adequate design, Construction and planning of Operation and maintenance are required that consider the potential normal and extreme conditions that might be encountered in this southern New Brunswick setting. As outlined in the introduction to this chapter (Section 22.0) and in Section 22.5, the nature of the Project requires that the design and construction materials be able to withstand the extreme conditions of the refining process itself. By following accepted building codes and standards, selecting the right construction materials, designs and practices, environmental stressors on the Project such as those that could arise as a result of climate change, severe weather, and other factors would be expected to be more than adequately addressed.

---

#### 22.5.1.3.1 Effects of Climate on Construction

The intended relatively short period of construction of even a large project is generally not considered as a period over which the effects of climate change can be considered. For Construction, it is most important to consider recent climate trends (1971-2000 averages and extremes) and climate change projections, and assess the likelihood and effect of severe and extreme weather events on the Project so that they may be accounted for in the design and construction of the Project. The historical and projected extremes in temperature, fog, intense precipitation or other storm events, storm surges, erosion and flooding, form important considerations in the design and Construction of the Project.

Extreme temperature and reduced visibility due to fog are not anticipated to bring about significant adverse residual effects of the environment on Construction. Extreme low temperatures have the potential to reduce the ductility of construction materials used to construct the Project components (e.g., marine terminal, tanks, ancillary facilities), and increase susceptibility to brittle fracture. The materials specified for the Project will be in compliance with all applicable codes (Section 2.9.2) and will maintain structural integrity at the anticipated minimum and ambient temperatures in the Assessment Area to prevent adverse effects of the environment on the Project.

Reduced visibility due to fog could make manoeuvring of equipment and vessels difficult in the early part of the day. However, these short delays are anticipated, can be predicted and disruption of the construction activities avoided by scheduling tasks that require precise movements (e.g., positioning pipes in place with cranes) for periods when the fog has lifted.

Weather conditions of greatest concern of causing a significant adverse effect on Construction are wind storm events, severe precipitation events, high waves and storm surges, erosion and flooding. Each of these could potentially cause:

- Increased structural loading;
- Construction delays;
- Erosion of soil and washout of both access and on-site roads;
- Reduced visibility and inability to manoeuvre safely; and
- Damage to structures already built.

Wind, snow and ice, for instance, have the potential to increase loadings on buildings. Extreme snowfall can also affect winter construction by causing delay in construction, delay in delivery of materials, and resulting in additional work for snow clearing and removal. Extreme snowfall contributing to unusual flooding during snowmelt and extreme rainfall events could potentially lead to

flooding and erosion on the construction site. Extreme precipitation events, however, are an expected work condition and the construction schedule allows for weather conditions typical for the region.

Coastal erosion, as a result of extreme precipitation and potential flooding, is not anticipated to have an adverse effect on Construction. The rugged and rocky coastline of the Bay of Fundy near the Project is less sensitive to erosion relative to sandy coastlines in Atlantic Canada which are known to be eroding and are the focus of many scientific studies (Bernier *et al.* 2006). Erodible soils on the construction sites will be carefully mitigated using appropriate site drainage and sedimentation and sedimentation control measures, as will be described in the Environmental Protection Plan (Section 2.9.5). As such, the effects of erosion on Construction are not anticipated to be significant, and are thus rated as such.

The effects from maximum current speeds and shear stresses on the sea bed as a result of the interaction of tidal currents and waves on the design and construction of the Marine Terminal and Marine-Based Infrastructure, will be determined and incorporated by the Design Team for the Project using data from a moored ADCP current meter and wave gauge at the location of the marine terminal. This information will be considered in the development of design mitigation for the Project and to minimize the potential effects of the environment on the Project.

Potential effects of climate and climate change on Construction will be communicated to the Design Team. These potential effects will be considered in the planning and design of construction site infrastructure and the scheduling of Construction activities to limit delays, prevent damage to infrastructure and the environment, and to maximize the safety of construction staff. Although it is possible for Saint John to experience extreme weather conditions resulting in Construction delays, a substantive delay (e.g., a delay for more than one season) is not anticipated. Therefore, a significant adverse residual effect of climate on Construction of the Project is not anticipated, and is thus rated not significant.

---

#### 22.5.1.3.2 Effects of Climate on Operation

A wide range of climate effects on Operation, including both land-based and marine-based infrastructure, must be considered in the design of this Project. Forecast climate changes may affect Operation in both positive and negative ways, and vary from nominal to extreme effects. Those climate changes that could potentially have residual environmental effects on Operation are:

- Increased frequency of heavy precipitation events;
- Increased frequency of extreme storms accompanied by heavy and/or freezing precipitation, thunderstorms, strong winds, and salt spray;
- Increased incidence of flooding and erosion;
- Increased sea level rise; and
- Increased frequency and intensity of storm surges.

Each of these effects must be considered in terms of how they may adversely affect the Project if they are not planned, engineered and designed to account for such effects. Such effects could cause:

- Delays in receipt of raw materials and feedstock;
- Increased structural loading;
- Flooding and erosion;
- Loss of electrical power resulting in potential loss of production;

- High restart costs, or excessive flaring and other emissions to the atmosphere; and
- Damages to infrastructure that are not feasible to fix, or that may put staff at risk.

As such it is important that the residual effects of climate change, and their anticipated resulting adverse effects on the Project, be carefully taken into account in the planning, design, and construction activities; the selection of materials to be used; and the operating plans for the Project to ensure the long-term viability and sustainability of the Project.

Saint John could, for example, experience heavy rain, snowfall and/or freezing rain events that are capable of, for example, delaying the receipt of raw materials, production and shipping; causing an interruption of services such as electrical power, natural gas or water supply for extended periods of time; or increased structural loading on the Project components. Such potentially adverse environmental effects are unlikely to occur due to the design of the Project. As outlined in Section 22.0 and 22.5, by selecting construction materials, designs and practices that withstand the conditions in the oil refining process (e.g., high temperatures and pressures), environmental stressors potentially associated with climate change and severe weather would be more than adequately addressed by engineering design and materials selection. As a result, structures will be designed such that they will be able to withstand extremes of temperature, wind, snow, and ice events. Qualified professional engineers, well acquainted with the climate of southern New Brunswick, will design the structures and foundations to withstand these weather-related factors and loads, in compliance with applicable codes and standards. Design factors of safety, inherently conservative, will likely exceed the projected range of extremes that will be clearly outlined for the Design Team.

Coastal erosion, as a result of extreme precipitation and potential flooding, is not anticipated to have an adverse effect on Operation. As stated in Section 22.5.1.2.1, the rugged nature of the coastline and the planned implementation of the EPP during Construction mitigate the risk of erosion on the Project, and thus an adverse effect of erosion on Operation is not expected. As such, the potential for erosion to cause an adverse effect on Operation of the Project is rated not significant.

Fault currents resulting from lightning and upset conditions of electrical facilities could result in danger to personnel and damage to coatings and the refinery piping and sleeperway pipes themselves. Such adverse effects can occur where a pipeline is close to the grounding facilities of electrical transmission line structures, sub-stations, generating stations, and other facilities that have high fault current-carrying grounding networks. Pipelines paralleling alternating current electrical transmission lines can also be subject to induced potentials. The Project will be constructed and operated in accordance with the various construction codes and standards, some of which were outlined in Section 2.9.2. Pipelines for the refinery, the marine terminal, rail line and electrical transmission lines will be built to construction standards in order to minimize effects of the environment on the Project, including fault currents. As outlined in Section 22.0 and 22.5, such potential for adverse effects of the environment on the Project will be determined by the Design Team and subsequently mitigated by design and adherence to codes and standards. As such, significant adverse effects of climate on the Project are not anticipated.

Lightning strikes can result in local or regional power outages that may cause temporary outages within the refinery and other infrastructure. Contingency plans, including emergency back-up power for necessary operations and fail-safe systems, will be in place to manage temporary power outages. Power outages could result in malfunctions of equipment and abnormal shut down of the units, potentially causing flaring events. This is discussed as an unplanned event in Chapter 23.

Extreme wind events could affect the berthing of ships and the transfer of fuel at the marine terminal. The TERMPOL review process to be conducted (Chapter 21) will evaluate and simulate navigational procedures and safety under various weather conditions, and these outcomes will be described in a Marine Terminal Manual. Tankers will not be allowed to dock or remain at the facility if sea conditions do not allow safe operation of the fuel transfer facilities. In the event of an extreme weather event during a transfer, the activities would be postponed, and tankers would be dispatched to Port of Saint John anchorages. Vessels in transit within the Bay of Fundy shipping lanes will follow the directions of the Canadian Coast Guard MCTS during extreme weather events. The scheduling and completion of a crude or finished product transfer, even after it has been initiated, is very flexible and can be halted at any time in the interests of safety for the personnel and equipment. Accidental events that could result from severe weather causing interruptions in crude oil and finished product transfer will be prevented by the uses of quick disconnects on transfer arms, such that minimal if any spills would result in such events.

Sea spray, often accompanied with high winds, contains salt that may lead to long-term corrosion on exposed oxidizing metal surfaces and structures of the Project, perhaps weakening these structures, potentially leading to malfunctions, and possibly disrupt electrical connections and transformers. This is, however, unlikely as materials used in Construction will be, by design, tolerant of these effects. Further, salt spray effects can be mitigated with operational procedures that include cleaning and the use of protective coatings as required.

Rising sea level and storm surges are not anticipated to have an adverse effect on the land-based Project facilities. The Project's land-based facilities are at an elevation unlikely to be affected by increased sea levels or potential storm surges. These facilities are approximately 50-100 m above sea level (Jacques Whitford 2008b). This elevation thus creates a buffer zone for Project facilities of approximately 86 m and 90 m, and for storage tanks of 40 m and 36 m, over maximum predicted sea level rise and storm surge levels (occurring at high tide) over the next 100 years, respectively. Additionally, rising sea levels and storm surges will be accounted for in the engineering of and design plans for near sea-level structures (*i.e.*, marine terminal and associated infrastructure). The marine terminal will be built to meet the current and anticipated extreme future environmental loads. Weather warning systems (*e.g.*, Atlantic Tsunami Warning System) will also be consulted on a regular basis as a part of normal Operation and factors of safety will envelope potential changes due to climate change.

As with Construction, the effects from maximum current speeds and shear stresses on the sea bed as a result of the interaction of tidal currents and waves on operation of the Marine Terminal and Marine-Based Infrastructure will be determined by the Design Team to minimize the potential susceptibility of the Project to be adversely affected by effects of the environment.

Potential effects of climate and climate change on Operation will be considered and incorporated in the planning and design of Project infrastructure to minimize the potential for long-term damage to infrastructure, taking into account the existing climate conditions and the reasonably foreseeable future climate conditions. Inspection and maintenance programs will prevent the deterioration of the infrastructure and will help to maintain it in compliance with applicable building codes. Although it is likely that southern New Brunswick will experience extreme weather conditions during Operation, the likely adverse effects on Operation will have been taken into consideration in the planning and design of the Project such that substantive damages are not anticipated. Therefore, a significant adverse residual effect of climate on Operation is not anticipated. Thus the potential effects of climate on the Operation of the Project are rated not significant.

---

### 22.5.2 Effects of Seismic Activity on the Project

The Geological Survey of Canada maintains a National Earthquake Database containing information on Canadian earthquakes. Historical information, including location (*i.e.*, epicentres) and magnitude, for the North Appalachian Seismic Zone, within which the Project is located, is available on line at [http://earthquakescanada.nrcan.gc.ca/index\\_e.php](http://earthquakescanada.nrcan.gc.ca/index_e.php).

In New Brunswick, earthquake epicentres occur in three regions: Passamaquoddy Bay, Central Highlands (Miramichi), and Moncton (Natural Resources Canada 2008c). Seismic events have been more frequent in these regions and occasionally of a magnitude to be potentially damaging to structures (*e.g.*, greater than magnitude 5 on the Richter scale), such as the magnitude 5.7 earthquake in the Miramichi Region in January 1982. The seismicity (characterization of seismic event, likelihood and magnitude) of the Assessment Area is discussed in Section 6.2.1.

The Project, and all related facilities, will be designed to the applicable standard for earthquakes in this area (Section 2.9.2). The intent of these design standards is to maintain the integrity of the facilities based on the level of risk for an earthquake in the area. An earthquake with a magnitude substantively greater than the design-base earthquake could result in damage to the Project facilities. However, design-base earthquake magnitude values are elected based on probability, and it would therefore be very unlikely that the design-base earthquake would be exceeded during the life of the Project. As a result, seismicity is not considered a significant factor with respect to Construction or Operation. With design mitigation including compliance with applicable codes and standards such as the National Building Code of Canada 2005, the potential effects of seismicity on the Project during all phases are rated not significant.

---

### 22.5.3 Effects of Acid Rock Drainage on the Project

When sulphide-bearing rock (SBR) is exposed to oxygen and water, oxidation reactions produce sulphuric acid. Non-sulphide forms of sulphur in rock do not contribute to acid generation. These oxidation reactions may occur continuously under natural conditions, but over the long-term the reaction rates slow as the sulphur is oxidized on exposed rock surfaces. However, any mechanism that disturbs the rock, such as fracturing by weathering processes, excavation, or blasting, can expose new sulphide and lead to renewed oxidation. This renewed acid generation may continue for many years until the available sulphur on exposed rock surfaces again becomes fully oxidized and stabilizes.

Acid produced at rock surfaces leaches away, driven by gravity and infiltrating water flow. If the disturbed, acid producing rock is above natural ground level; the generated acid from contact of precipitation to acid producing rock may enter the surface water flow regime directly, and be transported rapidly to the nearest downgradient water body. Alternatively, the acid may enter the groundwater flow regime and be transported more slowly.

To determine the sensitivity of the Project to acid rock drainage, preliminary sampling for SBR was conducted at the Project site as part of a geotechnical study conducted for the Project (ADI 2007). A sample is considered (MEND 1991) to be potentially acid generating if:

- Sulphide sulphur (Ss) concentrations are greater than or equal to 0.3%; and
- Neutralizing potential/acid producing potential (NP/AP) is less than 3.0.

The results from this preliminary geotechnical investigation showed that NP/AP ratios ranged between 36.4 and 1,611 in samples taken from the PDA (ADI 2007). This is consistent with the geological map

of the Assessment Area (Barr and White 2005) depicting the bedrock geology as red sedimentary rock that has long since been oxidized, thus suggesting SBR is not present at high enough concentrations to generate ARD (M. McLeod, personal communication, July 15, 2008). As a result, acid rock drainage is not anticipated to affect the design, Construction, or Operation, and a significant adverse effect of acid rock drainage on the Project during any phase is therefore not anticipated.

---

#### 22.5.4 Effects of Acid Rain/Acid Fog on the Project

As discussed in Chapter 7, emissions of sulphur dioxide and nitrogen oxides to the atmosphere contribute to the formation of acid fog and acid precipitation. These acidic particles, once transformed in the atmosphere, can become acid deposition. In New Brunswick, acid deposition is affected by local emissions of sulphur dioxide and nitrogen oxides, as well as by emissions from several large industrial regions located upwind (*i.e.*, the American Midwest, southern Ontario and Québec, and the Washington-Boston region). The effects of acid fog and acid deposition have been recognized, and have been the focus of many studies over the past several decades. As a result, there has been an extensive acid precipitation monitoring network in New Brunswick since the early 1980s.

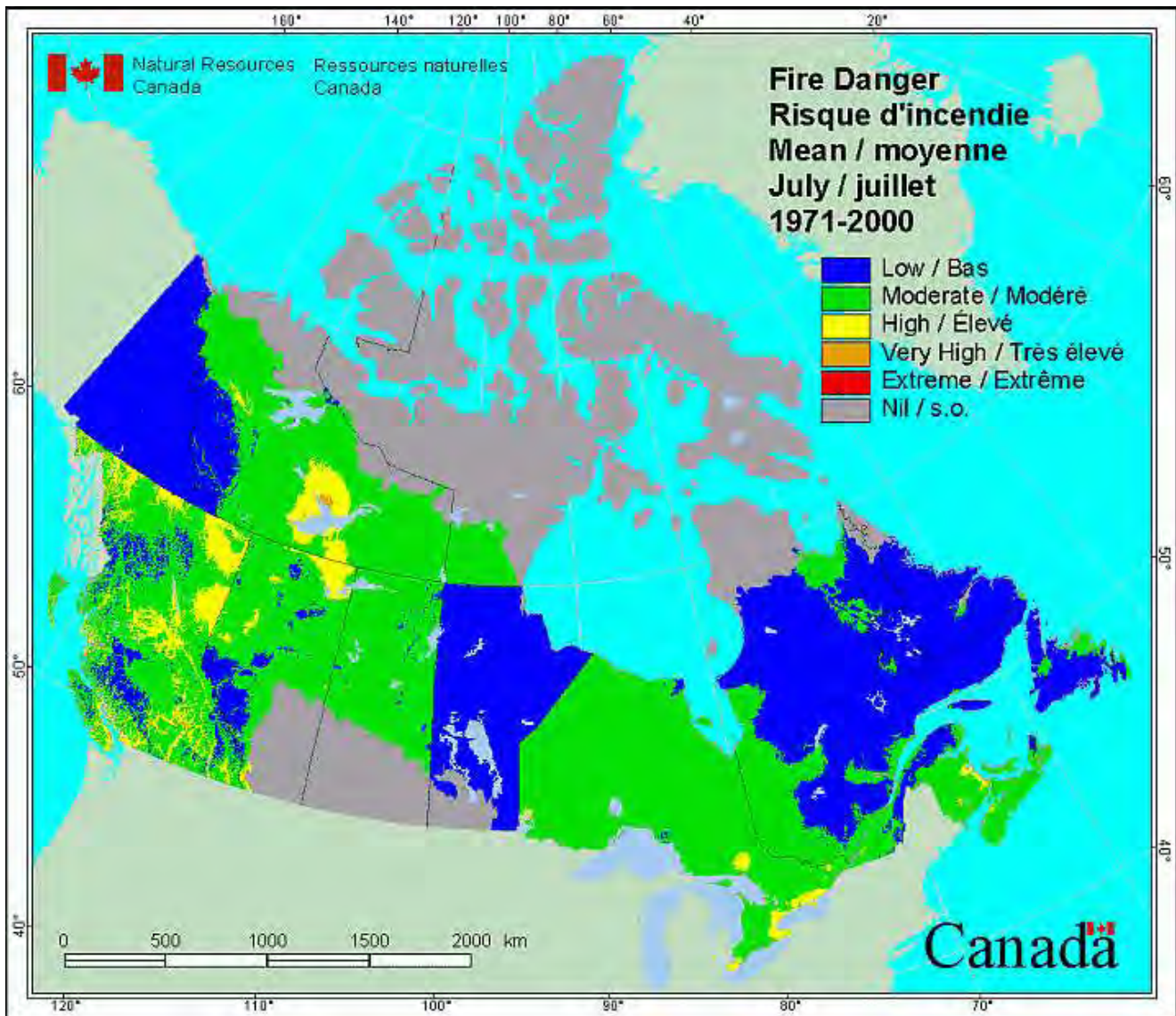
Acid deposition has generally and slowly declined in the province since the early 1990s (NBENV 2008a). Sulphate in precipitation, a key indicator of acid rain and acid deposition, was moderately higher in 2006 (the most recent year of data available) compared to 2005. However, there has been little change in the overall sulphate and nitrate concentrations in precipitation during the past decade.

In the southern half of the province and in the Saint John region, exceedances of critical loads for acid rain may occur. Critical loads for southern New Brunswick, which range from less than 8 kg/ha/a up to 11 kg/ha/a, are set to protect the most sensitive ecosystems. For instance, the mean annual sulphate wet deposition for the period of 1997 to 2006 was 14.75 kg/ha/a at the Lakewood Heights site in Saint John. While this deposition rate may have an effect on these most sensitive ecosystems, acid deposition beyond critical loads is not likely to affect the Project because of the construction materials that will be used to withstand acidity effects within highly corrosive environments, such as those that are typically found within a refinery. As a result, acid rain/acid fog are not considered an important factor with respect to Construction or Operation, and acid rain/acid fog will result in effects on the Project that are rated not significant for all Project phases.

---

#### 22.5.5 Effects of Forest Fires on the Project

The mean danger of forest fire in Saint John for July, when risk of forest fire is typically the greatest, is rated as moderate (for years 1971-2000) (Figure 22.3); where “moderate” is defined as creeping or gentle surface fires that are easily contained by ground crews with pumps and hand tools (Natural Resources Canada 2007d). While there is potential for natural forest fire to occur in or near the Assessment Area, it is not likely to have a substantive effect on Construction or Operation.



Source: Natural Resources Canada 2007d

**Figure 22.3 Average Canadian Fire Danger for the Month of July (1971-2000)**

New Brunswick has a forest fire control program in place to identify and control fires, minimizing the potential magnitude and extent of any forest fire, and their effects on the Project. The proposed safety and security programs for the site are capable of rapid detection and response to any forest fire threat. A cleared buffer will be maintained at the Project site for security reasons, and would also reduce the potential for a fire to affect the structures (which given the nature of the materials they contain are inherently fire resistant). Fire fighting capabilities on-site will be at a high level of training and readiness (Chapter 16), at a comparable level to those at the existing Saint John refinery. The safety and security programs will be in place in conjunction with facility, community, and provincial emergency response crews to provide for rapid detection and response to any fire threat. This includes fires that could start within the facility perimeter as well as fires approaching from outside the facility (*i.e.*, forest fires).

In the event that a forest fire did occur in close proximity of the Project, while Project-related infrastructure would not likely to be substantively affected by the fire, there is potential risk of contact with tanks, vessels, pipes and units that contain crude oil and finished products, thereby potentially

creating a risk of fire or explosion with these products which are by their nature highly flammable. As detailed in Chapters 2 and 3, however, substantive emergency response capability, emergency response plans, and fire trained individuals and response equipment is planned in readiness for, and in response to, such accidental events. The potential environmental effects of fires, explosions, and forest fires, as unplanned events, are assessed in Chapter 23.

With respect to the effects of forest fires on the Project, the facility structures will be constructed primarily of concrete and mild and stainless steel, which are not typically affected by fire. If fire were to break out in direct proximity to the Project, emergency measures would be in place to quickly control and extinguish the flames prior to contact with crude oil, finished products, and any flammable structures (*i.e.*, wood). In addition, the cleared safety buffer zone established around the perimeter of the site further decreases the likelihood of a forest or brush fire having a substantive effect on the Project. As a result, forest fires are not considered a significant factor with respect to Construction or Operation, and a significant effect of forest fires on the Project during any phase is not anticipated.

---

## 22.6 Determination of Significance

To summarize, upon consideration of the potential effects of the environment on the Project, professional engineers will design the Project to withstand these conditions by applying good engineering practices and various codes and standards from the National Building Code and other sources. The environment could potentially have an effect on the Project, specifically during Construction and Operation, but this will be mitigated through careful design in accordance with factors of safety, best engineering practice, and adherence with standards and codes. The mitigation measures and strategies described in this EIA Report and the selection of materials that are able to withstand high pressures, temperatures, corrosion, and loads that are typically found in refineries will more than adequately address these concerns.

Additional mitigation to the selection of materials that withstand these and other potential environmental stressors (*e.g.*, climate, sea spray, seismicity, and other effects of the environment) will include engineering specifications that contain design specific provisions, such as:

- Critical structures, piping, tanks and pressure vessels that will be constructed with resilient materials to prevent brittle fracture at low ambient temperature conditions;
- Piping designed to prevent overpressure due to volumetric expansion as a result of solar heat gains;
- Materials selected and designed to withstand or be protected from acid corrosion; and
- Winterization and freeze protection.

In consideration of the significance criteria (Section 22.4), the Project will be mitigated such that the environment will not affect the Project to the extent that there is:

- A substantial loss of the Project schedule;
- A substantive interruption in service;
- Damage to the Project infrastructure resulting in a substantial increase in public health and safety risk or business interruption;
- Damage to the Project infrastructure resulting in repairs that could not be technically or economically implemented; or

- Failed mitigation causing environmental damage that could not be technically or economically corrected or compensated in a feasible manner.

Planning, design, and construction strategies intended to minimize the potential effects of the environment on the Project reduce the risk of serious damage or interruption of service to acceptable levels. Mitigation measures include, among other things, designing structures to relevant codes and standards and applying conservative factors of safety to mitigate the potential effects of the environment (*e.g.*, earthquakes, climate change, global sea level rise, extreme weather, and other environmental phenomena), and scheduling of activities to allow for weather disruptions. A significant effect of the environment on the Project would be one that would result in a catastrophic interruption in service or damage to infrastructure that would persist for greater than three months or that would result in repairs that could not be economically implemented.

Therefore, based on a consideration of the various mitigation measures and strategies described in the Project Description and other sections of this EIA Report, it is concluded that the effects of the environment on the Project during any phase of the Project are not significant and will be managed by responsible design. Similarly, the effects of the environment on the Project are cumulatively rated not significant.