5.0 ENVIRONMENTAL ASSESSMENT

5.1 ATMOSPHERIC ENVIRONMENT

The atmospheric environment VC includes consideration of air quality, greenhouse gases and acoustic factors. These components constitute a VC due to:

- provisions under the *Air Quality Regulations* of the Nova Scotia *Environment Act*;
- emissions of Greenhouse Gases (GHG) and their accumulation in the atmosphere contributing to the greenhouse effect that is believed to influence climate;
- Health Canada guidelines for noise emissions and their potential impact on community health;
- the Noise Control Bylaw enforced by the MODG; and
- the function of the atmosphere as a pathway for the transport of air contaminants to the freshwater, marine, terrestrial and human environments.

Activities and components associated with construction and operation of Bear Paw have potential to interact with the environment in such a way that adversely affects air quality, greenhouse gas emissions and the acoustic environment. The specialized mitigation measures prescribed in Section 5.1.6 will be implemented to reduce potential effects on the atmospheric environment, in addition to the more generalized standard mitigation measures outlined in Section 2.5.3. As explained in the assessment below, with the application of these mitigation measures, residual Project-related CAC emissions levels will not exceed regulatory limits at the property boundary for the compressor station. The assessment demonstrates as well, that residual GHG emissions from Bear Paw construction activities will be temporary, will not likely contribute substantively to provincial or national GHG totals, and will not influence short and mid-term GHG release trends. GHG emissions during Bear Paw operation are anticipated to be low compared with provincial and national emission totals. The results of the assessment also indicate that noise emissions will be localized and are not anticipated to exceed Health Canada criteria. The assessment concludes with the prediction that, with the application of the mitigation recommended herein, the residual environmental effects of Bear Paw on the atmospheric environment are will be not significant.

The atmosphere has an intrinsic or natural value because its constituents are needed to sustain life and maintain the health and well-being of humans, wildlife, vegetation and other biota. Other VCs that are therefore closely linked to the assessment of Project-related effects on the atmospheric environment include Land and Resource Use (Section 5.8), Wildlife and Wildlife Habitat (Section 5.6) and Traditional Land and Resource Use (Section 5.7).

This assessment will focus on the potential effects that construction, and operation and maintenance could have on the atmospheric environment. Section 5.1.5 and 5.1.7 describes in detail these potential effects.

5.1.1 Regulatory and Policy Setting

5.1.1.1 Air Quality

The Government of Nova Scotia has established *Air Quality Regulations*, under the Nova Scotia *Environment Act* (Table 5.1.1). In addition to the provincial regulations, Canada has set an ambient air quality standard for fine particulate over two time averaging periods (Table 5.1.1).

Table 5.1.1 Summary of Regulations Pertaining to Ambient Air Quality in Nova Scotia

Contaminant	Averaging Period	Regulatory Threshold (µg/m³)	
		Federal[1]	Provincial[2]
Total Suspended Particulate (TSP)	24-hour	-	120
	Annual	-	70
Particulate Matter Less than 10 microns (PM_{10})	24-hour	-	-
Particulate Matter Less than 2.5 microns ($PM_{2.5}$)	24-hour	28 (2015) 27 (2020)	-
	Annual	10 (2015) 8.8 (2020)	-
Sulphur Dioxide (SO_2)	1-hour	-	900
	24-hour	-	300
	Annual	-	60
Nitrogen Dioxide (NO_2)	1-hour	-	400
	Annual	-	100
Carbon Monoxide (CO)	1-hour	-	34,600
	8-hour	-	12,700

Notes:
1 Canadian Council of Ministers of the Environment Canada-Wide Standards for $PM_{2.5}$.
2 *Nova Scotia Air Quality Regulations* (N.S. Reg. 179/2014).

5.1.1.2 Greenhouse Gases

At this time there is no consistent standard established for GHG emissions in Nova Scotia. The most recent federal GHG emissions reduction target was set in early 2015; it targets a reduction of 30% below 2005 levels by 200 (Environment Canada 2015c).

Nova Scotia enacted the *Environmental Goals and Sustainable Prosperity Act* in 2007 that commits to supporting and enabling energy efficiency, sustainable transportation options, increased renewable energy and enhanced use of natural gas to displace oil and coal. The Act includes renewable energy targets, improved energy efficiency in building codes and GHG reduction targets. The GHG related targets include the following:

- Nova Scotia will work with other levels of government on national emissions standards for greenhouse gases and air pollutants from new motor vehicles; and
- greenhouse gas emissions are to be, by 2020, at least 10% below the levels that were emitted in 1990.

GHG emissions were reported as 19,400 kt CO_2e in 1990 in Nova Scotia; therefore, the 2020 target would be a cap of 17,460 kt CO_2e. A Climate Action Plan was released in 2009 indicating the targeted GHG reductions would be primarily achieved through reducing emissions from power generation by generating less electricity and by generating it from lower GHG intensity sources (renewables and fossil fuels with lower GHG emissions on an equivalent energy basis). The electricity sector is noted as contributing 46% of the province's GHG releases (Nova Scotia Government 2009). Also in 2009, Nova Scotia released the *Greenhouse Gas Emissions Regulations* establishing GHG emission caps on the electricity sector. No other industries are provincially regulated for GHG releases in the province.

5.1.1.3 Acoustic Environment

For sound levels, the province of Nova Scotia has published a noise guideline, "Guideline for Environmental Noise Measurement and Assessment" (NSE 1989). This guideline includes noise criteria for different periods of the day (day, evening and night) and requires that the measurement duration be a minimum of two continuous hours of data in each time period to be representative. The Nova Scotia noise guidelines are presented in Table 5.1.2. Although not explicitly stated, these values are interpreted to represent hourly averages measured at the property boundary of sensitive receptors (e.g., residential properties, schools, retirement homes, medical facilities, places of spiritual significance).

Table 5.1.2 NSE Noise Guidelines

Averaging Time Period	NSE Noise Guideline (dBA)
Day (7:00 to 19:00)	65
Evening (19:00 to 23:00)	60
Night (23:00 to 7:00)	55

The MODG (the municipality within which the compressor station will be located) also enforces a Noise Control Bylaw (2011). This bylaw states the following, "Making any noise or combination of noises which, when measured on any property on which the noise is heard or the noises are heard, exceeds the applicable A-weighted continuous noise level as follows: 6:00 am to 11:00 pm – 65 dBA and 11:00 pm to 6:00 am – 55 dBA, would be deemed and declared to be noises which disturb or tend to disturb the peace and tranquility of residents".

Health Canada has published, "Useful Information for Environmental Assessments" (Health Canada 2010), which provides objectives for noise levels based on day-night average sound levels and annoyance. While Health Canada has not published regulations pertaining to noise, their publications provide guidance on assessing effects on the acoustic environment related to human health risk. Health Canada advocates that assessment of changes to the acoustic environment use the concept of annoyance first derived by the United States Environmental Protection Agency's (US EPA) in the investigation of community responses to perceived noise issues (US EPA 1974). Annoyance is calculated via a response function relating daytime and weighted nighttime sound pressure levels to a percentage of the population which is Highly Annoyed (%HA). The day-night sound level average is computed by averaging day time and night time sound pressure levels, where the night time value is weighted by an additional 10 dB to reflect the greater sensitivity or responsiveness of the community to noise effects at night.

The methods for computing %HA are found in the Canadian Standards Association *ISO 1996-1:2003, Acoustics – Description, measurement and assessment of environmental noise* (CSA 2003). The %HA is calculated for baseline sound pressure levels, then again at sound pressure levels predicted to occur from activities. Heath Canada recommends that the %HA at sensitive receptors not increase by more than 6.5% due to noise emissions from long term construction projects or project operations. Health Canada also recommends that absolute sound pressure levels not exceed 75 dBA at any receptor (Health Canada 2010).

A summary of Health Canada's (2010) guidance to noise assessments is provided in Table 5.1.3.

Table 5.1.3 Summary of Health Canada's Guidance to Assessing Noise

Phase	Criterion	Limit	Rationale
Temporary Construction (<2 months)	Community consultation is advised.	-	-
Short Term Construction (<1 year)	Mitigation is advised if levels are predicted to result in widespread complaints.	-	Mitigation required if resulting levels are predicted to result in widespread complaints or strong community reaction.
Construction (>1 year or operation with noise levels between 45-75 dB)	%HA	Change in %HA between project and baseline <6.5% at any specific receptor location	Annoyance is deemed to be a community health impact and mitigation is required if the %HA between baseline and project exceeds 6.5%.
Construction (>1 year) or operation with noise levels 45-75 dB)	Noise levels.	75 dBA at any specific receptor location	>75 dB mitigation required.

5.1.2 Boundaries

5.1.2.1 Spatial Boundaries

The assessment of potential environmental effects on atmospheric environment encompasses three spatial boundaries: Project Development Area (PDA), Local Assessment Area (LAA), and Regional Assessment Area (RAA). Spatial boundaries are presented below and shown in Figure 5.1.1.

Project Development Area (PDA)

Although the PDA includes the entire footprint, the assessment of potential environment effects on the atmospheric environment will, for the most part, focus on the potential effects that construction and operation of the compressor station could have, given its relatively higher level of interaction with the atmospheric components.

Local Assessment Area (LAA)

The LAA is the maximum area within which Project-related effects can be predicted or measured with a reasonable degree of accuracy and confidence. The LAA includes the PDA and adjacent areas where Project-related effects may reasonably be expected to occur. For a change in air quality, the LAA for construction is defined as an area that extends approximately 1 km on either side of the assessment corridor. For operation the LAA is defined as an area that is 10 km (west to east) by 10 km (north to south) centered on the compressor station. For a change in the acoustic environment, the LAA for construction is the same as for air quality. For operation the LAA is defined as a square area extending 3 km, in all directions, from the fence line of the compressor station. For a change in GHGs the LAA is defined as Nova Scotia.

The LAA for a change in air quality and the acoustic environment during operation is illustrated on Figure 5.1.1.

Regional Assessment Area (RAA)

The RAA is the area within which regional environmental effects on the atmospheric environment may occur and includes the presence of other regional emission sources. The RAA for air quality and the acoustic environment is identical to the corresponding LAAs. The RAA for GHGs is defined as global.

5.1.2.2 Temporal Boundaries

The temporal boundaries for the assessment of the potential environmental effects on atmospheric environment include construction, and operation and maintenance. Construction is currently scheduled to being in 2017 and will continue over a period of two years. Operation will follow construction and continue for the life of Bear Paw.

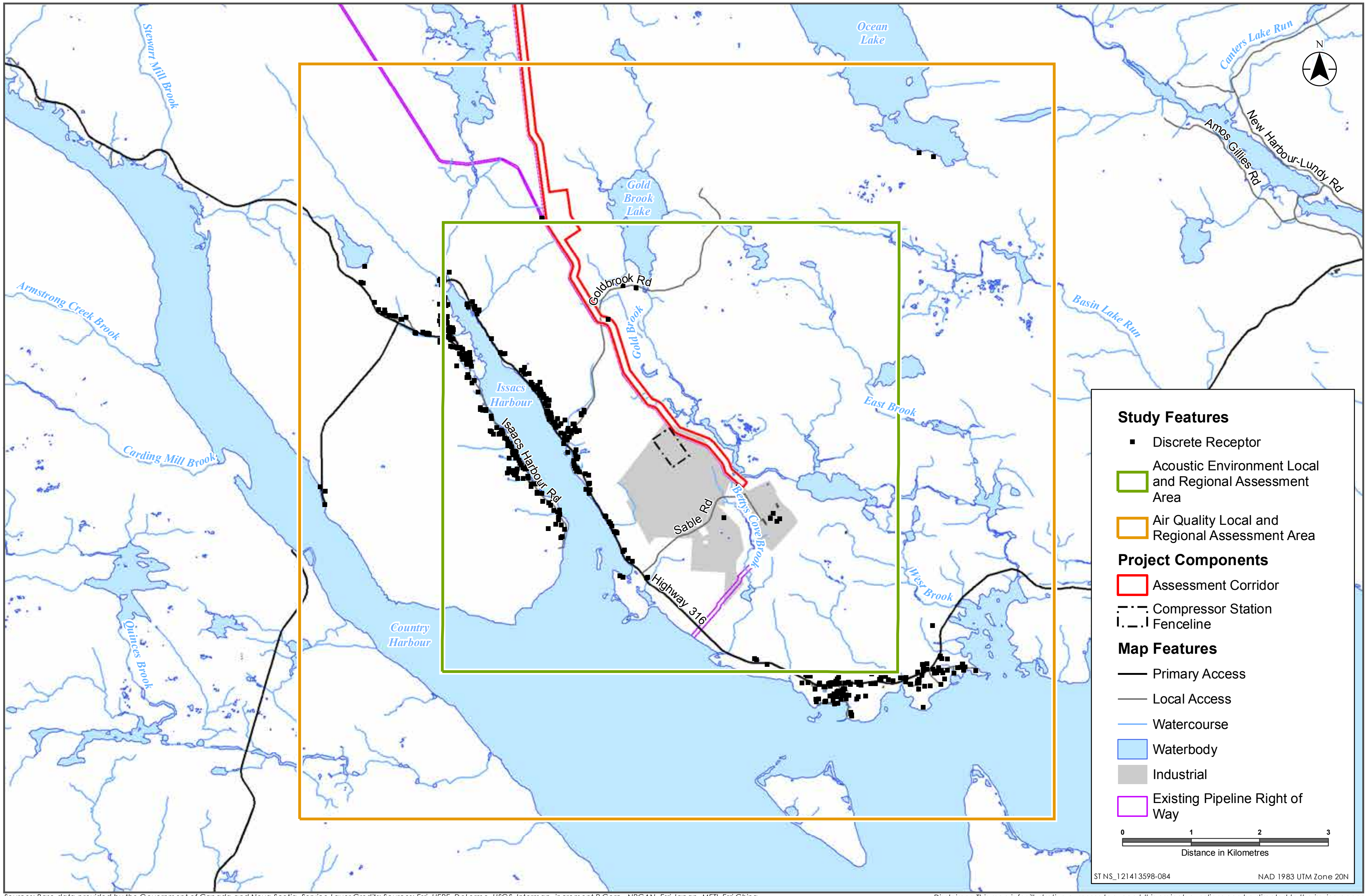
5.1.3 Significance Definition

For a change in air quality, provincial and national regulatory criteria for ambient air quality are used to determine if a change will be significant. A residual environmental effect on air quality would be considered significant if the concentrations of criteria air contaminants (CACs) resulting from the Project, plus existing ambient air quality, exceed the Nova Scotia *Air Quality Regulations* for NO_2 and CO, and the Canada Ambient Air Quality Standard for $PM_{2.5}$.

The Government of Nova Scotia has published two guidance documents for considering climate change during environmental assessment and project development: the "Guide to Considering Climate Change in Environmental Assessments in Nova Scotia" (NSE 2011a); and the "Guide to Considering Climate Change in Project Development in Nova Scotia" (NSE 2011b). The federal government has also developed a GHG assessment method which is based on guidance from the Federal-Provincial-Territorial Committee on Climate Change and Environmental Assessment, "Incorporating Climate Change Considerations in Environmental Assessment: General Guidance for Practitioners" (Federal-Provincial-Territorial Committee on Climate Change and Environmental Assessment 2003) (the Guidelines). The GHG assessment presented here follows the general guidance specified in these documents.

The provincial and federal guidance documents for assessing climate change in environmental assessments (referenced above) do not provide guidance on the determination of significance for GHGs; instead, these documents focus on the project GHG emissions and consideration of less emission-intensive ways to develop projects. In particular, the federal guidance states, "…the contribution of an individual project to climate change cannot be measured". As the effect on climate change from the contribution of a single project cannot be accurately measured or attributed, it is not reasonable to make a significance determination on atmospheric GHG concentrations or climate change from a single project.

For a change in the acoustic environment, a significant adverse residual environmental effect is defined as a Project-related environmental effect that results in sound pressure levels at the nearest residential receptors or sensitive receptors (i.e., daycares, schools, hospitals, places of worship) that exceed the Nova Scotia noise guidelines, the Municipality of Guysborough Noise Control Bylaw or that cause a change in the calculated %HA from baseline greater than 6.5%.



Sources: Base data provided by the Government of Canada and Nova Scotia. Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

Bear Paw Pipeline

Stantec

BEAR PAW PIPELINE PROJECT

Atmospheric Environment - Spatial Boundaries

Figure 5.1.1

5.1.4 Description of Existing Conditions

The existing atmospheric environment is described in the following section in the context of air quality, climate, greenhouse gases and the acoustic environment. This discussion is focused on the area surrounding the PDA.

5.1.4.1 Approach and Methods

Air Quality

Air quality is represented by the components of the ambient air, including the presence and quantity of air contaminants in the atmosphere. In general, the province of Nova Scotia has good air quality due to the combination of the local climate (which provides good dispersion of air contaminants), and the relatively small population and industrial sector presence. However, Nova Scotia's air quality can be influenced by the long-range transportation of air masses from other parts of Canada or from the US (NSDOE 1998).

NSE monitors air quality in the province with a network of monitoring stations, in conjunction with Environment Canada's National Air Pollution Surveillance Network (NAPS). The air pollutants most commonly monitored are SO_2, total particulate matter (TPM), $PM_{2.5}$, PM_{10}, CO, ozone (O_3), and NO_2. The nearest provincial air quality monitoring station is located in Port Hawkesbury, located approximately 52 km northeast from the compressor station.

The compressor station is sited in a rural area on lands zone for industrial use, with some nearby industrial development, including the SOEP Gas Plant.

Existing air quality surrounding the compressor station was characterized using data collected by the SOEP Gas Plant as presented in the Environmental Assessment Report for the proposed Goldboro LNG – Natural Gas Liquefaction Plant and Marine Terminal (Pieridae 2013). For those CACs not monitored by this program, data was acquired from the NAPS.

Climate

Climate is the statistical average (i.e., mean and variability) of meteorological and weather conditions of a region over a defined period of time. Climate is characterized by various weather elements such as air pressure, precipitation, temperature, humidity, sunshine, cloudiness, wind and fog (Environment Canada 2014).

Current climatic conditions are typically represented by the most recent 30 year period, for which Environment Canada has developed statistical summaries, referred to as climate normals (Environment Canada 2015a). The closest Environment Canada weather station with available historical data (1981-2010) is the Stillwater Sherbrooke station (45°08' N, 61°58' W), located approximately 26.8 km southwest from the compressor station. Data collected at this station was used to characterize existing climatic conditions at the compressor station.

In order to conduct dispersion modelling, five years of pre-processed MM5 (Fifth-Generation Penn State/NCAR Mesoscale Model) meteorological data was also acquired near the compressor station. This source of data is routinely used for such purposes and accepted by NSE and other regulators. As the climate normal data for the Stillwater Sherbrooke station does not include wind speed or direction data, the MM5 dataset was used to describe existing wind speed and direction conditions in and surrounding the PDA.

Greenhouse Gases

An understanding of the existing provincial, national and global GHG emissions is required when putting Project-related GHG emissions into context. The GHG emissions from other facilities in Canada were also considered (Environment Canada 2015d).

Provincial and national GHG emissions were obtained from the Environment Canada National Inventory Report for 1990–2013 (Environment Canada 2015b). Facilities that reported emissions of more than 50 kt CO_2e to Environment Canada for the 2013 reporting year were reviewed to support establishment of low, moderate and high emitter levels (Environment Canada 2015d).

An estimate of global GHG emissions is based on the Climate Analysis Indicators Tool, developed by the World Resources Institute. The Climate Analysis Indicators Tool has compiled estimates of global GHG emissions from sources such as the US Energy Information Administration, US EPA and the International Energy Agency (WRI 2015).

Acoustic Environment

The acoustic environment is characterized by the type, frequency, duration and intensity of noise (unwanted sound) in the outdoor environment.

Noise is measured as sound pressure levels (SPL) in decibels (dB). These measurements are conventionally expressed on the A weighted scale (denoted as dBA), as it emphasizes the frequencies of highest sensitivity to the human ear.

Humans are exposed to a broad range of sound pressure levels, which are represented on a logarithmic scale. A level of 0 dBA is the least perceptible sound by a human. A change in 3 dBA represents a physical doubling of the SPL but is barely perceptible as a change, whereas most people clearly notice a change of 5 dBA and perceive a change of 10 dBA as a doubling of the sound level. Typically, conversation occurs in the range of 50 dBA to 60 dBA. Loud equipment and trucks passing on a busy road can create noise levels above 85 dBA. Very quiet environments, such as still rural or suburban nights, typically fall below 40 dBA.

The existing ambient sound levels in and surrounding the area would be expected to be typical of rural ambient levels, as well as the existing industrial activities in the area, and any natural background sounds (e.g., wind).

To characterize the existing acoustic environment surrounding the PDA, data was acquired from the Environmental Assessment Report for the proposed Goldboro LNG – Natural Gas Liquefaction Plant and Marine Terminal (Pieridae 2013).

5.1.4.2 Summary of Existing Conditions

Air Quality

This section describes the ambient air quality in and surrounding the PDA based on data from the nearest representative ambient air monitoring stations.

The nearest NAPS air monitoring station to the proposed compressor station is located in Port Hawkesbury. This station measures ambient concentrations of NO_2, nitrogen oxide (NO), oxides of nitrogen (NO_x), $PM_{2.5}$ and O_3. As this station does not monitor all substances of interest for Bear Paw (CO, NO_2 and $PM_{2.5}$), data for CO was acquired from the Halifax NAPS station. Halifax is a much more urbanized area, and spatially separated from the study area, but can be used to infer a maximum possible level of CO that could occur in the study area. These data are presented in Table 5.1.4.

Table 5.1.4 Summary of NAPS Ambient Air Monitoring Data, 2011–2013

Contaminant	Averaging Time Period	Monitoring Data (µg/m^3)
NO_2	1-hour (99th Percentile)	26
	Annual (mean)	5.6
CO	1-hour (99th Percentile)	572
	8-hour (99th Percentile)	510
$PM_{2.5}$	24-hour (99th Percentile)	17
	Annual (mean)	6

Note:
All data was retrieved online from the National Air Pollution Surveillance (NAPS) Monitoring Results website $PM_{2.5}$ and NO_2 data was acquired from the Port Hawkesbury Station; CO data is from Halifax.
Source: Environment Canada 2013b.

In 2004, air quality monitoring was conducted in Seal Harbour, approximately 5.25 km southeast from the proposed compressor station, between June 10 and August 10, 2004 and the results of this monitoring have been summarized in the Environmental Assessment Report, Goldboro LNG – Natural Gas Liquefaction Plant and Marine Terminal (Pieridae 2013). These data are included in Table 5.1.5. The results presented in the table are the highest monitored contaminant concentrations collected during the monitoring period. Continuous monitoring was conducted for SO_2 and NO_2 during the time period referenced above. Monitoring for TSP and $PM_{2.5}$ was conducted for three 24-hour time periods (once during July, August and September 2004).

Table 5.1.5 Ambient Air Quality Monitoring Results, Seal Harbour, 2004

Contaminant	Averaging Time Period	Monitoring Data (µg/m^3)
NO_2	1 hour	-
	24 hours	3.8
	Annual	-
SO_2	1 hour	-
	24 hours	10.5
	Annual	-
TSP	24 hours	19.8
	Annual	-
$PM_{2.5}$	24 hours	4.0
	Annual	-
Source: Pieridae 2013		

When assessing residual Project-related environment effects and Project compliance with the provincial *Air Quality Regulations*, and Canada Wide Standards for $PM_{2.5}$, ambient air quality data from the NAPS station in Port Hawkesbury (for NO_2 and $PM_{2.5}$) and Halifax (for CO) was used (Section 5.1.7).

Climate

Table 5.1.6 provides a summary of the common meteorological elements, with brief descriptions provided in the following sections.

Temperature

Annual climate normals at the Stillwater Sherbrooke weather station indicate that January is typically the coldest month of the year, with a daily average temperature of -6.2°C. The warmest month of the year is usually August, with an average daily temperature of 18.6°C (Environment Canada 2015a).

Precipitation

The average annual precipitation is 1,524.7 mm, with November being the rainiest month (155.8 mm on average). February is the snowiest month, with an average snowfall amount of 45.6 cm (Environment Canada 2015a) (Table 5.1.6).

Table 5.1.6 Air Temperature and Precipitation Climate Normals, Stillwater Sherbrooke, Nova Scotia (1981–2010)

Month	Temperature (°C)					Precipitation (mm)					Mean No. of Days with								
	Averages			Extreme		Rainfall (mm)	Snowfall (cm)	Precipitation (mm)	Extreme daily Rainfall (mm)(Year)	Extreme Daily Snowfall (mm)(Year)	Temperature (°C)					Snow (cm)		Rain (mm)	
	Max	Min	Avg	Max (Year)	Min (Year)						<=0	> 0	>10	>20	>30	>=10	>=25	>= 10	>= 25
January	-1.2	-11.2	-6.2	17.5 (1995)	-31 (1993)	86.1	44.5	130.5	96 (1990)	32 (1987)	18.1	13	0.65	0	0	1.3	0.17	3.1	0.86
February	-0.2	-10.3	-5.3	14.5 (1981)	-39 (1985)	69	45.6	114.6	71.2 (1988)	38.1 (1972)	14.1	14.2	0.52	0	0	1.5	0.22	2.6	0.95
March	3.6	-6.1	-1.2	25.5 (1998)	-29 (1985)	101.2	28.9	130.1	80 (1972)	32 (1984)	6.8	24.2	2.4	0.05	0	1.1	0.05	3.6	1.4
April	8.6	-0.4	4.1	23.3 (1973)	-12.5 (1986)	100.1	11.8	111.9	85 (1982)	29 (1999)	0.45	29.6	9.5	0.1	0	0.45	0.05	3.8	0.95
May	14.9	3.9	9.5	32 (1992)	-6.1 (1972)	118.8	0.6	119.4	105.9 (1972)	6 (1985)	0	31	26.2	4.4	0	0	0	3.7	1.3
June	20.3	8.7	14.5	35 (1976)	-2.2 (1969)	112.7	0	112.7	78.7 (1970)	0 (1968)	0	30	29.6	15.2	0.22	0	0	3.9	1.4
July	24.2	12.9	18.5	34 (1999)	3.5 (1993)	96.3	0	96.3	75 (1983)	0 (1968)	0	31	31	27.5	0.91	0	0	3.5	1.1
August	24	13.1	18.6	34.5 (2002)	1.7 (1968)	110.4	0	110.4	134.8 (1990)	0 (1968)	0	31	31	27.2	0.64	0	0	3.4	1.5
September	20.2	9	14.6	32.2 (1969)	-3 (2000)	138.5	0	138.5	142.6 (1996)	0 (1967)	0	30	30	15.2	0	0	0	3.9	1.6
October	14.2	3.8	9	26.7 (1968)	-7 (1993)	139.3	0.1	139.4	81.3 (1967)	17.8 (1972)	0	31	25.6	2.1	0	0	0	4.5	2
November	8.1	0.1	4.1	18.5 (1983)	-15.5 (1989)	155.8	9.6	165.4	89.6 (1983)	25 (1989)	1.1	28.9	10	0	0	0.18	0.05	5.2	1.6
December	2.6	-5.8	-1.6	15.5 (1998)	-32.5 (1989)	118.7	37	155.7	114.3 (1975)	30 (1983)	9	22.1	2.3	0	0	1.4	0.05	3.8	1.3
Annual	**11.6**	**1.5**	**6.6**	**-**	**-**	**1346.7**	**178**	**1524.7**	**-**	**-**	**49.5**	**315.8**	**198.8**	**91.7**	**1.8**	**5.9**	**0.59**	**44.9**	**15.8**

Source: Environment Canada 2015a

Wind

To characterize wind conditions at and surrounding the PDA, five years of Fifth-Generation Penn Stat/NCAR Mesoscale Model (MM5) meteorological data (January 1, 2010 to December 31, 2014) was acquired for the general area representing the location of the compressor station. A summary of the data is presented in Table 5.1.7 and in Figure 5.1.2.

Table 5.1.7 Statistics for MM5-Derived Wind Data

Parameter	MM5 Data – Bear Paw Compressor station
Easting (m)	606,601
Northing (m)	5,005,632
Start Date	January 1, 2010
End Date	December 31, 2014
Total Hours	43824
Calm Winds (wind speeds <0.5 m/s) Hours	341
Calm Winds (wind speeds <0.5 m/s) Frequency (%)	0.78
Maximum Wind Speed (m/s)	18
Average Wind Speed (m/s)	5.35

Winds at the proposed compressor station location are predominantly from the southwest and south-southwest directions. Wind speeds average 5.35 m/s, and the maximum wind speed recorded for the data set was 18 m/s. For 60% of the time, wind speeds are less than 5.7 m/s, and 3% of the time winds are greater than 11.1 m/s.

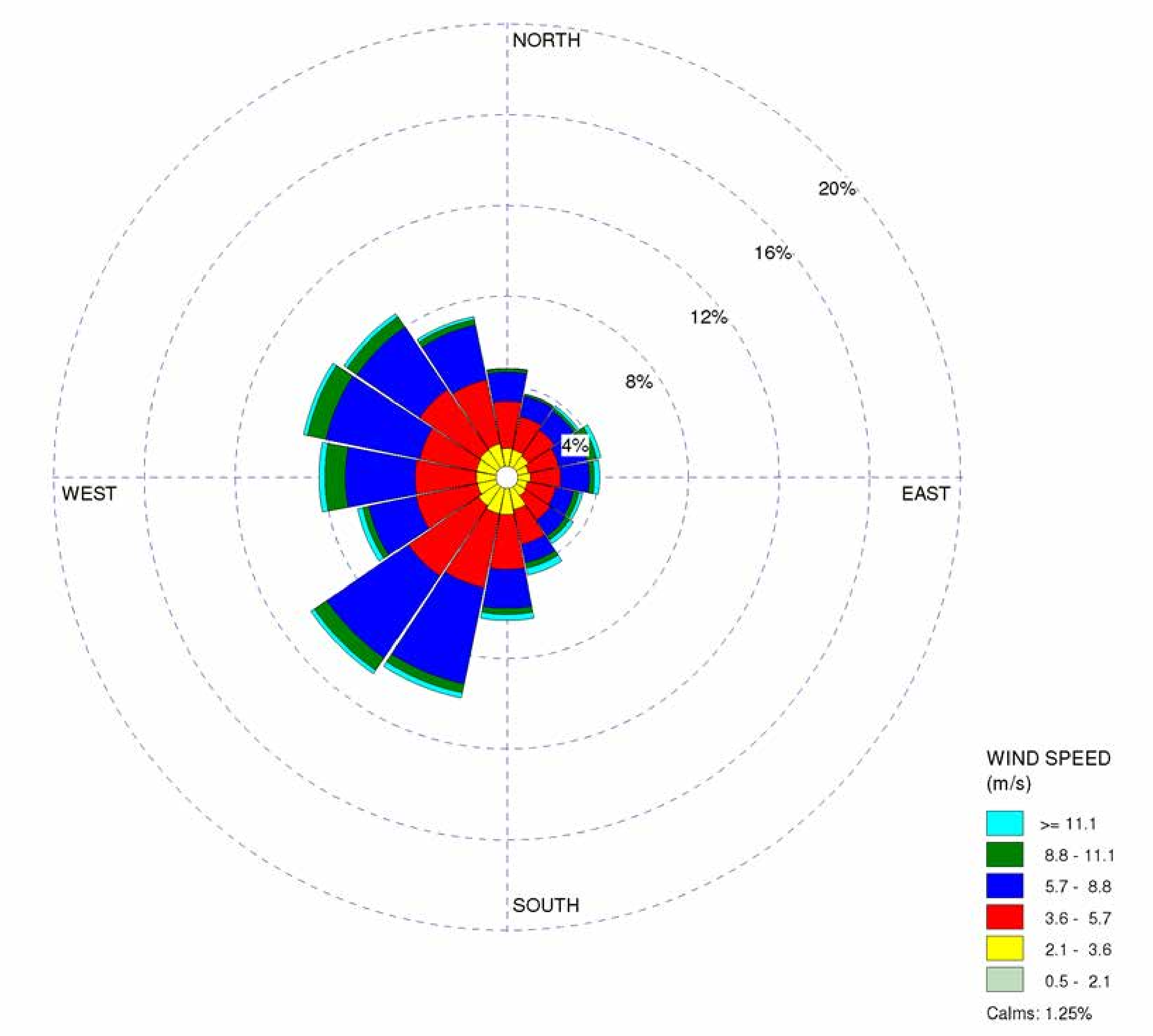


Figure 5.1.2 Joint Wind Speed and Direction Frequency Diagram (Winds Blowing From)

Greenhouse Gases

The provincial, national and global GHG emissions for 2005 through to 2013 are presented in Table 5.1.8.

In 2012, global emissions of GHGs were estimated to be 44,815,500 kt CO_2e, excluding emissions from land use change and forestry (WRI 2015). Canada's contribution to global GHG emissions in 2012 was 1.6%. Nova Scotia's contributed to the national total was approximately 2.5% in 2013 and to the global total, approximately 0.04% (based on 2012 totals as 2013 global data are not yet available).

Table 5.1.8 Global, National and Provincial GHG Emissions (kt CO2e), 2005–2013

Region	2005	2009	2010	2011	2012	2013
Global[1]	38,696,545	40,956,547	42,669,718	43,816,734	44,815,500	NA
Canada	749,000	699,000	707,000	709,000	715,000	726,000
Nova Scotia	24,000	21,000	20,700	21,400	19,600	18,300

Notes:

NA = not available.

Years 2005, 2009, 2010, 2011, 2012, 2013 are presented as these are the data provided in the most recent national inventory report (Environment Canada 2015b).

[1] Includes countries that report GHG emissions.

Source: Environment Canada (2015b), WRI (2015)

In 2013, 487 facilities reported GHG releases of more than 50 kt CO_2e to Environment Canada. Table 5.1.9 summarizes percentiles of GHG releases from these 487 facilities. These data provide a facility-based emissions profile for Canadian operated facilities (emissions on a per facility basis) and indicate that 50% of reporting facilities emitted approximately 150 kt CO_2e or more per year each, while 10% emitted more than 1,080 kt CO_2e per year.

Table 5.1.9 Facility GHG Emissions in Canada – 2013

Percentile	kt CO_2e
1st Percentile	50
10th Percentile	60
25th Percentile	80
50th Percentile	150
75th Percentile	450
90th Percentile	1,080
99th Percentile	5,900
Maximum	**12,550**

Note: Percentiles were derived from 2013 reported emissions for 487 facilities that reported more than 50 kt CO_2e, and were rounded.

Source: Environment Canada (2015b)

Acoustic Environment

Baseline noise data was acquired from the Environmental Assessment Report for the proposed Goldboro LNG – Natural Gas Liquefaction Plant and Marine Terminal (Pieridae 2013). This document summarizes two noise monitoring events that occurred near the compressor station, one for the SOEP Gas Plant and the other to support an Environmental Assessment for the proposed Keltic Project.

To assess potential environmental effects on the acoustic environment, predicted sound levels are typically added to existing sound levels. The results of noise monitoring conducted in 2004 for the SOEP Gas Plant were collected at locations immediately surrounding the Gas Plant and would not represent the existing acoustic environment of the residential receptors located along Route 316 and Goldbrook Road (approximately 2 km to 3 km away). Therefore the data collected for the Keltic Project (incorporated by Pieridae 2013) was used in the noise assessment for the compressor station (Section 5.1.7). This data is presented in Table 5.1.10.

Table 5.1.10 Sound Quality Monitoring Results, Site of the Proposed Pieridae LNG Terminal (2007)

Date	Time	Monitoring Location and L_{eq} (dBA)[1]			
		Keltic Project	Residence 1 (Isaac's Harbour)	Residence 2 (Goldboro Public Wharf)	Residence 3 (Drum Head)
Oct. 17, 2007	07:00 – 19:00	47	37	51	39
Oct. 18, 2007	07:00 – 19:00	45	27	46	37
Oct. 19, 2007	07:00 – 19:00	45	26	46	32

Note:
1 Exact locations of the monitoring sites are depicted in the Pieridae EA.
Source: Pieridae 2013.

Those monitoring locations, as presented in Table 5.1.10, that would best represent the nearest receptors to the proposed compressor station are the Keltic Project monitoring site (located approximately 1 km to the west of the SOEP Gas Plant) and the Drum Head Residence monitoring site (located approximately 3 km to the south of the SOEP Gas Plant). Based on distance to existing noise generating sources (i.e., the SOEP Gas Plant), the data collected at the Keltic Project monitoring site was assumed to be representative of existing daytime sound levels (46 dBA) and the data collected at the Drum Head Residence monitoring site for existing nighttime sound levels (36 dBA). These values are also consistent with guidance provided by the Alberta Energy Regulator (AER) in Directive 038: Noise Control (2007). This document states that the average ambient sound level in a rural environment during the night is typically 35 dBA, and 10 dBA higher in the day, 45 dBA. These levels were determined through research conducted by the Environment Council of Alberta and field verified by Stantec in a number of locations in Nova Scotia and Newfoundland.

5.1.5 Potential Environmental Effects and Project-Related Interactions

Activities and components could potentially interact with the atmospheric environment to result in adverse effects on air quality and increased levels of greenhouse gas emissions and noise levels. In consideration of these potential interactions, the assessment of Project-related environmental effects on the atmospheric environment is therefore focused on the following potential environmental effects:

- change in air quality;
- change in greenhouse gases; and
- change in acoustic environment.

The effect pathways and measurable parameters for the assessment of the environmental effects presented above are provided in Table 5.1.11.

Table 5.1.11 Potential Environmental Effects, Effects Pathways and Measurable Parameters for Atmospheric Environment

Potential Environmental Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in Air Quality	• Interactions between activities and the environment that result in direct effects to the quality of air.	• Oxides of nitrogen (NO_x), including nitrogen dioxide (NO_2) (µg/m^3); carbon monoxide (CO) (µg/m^3); and total particulate matter (TPM) (µg/m^3).
Change in Greenhouse Gases	• Interactions between activities and the environment that result in increased GHG emissions.	• Carbon dioxide (CO_2) (tonnes of CO_2e/year); methane (CH_4) tCO_2e/year); and nitrous oxide (N_2O) t CO_2e/year).
Change in Acoustic Environment	• Interactions between activities and the environment that result in changes to the existing acoustic environment.	• Sound Pressure Levels (L_{eq}, dBA); Day Night Average Sound Level (L_{dn}, dBA); and % Highly Annoyed (%HA).

5.1.5.1 Air Quality

The Project will interact with the atmospheric environment to result in a change in air quality through the release of air contaminants into the atmosphere during construction and operation. During construction the following activities will release CACs:

- operation of diesel powered heavy equipment during site preparation along the construction RoW and at the compressor station (i.e., dozers and graders, skidders, tree fellers, log processers, track hoes, generators, etc.);
- brush burning during site clearing (if required);

- operation of diesel powered heavy equipment during pipeline installation (i.e., pipe benders, excavators, generators, side boom tractors, rock drills);
- operation of HDD equipment at watercourse crossings;
- operation of diesel powered heavy equipment and engines during construction and installation of the compressor station and valve stations (pile driving, generators, cranes, etc.);
- operation of light duty trucks; and
- blasting (if substantial bedrock is encountered).

During operation, the following activities have the potential to release CACs into the atmosphere:

- operation of a gas compressor station equipped with six gas powered compression turbines (one stand-by), five gas fired electric generators and four gas boilers;
- operation of a 62.5 km pipeline, including fugitive emissions from the pipeline, valve stations and compressor station; and
- maintenance of the pipeline, valve stations and compressor station.

The majority of emissions from construction activities will include SO_2, CO, NO_2 and particulate matter and from operational activities $PM_{2.5}$, NO_x and CO. The level of sulphur present in the natural gas that will be combusted at the compressor station is considered minimal and therefore emissions of SO_2 from the operation of the compressor station were not considered in this assessment.

5.1.5.2 Greenhouse Gases

The Project will interact with the atmospheric environment to result in a change in GHGs through the release of GHGs into the atmosphere during construction and operation as defined above for air quality. Common GHGs potentially emitted from activities include carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O).

GHGs are known to contribute to changing the climate, leading to many other changes in the atmosphere, on land and in the oceans. These changes will have both positive and negative effects on people, plants and animals. Because the major greenhouse gases can stay in the atmosphere for tens to hundreds of years after being released, their warming effects on the climate will persist over a long time (US EPA 2013).

GHGs absorb heat radiated by the earth and subsequently warm the atmosphere, leading to what is commonly known as the greenhouse effect. The degree of warming is characterized as the global warming potential, relative to carbon dioxide. For the assessment, the global warming potential of CO_2, CH_4, and N_2O are 1, 25 and 298, respectively (IPCC 2013). Because GHGs contribute to different extents to the greenhouse effect, the unit of tonnes of carbon dioxide equivalent (t CO_2e) is used to express the total quantity of GHGs. The unit of t CO_{2e} is calculated by multiplying the tonnage emission of each GHG by its global warming potential (i.e., tonnes of CH_4 are multiplied by 25), then summing the contributions from CO_2, CH_4 and N_2O.

GHG emissions from construction activities will result from the combustion of fuel in construction equipment. These emissions will be relatively small scale and will occur over a short term. With standard mitigation as discussed in Section 2.5.3 and Section 5.1.6, these GHGs will not contribute substantively to provincial or national GHG totals and will not influence short and mid-term GHG release trends (notable changes occurring year over year). Therefore, potential environmental effects related to a change in GHGs during construction have not been further assessed.

Emissions from operation include mainly the emissions from combustion (CO_2, CH_4, N_2O) as well as small amounts of venting and fugitive emissions. The potential environmental effects from operations on a change in GHG emissions are further assessed in Section 5.1.7. Consideration would be given to the use of a mobile flare system in the event that a large amount of venting was required (such as a substantive length of pipeline). By converting methane to carbon dioxide, flaring (as opposed to direct venting) results in lower GHG emissions by a factor of 25.

Acoustic Environment

The Project will result in increases in sound levels above existing conditions during construction and operation. Those activities that have the potential to interact with the acoustic environment are very similar to those that could impact air quality, and are presented above.

The potential environmental effects from operation on a change in the acoustic environment are further assessed in Section 5.1.7.

5.1.6 Mitigation

The mitigation measures that will be implemented to reduce potential effects on existing ambient air quality, reduce emissions of GHGs and to reduce noise during construction and operation are presented in Table 5.1.12. These mitigation measures are specific to the atmospheric environment and are in addition to the standard mitigation presented in Section 2.5.3.

Table 5.1.12 Mitigation for Atmospheric Environment

Effect	Phase	Mitigation
Change in Air Quality	Construction	• Dust control on access roads through the application of water. • Maintaining construction equipment in good working order and properly muffled. • Reducing idling of equipment, where practical. • Brush burning, if required, to follow requirements noted in Section 2.5.3.
	Operation	• Gas turbines equipped with dry low emissions (DLE) combustion technology. • Boilers equipped with low NO_x burners.
Change in Greenhouse Gases	Construction and Operation	• Adherence to manufacturer's recommended maintenance schedules and limiting vehicle idling. • Adherence to fugitive and venting emissions management and controls (e.g., pipeline venting via a mobile flare will convert CH_4 releases to CO_2, reducing the overall GHG emissions). • Directed inspection and maintenance. • GHG Management Plan.
Change in Acoustic Environment	Construction	• Where practical, construction activities will be scheduled to occur during daytime hours. • Nearby residents will be notified in advance of substantial noise generating activities. • Where practical, equipment will be turned off when not in use. • Position HDD equipment to shield it as much as possible from nearby receptors. • Development of a noise complaint resolution procedure.
	Engineering Design	• Silencers on the air intakes and exhausts of the gas turbines. • Silencers on the exhausts of the generators.

The assessment of residual environmental effects (Section 5.1.7) considers residual effects on the atmospheric environment after the general mitigation measures, as provided above, have been implemented.

5.1.7 Residual Environmental Effects and Significance Determination

This assessment was conducted based on conservative assumptions and the lowest likely psi scenario for incoming gas, which would require the greatest amount of compression. The information presented represents the greatest number of emissions-generating equipment that would be associated with Bear Paw and is therefore the most conservative (i.e., worst) case.

5.1.7.1 Change in Air Quality

Construction

For construction, the residual environmental effects from the change in air quality were assessed quantitatively (Table 5.1.13). Information pertaining to the type of equipment, equipment quantities, fuel consumption, and duration of operation are based on preliminary design. Emission factors for non-road mobile sources were based on the US EPA NONROAD2008a model and for on-road mobile sources US EPA emission standards for heavy-duty compression ignition (CI) engines were used (US EPA n.d.).

Table 5.1.13 Estimated Releases of CACs from the Construction of the Compressor Station and Pipeline

Construction Phase	Emissions (tonnes/phase)			
	CO	NO_x	SO_2	PM
Facility - Clearing and Grading	2.17	11.35	0.02	0.14
Facility - Construction	17.44	25.15	0.07	0.97
Facility - Pick-up Trucks	1.74	0.02	0.05	0.00
Pipeline- Tree Clearing	3.14	9.92	0.05	0.46
Pipeline - Grading	0.92	11.66	0.02	0.08
Pipeline - Pipe Gang	1.09	10.14	0.01	0.10
Pipeline - Lower In and Backfill	0.41	5.85	0.01	0.04
Pipeline - Pressure Testing	0.01	0.19	0.00	0.00
Pipeline - Clean-up	0.40	5.99	0.01	0.03
Pipeline - Salmon River Crossing	0.36	3.40	0.01	0.04
Pipeline - Milford Haven River Crossing	0.23	0.82	0.00	0.02
Pipeline - Strait of Canso Crossing	1.80	10.32	0.02	0.16
Pipeline - Pick-up Trucks	9.35	0.12	0.28	0.01
Total	**39.06**	**94.94**	**0.56**	**2.05**
Note: All table values are approximate and subject to refinement following detailed engineering.				

In addition to the combustion emissions presented above, fugitive emissions of particulate matter (i.e., dust) could also result from site preparation and from vehicle traffic on temporary unpaved access roads. If substantial bedrock must be excavated, blasting may be required potentially resulting in emissions of particulate matter and combustion gases (NO_x, CO and SO_2).

Potential environment effects on air quality due to construction activities are inherently time limited, but are particularly limited in the case of linear facilities, such as a pipeline. Each element of construction will occur along the construction RoW for a finite interval as construction proceeds. During that brief period, however, construction activities can affect land use activities adjacent to the construction RoW on a short term and reversible basis. The most intensive construction activities will occur at the major watercourse crossings and at the compressor station.

The emissions resulting from the above activities will be localized (within 150 m of the assessment corridor) and will occur over a short term. With standard mitigation (Sections 2.5.3 and 5.1.6), these emissions will not contribute substantively to the existing air quality, are expected to be well within the regulatory standards, and will be similar to those generated by other large construction projects that have been undertaken in Nova Scotia.

Operation and Maintenance

For operation, the residual environmental effects on a change in air quality were assessed using quantitative methods based on the availability of a detailed emissions inventory of Project-related CAC emissions from the operation of the compressor station. Dispersion modelling, using AERMOD, was conducted to predict ground level concentrations of CACs from the operation of the compressor station. Details of the model are provided in Appendix C. This assessment of residual environmental effects focuses on the operation of the compressor station, as emissions from the operation of the valve stations and the fugitive emissions along the pipeline during operation and maintenance would be considered negligible in comparison.

The estimated annual CAC emissions from the operation of the compressor station are presented in Table 5.1.14. This emissions inventory includes the major sources of emissions that will be in operation at the compressor station. Other smaller sources of emissions, including diesel combustion equipment (e.g. pick-up trucks) were not included in this inventory as the emissions from these sources will be negligible in comparison to the operation of the compressors, boilers and generators.

Equipment emissions data for the major sources of emissions at the compressor station are based on preliminary design information and, where specific emissions data was not available, published emissions rates from the US EPA AP42, Compilation of Air Pollutant Emission Factors, were used along with details pertaining to the equipment heat input and power ratings. The annual emission estimates assume that all equipment is operating twenty-four hours a day, seven days a week. Details pertaining to these calculations have been included in Appendix C.

Table 5.1.14 Estimated Releases of CAC from the Operation of the Compressor Station

Equipment	Quantity	Power Rating per Unit (kW)	$PM_{2.5}$ (t/y)	NO_2 (t/y)	CO (t/y)
Compressors (Gas Turbines)	5	3500	13.9	245.3	298.7
Generators	5	936	0.02	246.0	173.4
Boilers	4	2,344	0.9	17.5	10.5
Total	**-**	**-**	**14.8**	**508.8**	**482.6**

Note: All table values are approximate and subject to refinement following detailed engineering.
Emission factors were acquired from US EPA 1998, US EPA 2000a, US EPA 2000b and Alberta Government 1996.

The maximum predicted ground-level concentrations of $PM_{2.5}$, NO_2 and CO (with and without background levels) are presented in Tables 5.1.15 and have been graphically illustrated (without background levels) in Attachment 1 of Appendix C. One operational scenario was modelled, which included the major pieces of equipment at the compressor station, operating continuously in order to quantify the maximum. Maximum predicted concentrations fell at or near the boundary of the compressor station, and predictions were below applicable regulatory limits.

Table 5.1.15 Maximum Predicted Ground Level Concentrations for the Operation of the Compressor Station

Contaminant	Time Averaging Period	Maximum Predicted Ground Level Concentrations (μg/m³)	% of Regulatory Limit	Ambient Background Concentration (μg/m³)[1]	% of Regulatory Limit	Maximum Predicted Ground Level Concentrations including Ambient Background (μg/m³)	% of Regulatory Limit	Regulatory Limit (μg/m³)
NO_2	1-hour	311	78	26	6.5	337	84	400[2]
	Annual	20	20	5.6	5.6	25.6	26	100[2]
CO	1-hour	534	1.5	572	1.6	1,106	3.2	34,600[2]
	8-hour	481	3.8	510	4.0	991	7.8	12,700[2]
$PM_{2.5}$	24-hour	7.7	29	17	63	24.7	91	27[3]
	Annual	0.86	9.8	6	68	6.86	78	8.8[3]

Note:

1 Section 5.1.4; NO_2, 1-hour values represent 99th percentiles; annual values are means; CO,1-hour and 8-hour values represent 99th percentiles; $PM_{2.5}$, 24-hour values represent 99th percentiles; annual values are means.

2 Nova Scotia *Air Quality Regulations* (N.S. Reg. 179/2014).

3 Canadian Council of Ministers of the Environment Canada-Wide Standards for $PM_{2.5}$ (2020).

The maximum predicted 1-hour ground level concentrations of NO_2 for the operation of the compressor station was 311 μg/m³. With ambient background added, this concentration increased to 337 µg/m³. All predicted and predicted plus ambient background concentrations are below the applicable Nova Scotia *Air Quality Regulations*.

The maximum predicted annual ground level concentration of NO_2 for the operation of the compressor station was 20 µg/m³. With ambient background added, this concentration increased to 25.6 µg/m³. All predicted and predicted plus ambient background concentrations are below the applicable Nova Scotia *Air Quality Regulations*.

The maximum predicted 1-hour ground level concentration of CO for the operation of the compressor station was 534 µg/m³. With ambient background added, this concentration increased to 1,106µg/m³. All predicted and predicted plus ambient background concentrations are below the applicable Nova Scotia *Air Quality Regulations*.

The maximum predicted 8-hour ground level concentration of CO for the operation of the compressor station was 481 µg/m³, respectively. With ambient background added, this concentration increased to 991 µg/m³. All predicted and predicted plus ambient background concentrations are below the applicable Nova Scotia *Air Quality Regulations*.

The maximum predicted 24-hour ground level concentration of $PM_{2.5}$ for the operation of the compressor station was 7.7 µg/m³. With ambient background added, this concentration increased to 24.7 µg/m³. All predicted and predicted plus ambient background concentrations are below the applicable Canada Wide Standards.

The maximum predicted annual ground level concentration of $PM_{2.5}$ for the operation of the compressor station was 0.86 µg/m³. With ambient background added, this concentration increased to 6.86 µg/m³. All predicted and predicted plus ambient background concentrations are below the applicable Canada Wide Standards.

As demonstrated in this section, although the design and operation of the compressor station will result in an increase of ambient CAC concentrations within the LAA, the change will not exceed the Nova Scotia *Air Quality Regulations* or Canada Wide Standards.

Summary of Change in Air Quality

In summary, the Project will result in a change in air quality, specifically, the emissions of CACs (particulate matter and combustion gases) during construction activities from the operation of heavy equipment and vehicle travel on unpaved roads, and emissions of $PM_{2.5}$, NO_2 and CO from the compressor station during operation. Fugitive releases of CACs will also occur through the operation and maintenance of the pipeline and valve stations. CACs will increase above current conditions; however, with the implementation of mitigation such as dust control, maintaining equipment in good order and reduction in idling equipment, the resulting levels will not exceed regulatory limits at the property boundary for the compressor station. These effects would be localized and air emissions during construction will be temporary. With the application of recommended mitigation, residual effects of the Project on air quality are predicted to be not significant.

5.1.7.2 Change in Greenhouse Gas Emissions

The Project will result in GHG emissions that will contribute to provincial, national and global GHG emission totals. This assessment is based on guidance provided by the Federal-Provincial-Territorial Committee on Climate Change and Environmental Assessment (2003), which is generally consistent with guidance provided by Nova Scotia Environment (NSE 2011a; NSE 2011b):

- establish the quantities of GHG emissions for the project;
- estimate the contribution of the project GHG emissions to the provincial and national emissions;
- establish relevant jurisdictional policies;
- establish the industry profile for GHG emissions and best practices for projects that are similar in nature to the project;
- determine if the project will be a low, medium or high emitter;
- determine if the project will exceed relevant jurisdictional policies;
- determine if the project will exceed the industry profile; and
- determine what best practices are required.

Because the federal guidance does not define relative emitter levels quantitatively, Stantec has developed a quantitative ranking scheme for comparative purposes (high, medium, low). These categories are based on the relative magnitudes of emissions reported by facilities operating in Canada during 2013 and the most recent reported data publically available, as provided in Table 5.1.8. The low emitter category is set below the federal reporting threshold, and the high emitter is based on the 90th percentile of facility emissions reported above the 50 kt threshold. These rankings are defined as:

- a low emitter is one with less than 50 kt CO_2e annually;
- a moderate emitter is one with greater than or equal to 50 kt CO_2e, but less than 1,080 kt (1.1 Mt) CO_2e annually; and
- a high emitter is one with greater than 1,080 kt CO_2e emitted annually.

Moderate and high emitter levels require a GHG Management Plan under the federal guidelines. NSE suggests that a GHG Management Plan is required for those projects that will exceed 10,000 tonnesCO_2e emissions annually (NSE 2011a).

According to the Intergovernmental Panel on Climate Change (IPCC), "*GHG emissions from energy supply can be reduced significantly by replacing current world average coal fired power plants with modern, highly efficient natural gas combined-cycle power plants or combined heat and power plants, provided that natural gas is available and the fugitive* *emissions associated with extraction and supply are low or mitigated (robust evidence, high agreement). In mitigation scenarios reaching about 450 ppm CO_2eq concentrations by 2100, natural gas power generation without CCS acts as a bridge technology, with deployment increasing before peaking and falling to below current levels by 2050 and declining further in the second half of the century.*" (IPCC 2014). In consideration of this, Bear Paw can be considered to be aligned with achieving global GHG mitigation targets as it will facilitate provision of natural gas supply to broader markets.

Construction

GHG emissions from the construction of the compressor station and pipeline were determined using emission factors from the National Inventory Report (Environment Canada 2015) and the US EPA AP42, Compilation of Air Pollutant Emission Factors, Chapters 3.3 (US EPA 1996a) and 3.4 (US EPA 1996b) (Table 5.1.16). Fuel consumption is based on preliminary design information. As project design and engineering proceeds, the contribution of these will be better defined and included in the GHG management plan.

Table 5.1.16 Estimated Releases of GHGs from the Construction of the Compressor Station and Pipeline

Construction Phase	GHG Emissions (tonnes/phase)			
	CO_2	CH_4	N_2O	CO_2e
Facility - Clearing and Grading	908	0.051	0.371	1,020
Facility - Construction	3,463	0.142	1.04	3,776
Facility - Pick-up Trucks	51	0.003	0.001	52
Pipeline- Tree Clearing	1,002	0.055	0.404	1,124
Pipeline - Grading	1,282	0.071	0.524	1,440
Pipeline - Pipe Gang	1,038	0.058	0.425	1,166
Pipeline - Lower In and Backfill	609	0.034	0.249	684
Pipeline - Pressure Testing	94	-	-	94
Pipeline - Clean-up	692	0.039	0.283	777
Pipeline - Salmon River Crossing	1,044	0.009	0.064	1,063
Pipeline - Milford Haven River Crossing	147	0.003	0.023	154
Pipeline - Strait of Canso Crossing	4,334	0.009	0.064	4,353
Pipeline - Pick-up Trucks	1,043	0.052	0.032	1,054
Total	15,707	0.526	3.48	16,757

Notes:
Totals may not add due to rounding.
Global warming potentials based on IPCC 4th assessment report, CO_2=1, CH_4=25, N_2O = 298.
Emission factors were acquired from Environment Canada 2015, US EPA 1996a, and US EPA 1996b.

Compared to provincial, national and global GHG emissions (see Section 5.1.4.2 Table 5.1.8), the construction of Bear Paw represents 0.09% of Nova Scotia's 2013 annual reported emissions, 0.002% of Canada's 2013 GHG releases and 0.00004% of 2012 global emissions

GHG emissions from the operation of the compressors, generators and boilers were determined based on the principles incorporated into the National Standard of Canada ISO 14064:1 (CSA 2006) (Table 5.1.17). Emission factors were acquired from the Western Climate Initiative (WCI) (WCI 2011) and fuel consumption was estimated based on manufacturer specifications for heat input for each piece of equipment and assuming a natural gas heating value of 38.32 MJ/m^3 (WCI 2011). For the fugitive GHG releases from transmission, the valve stations, and from the venting/blowdown of the compressors during maintenance, emission factors were acquired from the Interstate Natural Gas Association of America (INGAA), Tier 3 factors (INGAA 2005).

Only those GHGs typically released from the combustion of natural gas were included in this inventory; other gases are not expected to be present (US EPA 1998; US EPA 2000a). As project design and engineering proceeds, the contribution of these and potentially other GHGs will be better defined and included in the GHG management plan. Details pertaining to these calculations have been included in Appendix C.

Table 5.1.17 Estimated Releases of GHGs from Project Operation

Equipment	GHG Emission (tonnes/year)			
	CO_2	CH_4	N_2O	CO_2e
Compressors	239,391	62	6	242,812
Generators	22,446	6	1	22,767
Boilers	14,502	4	0	14,709
Fugitive and Venting	65	1,251	None	31,335
Total GHG (tonnes/year)	**276,405**	**1,323**	**7**	**311,624**

Notes:
Totals may not add due to rounding.
Global warming potentials based on IPCC 4th assessment report, CO_2=1, CH_4=25, N_2O = 298.
Emission factors were acquired from WCI 2011 and INGAA 2005.

Compared to provincial, national and global GHG emissions (see Section 5.1.4.2 Table 5.1.8), the Bear Paw operation represents 1.7% of Nova Scotia's 2013 annual reported emissions, 0.04% of Canada's 2013 GHG releases and 0.0007% of 2012 global emissions.

Assuming a conservative case, Bear Paw is estimated to be a moderate emitter (50 kt CO_2e to 1,080 kt CO_2e per year) and will exceed 10,000 tonnesCO_2e emissions annually; therefore a GHG Management Plan will be developed pre-operation.

Summary of Change in Greenhouse Gas Emissions

In summary, the Project will result in a change in GHG emissions from the combustion of fuel in heavy construction equipment and vehicle operation. GHG emissions from construction activities will be temporary and will not contribute substantively to provincial or national GHG totals, and will not influence short and mid-term GHG release trends (notable changes occurring year over year). Operation will result in GHG emissions from operation of the compressor station, valve stations and from fugitive and venting releases of natural gas. These emissions during operation are anticipated to be low compared with provincial and national emission totals for GHGs. Potential effects will be reduced through design and implementation of mitigation such as adherence to to fugitive and venting emissions management and controls. The Project would be considered a moderate GHG emitter and will be required to prepare a GHG Management Plan.

5.1.7.3 Change in Acoustic Environment

Construction

The residual environmental effects of the change in the acoustic environment within the PDA were assessed qualitatively, for the most part. Construction activities at the water crossings were assessed quantitatively where HDD might be used.

Noise generated during construction activities will be louder than current background conditions within the PDA. Construction along the pipeline route is localized and transient, although it can affect land use activities adjacent to Bear Paw on a short-term basis.

Temporary changes in the acoustic environment will result from operation of heavy construction equipment and trucks during the installation of the head compression site (including pile driving), the installation of the pipeline (including HDD at watercourse crossings), and blasting, if required.

The laying of the pipeline involves crossing two major marine watercourses (Strait of Canso and the Milford Haven River) and a number of freshwater watercourses, including one major freshwater course, the Salmon River. Although not yet finalized, a watercourse crossing method being considered for all three of these crossings is HDD. The potential effects from HDD, at each of the three major watercourse crossings, were determined through acoustic modelling using CadnaA. Construction at the compressor station, including potential pile driving, will be temporary (approximately two months). Therefore, it was determined that pile driving would have a lower impact than the operation of the compressor station; the latter is not addressed further here. Details pertaining to the CadnaA model and all input parameters for each of the three HDD scenarios, including equipment lists and sound power level data, are included in Appendix C.

HDD activities at each watercourse crossing are expected to occur over a period of two to four months for the Salmon River, and six to eight months for the Strait of Canso and Millford Haven River.

The predicted sound pressure levels by distance from the HDD activities at each of the three major crossings are presented in Tables 5.1.18, 5.1.19 and 5.1.20 and graphically in Attachment 1 of Appendix C. These results reflect the simultaneous operation of two drill rigs (one at the entry pad and one at the exit pad), twenty-four hours a day. The ranges in values presented below are due to the orientation of the receiver in relation to the two source areas.

Table 5.1.18 Predicted Sound Pressure Levels (dBA) by Distance for Construction, Strait of Canso HDD

Distance from Entry/Exit Pad (m)	Predicted Sound Pressure Level (dBA)
Entry Pad	
200	59 – 63
400	48 – 58
600	41 – 55
800	39 – 53
1000	40 – 53
Exit Pad	
200	47 - 56
400	44 - 54
600	38 - 46
800	35 - 54
1000	32 - 56

Note:
Noise level limits: 65 dBA, 6:00 am – 11:00 pm; 55 dBA, 11:00 pm – 6:00 am (MODG Noise Control Bylaw).
Health Canada Criteria: Temporary Construction (< 2 months), community consultation is advised; Short Term Construction, Mitigation is advised if levels are predicted to result in widespread complaints; Construction >1 Year, Noise levels >75 dBA mitigation is required.

Table 5.1.19 Predicted Sound Pressure Levels (dBA) by Distance for Construction, Milford Haven River HDD

Distance from Entry/Exit Pad (m)	Predicted Sound Pressure Level (dBA)
Entry Pad	
200	53 - 63
400	49 - 58
600	48 - 55
800	46 - 51
1000	45 - 47
Exit Pad	
200	50 - 59
400	44 - 53
600	41 - 51
800	40 - 48
1000	40 - 46

Note:
Noise level limits: 65 dBA, 6:00 am – 11:00 pm; 55 dBA, 11:00 pm – 6:00 am (MODG Noise Control Bylaw).
Health Canada Criteria: Temporary Construction (< 2 months), community consultation is advised; Short Term Construction, Mitigation is advised if levels are predicted to result in widespread complaints; Construction >1 Year, Noise levels >75 dBA mitigation is required.

Table 5.1.20 Predicted Sound Pressure Levels (dBA) by Distance for Construction, Salmon River HDD

Distance from Entry/Exit Pad (m)	Predicted Sound Pressure Level (dBA)
Entry	
200	58 – 63
400	46 – 58
600	38 – 59
Exit Pad	
200	53 – 60
400	52 – 58
600	44 – 63

Notes:
Entry and exit pads are located within 800 mof each other, therefore overlapping sound levels (i.e., beyond 600 m) were not recorded.
Noise level limits: 65 dBA, 6:00 am – 11:00 pm; 55 dBA, 11:00 pm – 6:00 am (MODG Noise Control Bylaw).
Health Canada Criteria: Temporary Construction (< 2 months), community consultation is advised; Short Term Construction, Mitigation is advised if levels are predicted to result in widespread complaints; Construction >1 Year, Noise levels >75 dBA mitigation is required.

Noise limits, as set by the MODG, would be met during daytime hours within 200 m from the operation of the HDD equipment. Based on the results presented above, there is potential for the evening and nighttime limits to be exceeded up to 400 m from the operation of the HDD equipment. In some instances noise levels are higher further away from the drill pad than near it; this is due to the overlapping effects of both the primary drill rig (located at the entry site) and the secondary drill rig (located at the exit site) operating simultaneously. In most cases, these locations occur over the watercourse and not at discrete receptor locations.

Health Canada also recommends that absolute sound pressure levels not exceed 75 dBA at any receptor during project construction. As shown in the tables above there were no exceedances of Health Canada's guidance (75 dBA).

Additional mitigation may be identified during consultation with the MODG when requesting an exemption to the Noise Control Bylaw. A noise compliant resolution process will also be implemented (see Section 5.1.6).

Operation

As sound levels associated with operation and maintenance of the pipeline RoW are considered negligible, this assessment of residual environmental effects focuses on the operation of the compressor station. Acoustic modelling using CadnaA was conducted to predict the sound pressure levels resulting from the operation of the compressor station. Details of the methods used are provided in Appendix C.

The baseline sound pressure levels, predicted sound pressure levels, and background plus Project predicted sound pressure levels for the operation of the compressor station are presented in Table 5.1.21. The results are representative of the levels at the closest receptors to the compressor station. Predicted sound pressure levels resulting from operation (without baseline) are also presented on Figure 15 in Attachment 1 of Appendix C.

Table 5.1.21 Predicted Sound Pressure Levels Associated with the Operation of the Compressor station

Receptor No.	Background Sound Levels (dBA)[1]		Predicted Operation Sound Levels (dBA)		Background Plus Predicted Sound Pressure Levels (dBA)	
	Day	Night	Day	Night	Day	Night
1	46	36	42.4	42.4	47.6	43.3
2	46	36	42.6	42.6	47.6	43.5
3	46	36	42.0	42.0	47.5	43.0
4	46	36	42.6	42.6	47.7	43.5

Note:
1 Keltic Project Monitoring Site – Section 5.1.4.2.

The predicted sound pressure levels at the nearest residential receptors ranged from 42 dBA to 43 dBA for both the day and nighttime periods. By adding the existing sound levels to the Project, the cumulative (Project plus background) increase to 48 dBA during the daytime and 43 dBA to 44 dBA at night.

As presented above in Table 5.1.21 and on Figure 15 in Appendix C, all predicted sound pressure levels at the discrete receptors are below the noise limits set by the MODG during the daytime (65 dBA) and nighttime (55 dBA).

The L_{dn} and %HA for the operation of the compressor station (background plus predicted) was also calculated for the closest receptors and is presented in Table 5.1.22. The methods for computing %HA are found in the Canadian Standards Association *ISO 1996-1:2003, Acoustics – Description, measurement and assessment of environmental noise* (CSA 2003). The %HA is calculated for baseline sound pressure levels, then again at sound pressure levels predicted to occur from activities. Heath Canada recommends that the %HA at sensitive receptors not increase by more than 6.5% due to noise emissions from long term construction projects or project operations.

Table 5.1.22 L_{dn} and Percent HA for the Operation of the Compressor station

Receptor No.	L_{dn} (dBA)	Change in % HA	Meet Health Canada Criteria, Change < 6.5 %
1	50.6	1.1	Yes
2	50.8	1.1	Yes
3	50.4	1.0	Yes
4	50.8	1.1	Yes

As presented in Table 5.1.22, the operation (background plus predicted) of the compressor station would also meet noise criteria advocated by Health Canada (change in %HA less than 6.5).

Summary of Change in Acoustic Environment

In summary, the Project will result in a change in ambient noise levels from operation of heavy equipment, diesel engines, pile driving and HDD activities during construction. Operation will result in noise emissions from operation of the compressor station. These effects will be reduced through implementation of mitigation such as scheduling construction activities during daytime hours where practical. In general, potential effects will be localized and will meet noise limits enforced by the MODG, and are not anticipated to exceed Health Canada criteria. With the implementation of recommended mitigation, residual environmental effects of the Project on the acoustic environment are predicted to be not significant.

5.1.8 Monitoring and Follow-up

Based on the results of this assessment, Bear Paw Pipeline will meet relevant regulatory criteria; therefore, no follow-up and monitoring activities are recommended as necessary for the atmospheric environment. Air quality and sound monitoring shall be carried out at the request of NSE.

During the operation, annual emissions of CACs and GHGs will be calculated and if such emissions exceed reporting triggers/thresholds (as defined by EC under the National Pollutant Release Inventory Program and Greenhouse Gas Emissions Reporting Program); these emissions will be reported to EC by June 1 of every year.

As a moderate level emitter of direct GHG emissions, Bear Paw Pipeline is responsible for developing a GHG Management Plan in accordance with the assessment methodology described herein, which will mitigate the GHG emissions.

During construction, especially during pile driving and HDD when activities have the potential to occur twenty-four hours a day, an exemption of the Noise Control Bylaw, through the MODG, may be required.

5.2 FRESHWATER ENVIRONMENT

The freshwater environment was selected as a VC for environmental assessment due to the importance of freshwater habitat as an ecosystem component and the associated regulatory protection afforded to it. Freshwater habitats are also of social and cultural importance to the people of Nova Scotia, for the fisheries they support.

Activities and components associated with construction and operation of Bear Paw have potential to interact with the environment in such a way that they directly or indirectly adversely affect freshwater populations through loss or alteration of habitat and/or direct mortality of fish. In addition to the more generalized standard mitigation measures outlined in Section 2.5.3.,the specialized mitigation measures prescribed in Section 5.2.6 will be implemented to reduce potential effects on the freshwater environment.

As explained in the assessment below, with the application of these mitigation measures, residual Project-related environmental effects on the freshwater environment are predicted to be localized, temporary and largely reversible. The assessment concludes that, with the application of the mitigation proposed herein, the residual environmental effects of Bear Paw on the freshwater environment are predicted to be not significant.

The freshwater environment VC is intrinsically linked to the Vegetation and Wetlands VC (Section 5.5) through riparian vegetation and wetlands, and the Marine Environment VC (Section 5.4) through diadromous species and nutrient cycling between freshwater and marine water. The VC is also linked to recreational and traditional fisheries addressed in Section 5.8 and Section 5.7, respectively.

5.2.1 Regulatory and Policy Overview

The key federal and provincial acts and regulations that apply to the freshwater environment in Nova Scotia are listed below and followed by brief descriptions:

- the *Fisheries Act (R.S.C., 1985, c.F-14)*;
- the *Species at Risk Act (S.C., 2002, c.29)*;
- the Nova Scotia *Endangered Species Act (c.2, s.99)*; and
- Nova Scotia *Activities Designation Regulations – Watercourse Crossings (N.S. Reg. 124/2014)*.

These key acts and regulations are supported by federal, provincial and non-governmental policies and guidelines including:

- the Fisheries Protection Policy Statement (DFO 2013);
- Watercourse Alterations Standard (NSE 2015a); and
- Canadian Council of Ministers of the Environment (CCME) Water Quality Guidelines for the Protection of Aquatic Life (CCME 1990).

5.2.1.1 *Fisheries Act*

The *Jobs, Growth and Prosperity Act* came into force on November 25, 2013 and resulted in changes to several sections of the *Fisheries Act*, most notably Section 35 that defines serious harm to fish and their habitat. An updated Fisheries Protection Policy Statement was released, replacing the previous Fish Habitat Policy. The amendments in Section 35 of the *Fisheries Act* adopt "serious harm to fish" replacing "harmful alteration, disruption or destruction (HADD), of fish habitat". The updated Fisheries Protection Policy Statement interprets "serious harm" to CRA fish and fish that support a fishery as:

- *the death of fish;*
- *a permanent alteration to fish habitat of a spatial scale, duration or intensity that limits or diminishes the ability of fish to use such habitats as spawning grounds, or as nursery, rearing, or food supply areas, or as a migration corridor, or any other area in order to carry out one or more of their life processes; and*
- *the destruction of fish habitat of a spatial scale, duration, or intensity that fish can no longer rely upon such habitats for use as spawning grounds, or as nursery, rearing, or food supply areas, or as a migration corridor, or any other area in order to carry out one or more of their life processes.*

With the recent amendments, the requirement under the Act to gain authorization will apply only where a project results in "serious harm" to a CRA fishery. An alteration of fish habitat must be deemed to be permanent to be of regulatory consequence under the Act.

Table 5.2.1 outlines the relevant requirements for Bear Paw under the federal *Fisheries Act* and regulations.

Table 5.2.1 Relevant Directives under the *Fisheries Act*

Regulations	Nature of Directive	Relevance to Bear Paw	Federal Authority
Section 20(1)	Regulate designs that provide the free passage of fish without harm and maintain a flow of water sufficient to allow the free passage of fish.	Watercourse crossing designs and provision of fish passage.	DFO
Section 35(1)	Provide protection of fish and fish habitat.	Watercourse crossing designs.	DFO
Section 35(2)	Permit authorizations for the alteration of fish habitat.	Permit *Fisheries Act* authorizations for habitat alterations, if required.	DFO
Section 36	Implement mitigation as per guidelines to prevent introduction of deleterious substances into fish bearing waters.	All heavy equipment work within watercourse buffers (30 m) and need to prevent erosion and sedimentation of watercourses, or fuel spills from reaching watercourses.	DFO/ Environment Canada

5.2.1.2 Species at Risk Act

Species listed provincially as *extirpated*, *endangered*, *threatened* or of *special concern* are formally protected under the Nova Scotia *Endangered Species Act* (NS *ESA*). Federally, species listed under Schedule 1 as *extirpated*, *endangered* or *threatened* are formally protected under the Federal *Species at Risk Act* (*SARA*). Species at risk are formally protected through prohibitions on killing, harassing or capturing a listed species, unless otherwise approved through a ministerial order (i.e., license or permit). Habitat critical to the survival of listed species at risk is protected by prohibitions on destruction or alteration.

5.2.1.3 Nova Scotia *Activities Designation Regulations* – Watercourse Alteration

The purpose of the Watercourse Alteration Program is to protect the water quality and aquatic habitat of the streams, rivers, lakes and wetlands of Nova Scotia from unmitigated works in or near watercourses and wetlands. The regulation provides for Nova Scotia Environment (NSE) to issue either an approval (stipulating project specific mitigation measures), or a notification to the department (stating the work is to be carried out in accordance with the Nova Scotia Watercourse Alterations Standard).

A Watercourse Alteration Permit is required before:

- the physical modification of the bed or banks of a watercourse; or
- the modification of flow of water (i.e., diversion or pumping).

5.2.2 Boundaries

5.2.2.1 Spatial Boundaries

The assessment of potential environmental effects on freshwater environment encompasses three spatial boundaries: Project Development Area (PDA), Local Assessment Area (LAA), and Regional Assessment Area (RAA). The PDA is defined within Section 2.1. The LAA and RAA spatial boundaries are presented below and in Figure 5.2.1.

Local Assessment Area (LAA)

The LAA for the freshwater environment is the corridor assessed during the field studies (Figure 5.2.1). The LAA was selected to encompass all areas with the potential to have direct and indirect loss of fish habitat under normal conditions. The LAA is where environmental effects are reasonably expected to occur and are measureable with a high degree of confidence. For example, the LAA includes sufficient upstream and downstream freshwater habitat at all crossings to evaluate anticipated measureable Project-related environmental effects.

Regional Assessment Area

The RAA is the area that establishes the context for determining significance of project-specific effects (Figure 5.2.1). It is also the area within which effects from other past, present and reasonably foreseeable projects can be understood. The RAA is defined as the secondary watershed boundaries and encompasses both the PDA and the LAA (Figure 5.2.2).

5.2.2.2 Temporal Boundaries

The temporal boundaries for the assessment of the potential environmental effects of Bear Paw on freshwater environment include construction, and operation and maintenance. Construction is currently scheduled to begin as early as 2017 and continue over a period of two years. Operation will follow construction and continue for the life of Bear Paw.

Most potential Project-related environmental effects on the freshwater environment will begin and peak during construction, and diminish during operation and maintenance.

5.2.3 Significance Definition

A significant adverse residual environmental effect on the freshwater environment is one that:

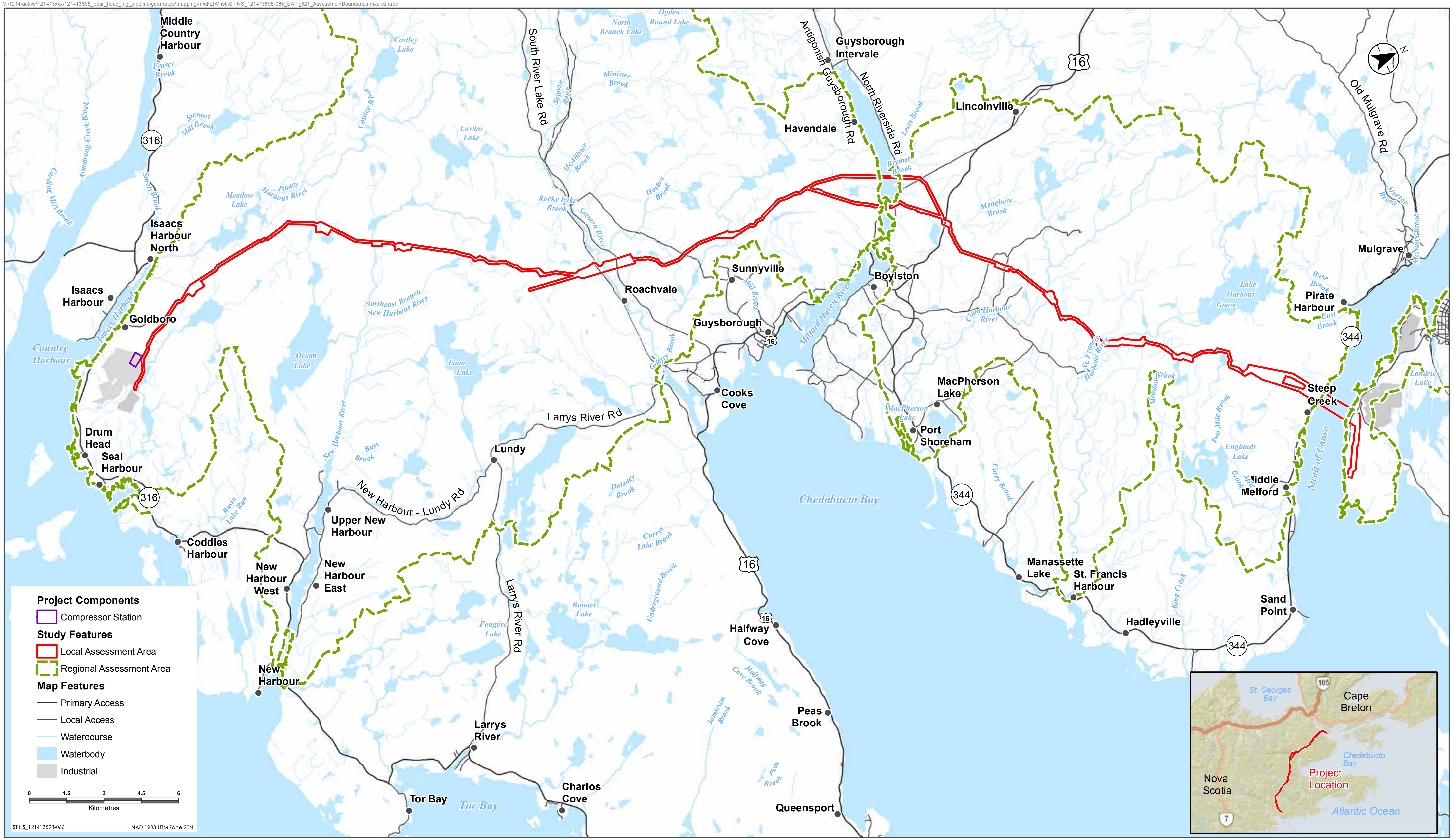
- **Fish Mortality:** causes increased mortality of CRA or fish Species at Risk which would contravene the *Fisheries Act* or *Species at Risk Act*.
- **Habitat Alteration:** causes *a permanent alteration to or the destruction of* fish habitat of a spatial scale, duration or intensity that limits or diminishes the ability of fish to use such habitats and results in a decrease in the sustainability of the populations or the local fisheries.
- **Water Quality:** decreases water quality to a level which induces mortality or diminishes the ability of fish to use such habitats and results in a decrease in the sustainability of the populations or the local fisheries.

Applicable legislation and regulations used to characterize the significance determinations for increased fish mortality, permanent alteration or destruction of fish habitat or changes in water quality include: the *Fisheries Act;* The Fisheries Protection Policy Statement (DFO 2013a); *Species at Risk Act*, *Nova Scotia Endangered Species Act (c.2, s.99);* Nova Scotia's *Watercourse and Wetland Alteration Regulations (N.S. Reg. 124/2014)*; Nova Scotia's Watercourse Alteration Standards (NSE 2015a); and Canadian Council of Ministers of the Environment (CCME) Water Quality Guidelines for the Protection of Aquatic Life (CCME 2007).

5.2.4 Description of Existing Conditions

This section describes the existing conditions of the freshwater environment for the LAA, RAA and information gathering methods.

V:\1214\active\121413xxx\121413598_bear_head_lng_pipeline\geomatics\mapping\mxd\EIA\fish\ST NS_121413598-066_EAFig521_AssessmentBoundaries.mxd cshupe



Sources: Base data provided by the Government of Canada and Nova Scotia.

Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

Bear Paw Pipeline

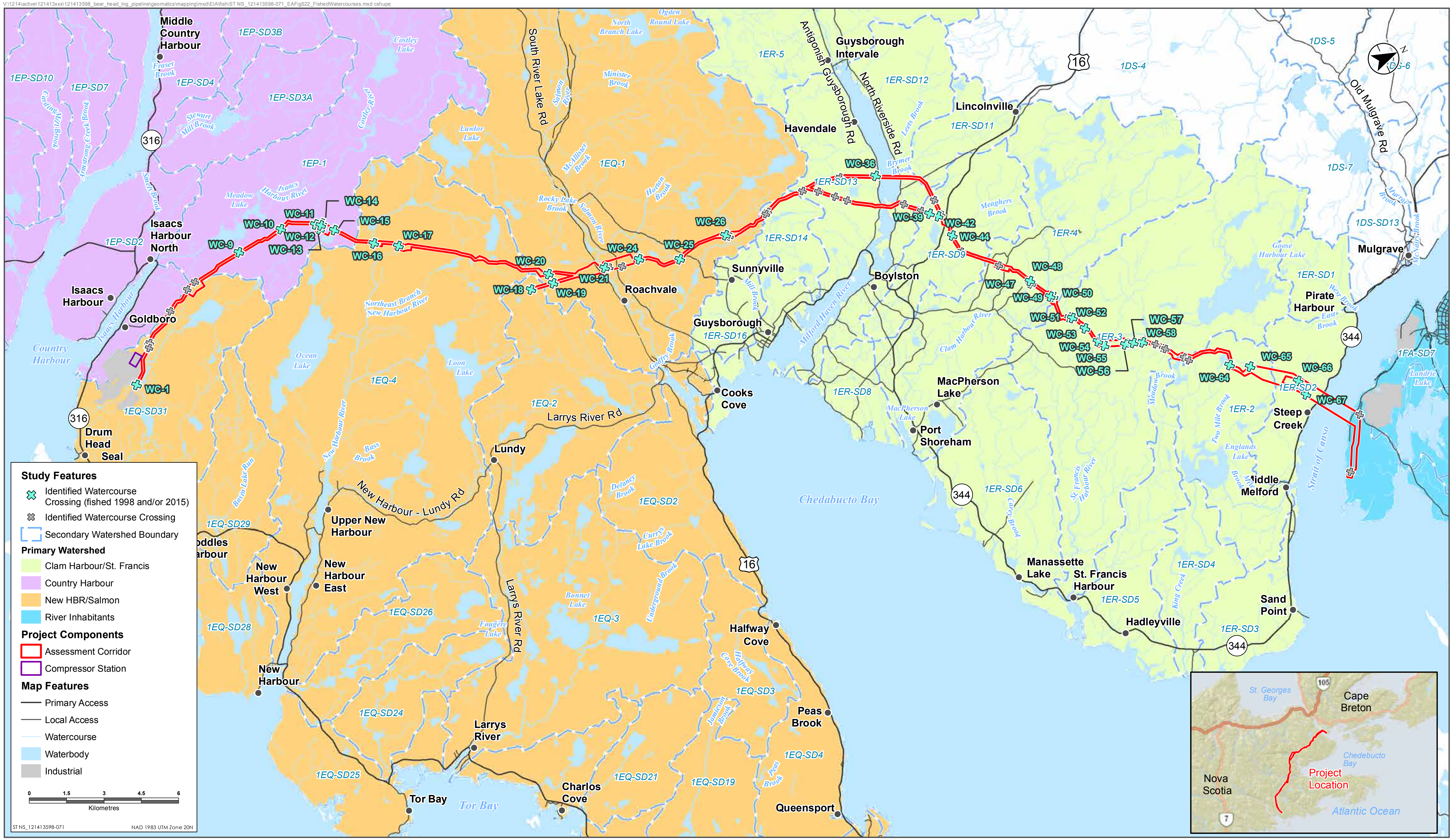
Stantec

BEAR PAW PIPELINE PROJECT

Freshwater Environment - Spatial Boundaries

Figure 5.2.1

V:\1214\active\121413xxx\121413598_bear_head_lng_pipeline\geomatics\mapping\mxd\EIA\fish\ST NS_121413598-071_EAFig522_FishedWatercourses.mxd cshupe



Sources: Base data provided by the Government of Canada and Nova Scotia.

Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

BEAR PAW PIPELINE PROJECT

Watercourse Crossings within the Assessment Corridor

Figure 5.2.2

5.2.4.1 Approach and Methods

This description of existing conditions includes information gathered during a previous fish and fish habitat study for the SOEP pipeline (JWEL 1998) and field and desktop studies undertaken by Stantec on behalf of Bear Paw Pipeline in 2015. Detailed routing for Bear Paw will be developed in the next phase of engineering design. Bear Paw Pipeline is endeavoring to place the route parallel to and in close proximity to the existing SOEP pipeline; this assessment will also draw on data collected for the SOEP pipeline.

Based on existing 1:10,000 scale GIS mapping, 69 watercourses were identified which may potentially be intersected by the LAA (Figure 5.2.2; Table 5.2.3). At the time of the field surveys in September 2015, Stantec field crews did not have access to private land and were limited to executing watercourse field program on those watercourses accessible from Crown land. Of the 69 identified watercourses, 29 were accessible from Crown land. These 29 watercourses were assessed for fish presence with a further sub-set of watercourses assessed for fish habitat.

Based upon initial discussions with Fisheries Protection representatives from DFO Maritimes Region on August 27, 2015, it was decided that it would be unnecessary to assess fish habitat for every watercourse along the Bear Paw route. A sub-set of watercourses along the proposed Bear Paw route were selected and assessed, incorporating or comparing, the results to those compiled for the SOEP pipeline assessment, where applicable.

Results from the 2015 survey indicated that many of the watercourses consisted of more than one tributary yet were assessed as single watercourses in 1998 (JWEL 1998). For example, WC52 and WC53 were described as a single water crossing in 1998 (JWEL 1998). Table 5.2.7 denotes these redundant watercourses with an asterisk.

Nineteen watercourses were common to the SOEP and Bear Paw projects; 11 of these were accessible via Crown Lands and were resurveyed for fish populations in 2015 by electrofishing to reconfirm the presence of CRA fish species. In addition to these 11 sites, 17 watercourses not previously surveyed were included in the 2015 electrofishing survey for a total of 28 watercourses (Section 5.2.4.2.4, Table 5.2.6). A qualitative determination of fish presence and community structure was completed at each of these watercourses using a Smith Root LR-24 backpack electrofishing unit.

Of the 28 watercourses accessed for fish population surveys, fish habitat assessments were conducted at 16. Eight of these watercourses were previously assessed for the SOEP pipeline, with the remaining eight not previously assessed. During a follow-up teleconference on September 28, 2015, DFO representatives indicated they were satisfied with the proportional number and representative distribution of sites along the assessment corridor.

The standard Stantec approach to freshwater habitat assessment was modified to accommodate the varying width of the assessment corridor (100 m to approximately 350 m).

Each watercourse was assigned a stream order by GIS specialists using the method described by Strahler (1952). Using stream order and bankfull width as measured in the field, watercourses were classified into five categories as described below.

- **No visible channel (NVC):** typically a low-lying depression that does not provide direct or indirect habitat values for fish.
- **Ephemeral:** watercourses defined as a seasonal, sometimes flowing, unnamed watercourse with poorly- to well- defined bed and banks. Although these watercourses may have surface water flow during high precipitation events, they likely do not provide direct or indirect habitat values for fish (e.g., acceptable water quality or quantity, suitable substrate or habitat structure for feeding, spawning, rearing, overwintering).
- **Small:** watercourses are identified as fish habitat and are first order to third order watercourses, including intermittent channels and springs that were found to have fish habitat.
- **Medium:** watercourses are identified as fish habitat and are fourth order or greater, with a bankfull width of less than 35 m at the pipeline crossing location.
- **Large:** watercourses are identified and are fourth order or greater, with a bankfull width of 35 m or greater at the pipeline crossing location.

The exact PDA route through the freshwater environment has not yet been finalized; therefore the PDA was assumed to have the potential to be placed anywhere within the assessment corridor (100 m to approximately 350 m wide). At each watercourse, crossing characteristics were collected at six transects:

- 100 m upstream of the upstream extent of the assessment corridor (Transect 1);
- the upstream extent of the assessment corridor (Transect 2);
- the assessment corridor centre line (Transect 3);
- the downstream extent of the assessment corridor (Transect 4);
- 100 m downstream of the downstream extent of the assessment corridor (Transect 5); and
- 200 m downstream of the downstream extent of the assessment corridor (Transect 6).

Where a watercourse did not extend beyond the upstream or downstream extent(s) of the corridor, the number of transects sampled was reduced. Limited data were collected at watercourses classified as NVC. Channels defined as NVC were photographed and assessed only at the upstream and downstream extents of the corridor.

Data collected from each transect included, but was not limited to, the following:

- channel width;
- wetted width;
- water depth at 0.25, 0.50 and 0.75 of wetted width;
- velocity at evenly spaced stations across one transect (corridor centre line);
- abiotic water column measures (temperature, conductivity, pH, turbidity, dissolved oxygen);

- substrate composition;
- bank description, including height, slope and stability;
- functional in-water and riparian cover type and abundance; and
- photographs looking upstream, downstream, at left bank and at right bank

Fish habitat assessments were conducted using Stantec's internal protocols along the surveyed reach. This habitat assessment procedure was based on differentiating habitat units (runs, riffles, pools), and recording channel characteristics, cover types and abundance and channel stability for each unit.

5.2.4.2 Summary of Existing Conditions

The existing conditions of the freshwater environment are summarized in this section including: Species of Conservation Interest (SOCI) which have potential to inhabit the watercourses in the LAA; freshwater fish species and habitats observed during the 1998 and 2015 fish and fish habitat assessments; and observed water quality.

Species of Conservation Interest

Fish SOCI were defined as those species which likely inhabit the LAA and are:

- listed under the NS *ESA* or the federal *SARA* as being either *endangered, threatened, vulnerable*, or of *special concern* (i.e., Species at Risk or "SAR");
- not yet listed under provincial or federal legislations, but identified by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as being either *endangered, threatened*, or of *special concern*;
- listed by the NSDNR (2014) to be *at risk*, *may be at risk*, or *sensitive* to human activities or natural events; and
- ranked as *S1, S2,* or *S3* by the Atlantic Canada Conservation Data Centre (AC CDC) (2014).

Table 5.2.2 lists the SOCI which may potentially inhabit the LAA.

General species descriptions are presented for SOCI listed in Table 5.2.2. Legal protection for SOCI is limited to species listed under Schedule 1 of *SARA* and those species listed under NS *ESA*. Within the LAA, legal SOCI protection is limited to the brook floater, which is listed as *threatened* under NS *ESA* (Table 5.2.2).

Table 5.2.2 Species of Conservation Interest that Potentially Inhabit the LAA

Common Name	Scientific Name	*SARA* Rank[1]	NS ESA Rank[2]	COSEWIC Rank[3]	NSDNR General Species Rank[4]	AC CDC Species Rank[5]
American Eel	*Anguilla rostrata*	Threatened (No schedule)	-	Threatened		S5
Atlantic Salmon (Nova Scotia Upland Pop.)	*Salmo salar*	Endangered (No Schedule)	-	Endangered	May be at Risk	S2
Atlantic Salmon (Eastern Cape Breton Pop.)	*Salmo salar*	Endangered (No Schedule)	-	Endangered	May be at Risk	S2
Brook Floater	*Alasmidonta varicosa*	Special Concern (Schedule 1)	Threatened	Special Concern		-
Brook Trout	*Salvelinus fontinalis*	-	-	-	Sensitive	S4
Four-spined stickleback	*Apeltes quadracus*	-	-	-	Sensitive	S5

Notes:

[1] Species At Risk Public Registry. 2015. Accessed December 1, 2015. Available online at: http://www.sararegistry.gc.ca/.

[2] Nova Scotia *Endangered Species Act*.1999. Accessed December 1, 2015. Available online at http://www.novascotia.ca/natr/wildlife/biodiversity/.

[3] Committee on the Status of Endangered Wildlife in Canada. 2015. Wildlife Species Assessments Wild Species: The General Status of Wild Species in Canada. 2011. Accessed December 1, 2015. Available at: http://www.wildspecies.ca/.

[4] Nova Scotia Department of Natural Resources General Species Rank. 2015. Accessed December 1, 2015. Available online at: http://novascotia.ca/natr/wildlife/genstatus/.

[5] Atlantic Canada Conservation Data Centre, 2015. Accessed December 1, 2015. Available online at http://www.accdc.com/en/ranks.html.

``-`` = No data.

Atlantic Canada Conservation Data Centre

S1 = Critically imperiled in the province because of extreme rarity (often 5 or fewer occurrences). May be especially vulnerable to extirpation.

S2 = Imperiled in the province because of rarity due to very restricted range, very few populations (6 to 20 occurrences or few remaining individuals). May be vulnerable to extirpation due to rarity or other factors.

S3 = Vulnerable - Vulnerable in the province due to a restricted range, relatively few populations (often 80 or fewer).

S4 = Uncommon but not rare; some cause for long-term concern due to declines or other factors (80+ occurrences).

S5 = Common, widespread, and abundant in the province.

'-' = Not included in AC CDC species list.

American Eel

American eel are listed as *threatened* under COSEWIC (2012a) and are currently being considered for inclusion under *SARA*. The American eel occurs throughout fresh and salt waters of Eastern Canada. It faces a number of threats, including barriers to upstream migration, turbine mortality in hydroelectric dams, fisheries and the swim-bladder parasite, *Anguillicola crassus* (COSEWIC 2012a).

American eels are catadromous, meaning that they move downstream to marine waters to spawn in the Sargasso Sea. As young eels grow, they drift toward the continental shelf and eventually move into inshore waters. Some eels migrate up rivers to freshwater habitats, others remain in brackish or salt waters, and others move between fresh and salt waters (COSEWIC 2012a). Winters are spent buried in mud (Scott & Crossman 1998). After 8 to 23 years of growth, they mature into silver eels and will migrate back to the spawning grounds. Spawning occurs only once. In Nova Scotia, the migration of American eels exiting freshwater systems occurs between August and November (COSWEIC 2012a). Eels are carnivores and consume a wide variety of prey that includes larval insects, crayfish, snails, earthworms and small fish (Scott & Crossman 1998).

American eel were the second most common species found during the electrofishing surveys and were identified at 12 locations within the LAA. These eels ranged in size from 120 mm to 370 mm in length. They were found in all three watersheds in which fish were captured (Country Harbour, New Harbour/Salmon River and Clam Harbour/St. Francis River). This species support the CRA fishery.

Atlantic Salmon

Atlantic salmon identified in the LAA are part of either the Nova Scotia Southern Upland Population, or the Eastern Cape Breton Population. Both these populations are designated as *endangered* under COSEWIC (2010a), but are not currently listed under *SARA*. Threats to Atlantic salmon include climate change, fishing, dams and other barriers to freshwater movement, agriculture, urbanization, acidification, aquaculture and invasive species (COSEWIC 2010a).

The Eastern Cape Breton population (COSEWIC Designatable Unit 13) breeds in rivers draining into the Atlantic Ocean and the Bras d'Or Lakes. Recent reports indicate that the number of adults returning to spawn is in decline (COSEWIC 2010a). In 2008, the total number of mature individuals in 5 rivers thought to support the majority of the population was approximately 1,150. These fish face poor marine survival due to ill understood changes in the marine ecosystem.

The Nova Scotia Southern Upland population (COSEWIC Designatable Unit 14) extends from northeastern mainland Nova Scotia southward and into the Bay of Fundy and Cape Split. This population has been in decline for a number of years (COSEWIC 2010a). These declines are expected to be even higher in rivers with high levels of acidification. The most recent population estimate for the two index rivers in this Designatable Unit was 1,427 individuals. Over the past century, spawning occurred in 63 rivers in this Designatable Unit. However, a 2008 survey detected juveniles in only 21 of 51 rivers examined. Maximum lifetime reproductive rates of salmon in this population are very low (COSEWIC 2010a).

This species is an anadromous fish that has different habitat requirements at each life history stage. Spawning occurs in freshwater streams in October and November, usually at a gravel-bottom riffle area above or below a pool (Scott & Crossman 1998). After remaining in gravelly streams for 2 to 3 years, young descend the river and enter the sea as smolts (with the exception of land-locked populations). At sea, salmon may travel huge distances. During this time they prey on a variety of organisms, including crustaceans and fish. In turn, they are preyed upon throughout their lives by birds, seals, marine mammals and many fish species. After spending one or more years at sea, Atlantic salmon return to their natal freshwater stream to spawn; they may spawn more than once in their lifetime (Scott & Crossman 1998).

Atlantic salmon are a highly prized species for both recreation and Aboriginal fisheries. Atlantic salmon were not caught during the 2015 aquatic fish surveys; one water crossing in the LAA, the Salmon River (WC21), is known to have an Atlantic salmon population (JWEL 1998). The Salmon River is the largest freshwater watercourse within the LAA and provides important habitat for several species of fish. The LAA is commonly used by anglers to access sections of this river for fishing.

<u>Brook Floater</u>

The brook floater is a small freshwater mussel measuring up to 70 mm long, 40 mm wide and 30 mm high (DFO 2013b). They can be found in shallow rivers and streams with sand and gravel substrates in moderate to high water flows (COSEWIC 2009). Small numbers were identified in the Salmon River, 1 individual over 3 sites (NS DNR 2005), with population estimates from 100 to 500 (COSEWIC 2009). Nedeau et al. (2000) indicated that spawning occurs between April and June, though spawning adults have reported from August to May in coastal rivers (COSEWIC 2009). Larvae (glochidia) are released from the female brook floater and attach to host fish, the species of host fish are not known though locally may include: ninespine stickleback; longnose and blacknose dace; golden shiner, slimy sculpin and yellow perch (COSEWIC 2009). Once adapted for benthic dwelling juveniles release from the host fish and further adapt to a benthic sedentary existence. This life cycle helps disperse the bivalve over distances unattainable solely through the movement of adults.

Brook floater habitat is subject to impacts from change in water quality (i.e., sedimentation, excess nutrients and contaminants), shoreline development and disturbance to movement (i.e., barriers to host fish) (DFO 2013b).

Brook Trout

The brook trout is a North American endemic species that is common throughout Nova Scotia's rivers. They can be found in clear, cool well-oxygenated streams and lakes with temperatures below 20°C (Scott & Crossman 1973). When temperatures rise, brook trout move downstream to larger water bodies to find cooler water. Facultative anadromous, some brook trout populations contain individuals that go out to sea to feed and grow. This species spawns in the late summer or early fall, generally between September and November (Scott & Crossman 1973). Spawning occurs over gravel beds, usually located in shallow headwaters of streams, but occasionally in shallow lakes. Fish often travel long distances upstream to reach spawning grounds. Brook trout are carnivores and feed on a huge variety of insect larvae, insects, molluscs and fish. Large fish have also been known to eat frogs, salamanders and even small mammals.

During the 1998 and 2015 electrofishing surveys, brook trout were found in 20 of the 39 streams that were fished, and in three of the four watersheds within the LAA (Country Harbour, New Harbour/Salmon River and Clam Harbour/St. Francis River). The brook trout that were caught during electrofishing surveys were of varying sizes and had fork lengths ranging from 51 mm to 178 mm. This was the most common fish species found in watercourses along the assessment corridor. Brook trout are an important component of recreational fisheries in Nova Scotia.

Fourspine Stickleback

Fourspine sticklebacks are generally a nearshore marine species though inland populations occur in freshwater in Atlantic Canada. Spawning takes place in nests constructed by the male from plant fragments (Curry et al. n.d.) and occurs from May to July with incubation lasting about six days at 70°F (Bigelow and Schroeder 1953). During the 1998 surveys, fourspine stickleback were found in a tributary to Beech Hill Lake (WC-11), but were not observed in the 2015 electrofishing surveys. Inland populations have been associated with lake habitats in Nova Scotia (Page and Burr 2002) and the observation of fourspine stickleback in a tributary to Beech Hill Lake is probable.

Freshwater Fish and Habitat

The LAA crosses 69 watercourses, which are illustrated in Figure 5.2.2 and listed in Table 5.2.3. The crossing at one of these watercourses, Milford Haven River (WC36), is estuarine and is discussed in Section 5.4 (Marine Environment).

Table 5.2.3 Summary of Water Crossings in LAA

Project Site ID	Watercourse Name	Start Coordinates		End Coordinates	
		Easting	Northing	Easting	Northing
WC1	Tributary to Goldbrook	608335	5003701	608343	5003638
WC2	Tributary to Goldbrook	607184	5004627	607223	5004709
WC3	Tributary to Goldbrook	607189	5004731	607246	5004707
WC4	Tributary to Goldbrook	607029	5004735	607113	5004789
WC5	Tributary to Goldbrook	606993	5004782	607106	5004799
WC6	Tributary to Goldbrook	606186	5006128	606299	5006136
WC7	Tributary to Isaacs Harbour	605741	5007103	605740	5007099
WC8	Tributary to Isaacs River	605599	5007498	605589	5007499
WC9	Tributary to Meadow Lake	605257	5009623	605245	5009622
WC10	Tributary to Meadow Lake	605167	5011575	605076	5011526
WC11	Tributary to Little Beech Hill Lake	605514	5012924	605553	5012829
WC12	Tributary to Beech Hill Lake	605710	5013268	605670	5012864
WC13	Tributary to Beech Hill Lake	605892	5012916	605694	5012924
WC14	Tributary to Beech Hill Lake	605574	5013151	605654	5013096
WC15	Tributary to Beech Hill Lake	606022	5013510	606094	5013439
WC16	Tributary to Ephraims Lake/ New Harbour River NE	607127	5014718	607327	5014667
WC17	Tributary to Lower Stillwater	607738	5015740	607850	5015405
WC18	Tributary to Goal Lake	611532	5019663	611629	5019633
WC19	Tributary to The Three Ponds	611768	5020552	611667	5020553
WC20	Tributary to The Three Ponds	611358	5020533	611261	5020561
WC21	Salmon River	611857	5022676	612191	5022611
WC22	Tributary to Salmon River/Poder Lake	612055	5022991	612215	5022770
WC23	Tributary to Salmon River/Poder Lake	612240	5023403	612292	5023263
WC24	Tributary to Salmon River/Poder Lake	612249	5024088	612363	5024108
WC25	Tributary to Skinner Lake	612951	5025547	613031	5025627
WC26	Tributary to Godfry Brook	612891	5027805	613010	5027598
WC27	Tributary to Godfry Brook	612891	5027805	612891	5027805
WC28	Tributary to Nickerson Lake	612778	5029421	612844	5029526
WC29	Tributary to Nickerson Lake	612723	5029564	612831	5029562
WC30	Tributary to Fraser Lake	612558	5031164	612644	5031237
WC31	Tributary to Fraser Lake	612864	5031659	613013	5031821
WC32	Tributary to Fraser Lake	613370	5032210	613347	5032333

Table 5.2.3 Summary of Water Crossings in LAA

Project Site ID	Watercourse Name	Start Coordinates		End Coordinates	
		Easting	Northing	Easting	Northing
WC33	Tributary to Fraser Lake	612688	5032779	612688	5032779
WC34	Tributary to Fraser Lake	613735	5032607	613691	5032707
WC35	Tributary to Milford Haven River	613278	5034111	613278	5034119
WC36	Milford Haven River	613283	5034130	613288	5034139
WC37	Tributary to Milford Haven River	614864	5034638	614773	5034697
WC38	Tributary to Meaghers Lake	615386	5035125	615320	5035247
WC39	Tributary to Meaghers Lake	615546	5035489	615643	5035446
WC40	Tributary to Meaghers Lake	615163	5035891	615195	5035791
WC41	Tributary to Meaghers Lake	615166	5035891	615165	5035888
WC42	Tributary to Meaghers Lake	615825	5035789	615854	5035673
WC43	Tributary to Meaghers Lake	615819	5035904	615825	5035804
WC44	Tributary to Meaghers Lake	616766	5035954	616779	5035855
WC45	Tributary to Broad Cove	617490	5035975	617540	5035932
WC46	Tributary to Unknown	618694	5037191	618777	5037061
WC47	Tributary to Birchtown Lake	619699	5037998	619780	5037927
WC48	Tributary to Birchtown Lake	619906	5037989	619771	5037938
WC49	Clam Harbour River	620452	5038469	620806	5038323
WC50	Clam Harbour River	620646	5038622	620705	5038464
WC51	Tributary to St. Francis River	621689	5038812	621809	5038806
WC52	Tributary to St. Francis River	621808	5038945	621827	5038825
WC53	Tributary to St. Francis River	622401	5039185	622407	5039162
WC54	St. Francis River	623228	5039334	623228	5039334
WC55	St. Francis River	623285	5039893	623228	5039334
WC56	Tributary to St. Francis River	623695	5040417	623699	5040319
WC57	Tributary to St. Francis River	623873	5040827	623573	5040604
WC58	Tributary to St. Francis River	624012	5040916	623716	5041112
WC59	Tributary to Hansons Lake	624248	5041459	624139	5041481
WC60	Tributary to Hansons Lake	624454	5041736	624454	5041736
WC61	Tributary to Hansons Lake	624587	5041721	624454	5041736
WC62	Tributary to West Lake	625078	5042443	625176	5042077
WC63	Tributary to West Lake	625314	5042405	625354	5042386
WC64	Tributary to Carters lake	626198	5043868	626196	5043763

Table 5.2.3 Summary of Water Crossings in LAA

Project Site ID	Watercourse Name	Start Coordinates		End Coordinates	
		Easting	Northing	Easting	Northing
WC65	Tributary to Carters lake	626592	5044616	626587	5044447
WC66	Tributary to Strait of Canso	627907	5046045	627981	5046045
WC67	Tributary to Strait of Canso	628330	5046081	628789	5046177
WC68	Tributary to Strait of Canso (CB)	630273	5047666	630176	5047717
WC69	Tributary to Strait of Canso (CB)	632290	5046434	631996	5046483

Water Quality

Water quality measurements were taken at 14 watercourses within the assessment corridor between September 15 and September 24, 2015. The results are summarized in Table 5.2.4; pH values for these watercourses ranged from 4.6 to 6.8. The CCME Guidelines for the protection of Freshwater Aquatic Life recommends pH values in the range of 6.5 to 9 as suitable for all life stages of aquatic life. The subset of watercourses sampled in the LAA is considered generally acidic, with an average pH of 5.6; only two had pH values of greater than or equal to 6.6. The eastern shore of Nova Scotia is known to have naturally occurring low pH values (acidic waters) in areas dominated by Halifax formation bedrock (Stantec 2012a). Other factors usually associated with low pH values in Nova Scotia include bogs and dystrophic waters, as well as acid rain and runoff from exposed pyritic slate formations (Davis & Brown 1996). Fish species in this region are believed to be locally adapted to naturally low pH conditions.

Turbidity ranged from 0.75 NTU to 5.96 NTU at the time when the measurements were taken. The CCME guideline for turbidity is based on a change from baseline. For short-term effects (e.g., 24-h period) a maximum increase of 8 NTU is recommended; over the long-term, (e.g., 30-d period) this guideline value reduces to 2 NTU. Dissolved oxygen ranged from 4.4 mg/L to 10 mg/L, with an average of 7.3 mg/L. The CCME guidelines for freshwater aquatic for dissolved oxygen states a minimum acceptable dissolved oxygen concentration of 9.5 mg/L for early life stages for cold water biota, and 6.5 mg/L for other life stages. Eleven of the 14 measured watercourses met the minimum guideline of 6.5 mg/L, but only one (WC21) met the minimum guideline of 9.5 mg/L for early life stages. The major sources of dissolved oxygen in water are the atmosphere and photosynthesis of aquatic plants. Other variables that influence these levels include surface and water velocity, channel roughness, hydraulic gradient, sediment texture and porosity, daily water temperature fluctuation, and the consumptive oxygen demand of the substrate (CCME 1999).

Table 5.2.4 Water Quality Summary

Project Site ID	Watercourse Name	Stream Order	Water Temp. (°C)	Conductivity (µS/cm)	Dissolved Oxygen (mg/L)	pH	Turbidity (NTU)
WC10	Tributary to Meadow Lake	2	20.1	267	7.9	4.6	1.3
WC11	Tributary to Little Beech Hill Lake	1	13.1	32	4.4	6.2	1.32
WC16	Tributary to Ephraims Lake/New Harbour River NE	2	19.6	27	7.8	5.1	1.76
WC19	Tributary to The Three Ponds	1	14.1	27	7.1	4.8	1.02
WC20	Tributary to The Three Ponds	2	14.1	31	5.4	6.8	0.90
WC21	Salmon River	4	14.8	28	10	6.1	0.74
WC25	Tributary to Skinner Lake	2	15.2	43	6.5	6.1	2.02
WC51	Tributary to St. Francis River	1	12.4	48	8.7	6.4	5.96
WC52	Tributary to St. Francis River	1	16.7	27	7.8	5.3	0.82
WC54	St. Francis River	3	17.1	25	8.4	5.3	-
WC55	St. Francis River	3	17.2	24	9.1	6.0	-
WC65	Tributary to Carters lake	1	14.7	20	6.9	4.9	0.75
WC66	Tributary to Strait of Canso	1	15.2	21	5.4	4.3	0.77
WC68	Tributary to Strait of Canso	1	14.7	20	7.4	6.6	-

Habitat Assessment Results

Habitat assessments occurred from September 9 to September 24, 2015 at a sub-set of sites accessible without traversing private lands. Further details regarding sites on private lands surveyed previously can be found in JWEL (1998).

WC1 Tributary to Goldbrook

Only the electrofishing portion of the assessment was carried out on this watercourse crossing (Figure 5.2.2). No fish were captured or observed.

WC9 Tributary to Meadow Lake

Only the electrofishing portion of the assessment was carried out on this watercourse crossing (Figure 5.2.2). No fish were captured or observed.

WC10 Tributary to Meadow Lake 2

Located approximately 5.5 km from Isaacs Harbour along the Eight Mile Lake road (Figure 5.2.2), WC10 feeds into Meadow Lake. The upstream extent of the LAA is a small lake, which collects and flows down a series of steep cobble and boulder riffles on its way towards Meadow Lake (Photo 5.2.1). This watercourse had a consistent, mean channel width of approximately 5.10 m and mean depth of 0.17 m (Table 5.2.4). Substrates throughout the assessed corridor consisted of mean coverage estimates of approximately 45% cobble, 25% boulders, 12% large gravel, 12% gravel, 3% fines, 2% large boulders, and 2% organics. Embeddedness was determined to be low throughout the measured extents of WC10. Composed predominately of submerged plant species, aquatic vegetation was minimal (<5% coverage) and was noted only in a few localized, slower pools. Riparian vegetation in the sections assessed through the LAA predominately consisted of deciduous trees (mean ~37%), with shrubs (~26%), grasses (~23%), bare areas (~13%) and coniferous trees (~2%) comprising the remainder. WC10 had both the highest water temperature (20.1°C) and the highest conductivity (267µS/cm) of all the streams measured (Table 5.2.4). Dissolved oxygen was 7.9 mg/L, pH was 4.6, and turbidity was 1.3 NTU. Velocity was recorded to be approximately 0.195 m/sec. During an electrofishing survey, both brook trout and American eel were caught.

Photo 5.2.1 WC10 Upstream (left photo) and Downstream (right photo) views at Transect 3

WC11 Tributary to Little Beech Hill Lake

This watercourse is located approximately 1.1 km to the northeast of an unnamed road, along the existing pipeline RoW (Figure 5.2.2). Excluding a pool, approximately 60 m in length by 10 m wide and deepest in its centre at 0.9 m, WC11 had a mean width of 5.06 m and a mean depth of 0.59 m (Table 5.2.5). Multiple beaver dams were observed towards the southeast extent of the assessment corridor. This beaver activity had slowed flow such that surface flow was non-detectable (Photo 5.2.2). This is likely a contributing factor to the accumulation of approximately 17% organic matter in the substrate. The remaining substrate consisted of 63% cobble, 10% large gravel, and 10% large boulders. Embeddedness was low in all locations assessed along WC11. Aquatic vegetation was consistently distributed, covering approximately 20% by area and consisting of approximately 50% macrophytic algae, 25% submerged plants and 5% for both floating-leaved and emergent species. WC11 flows through a forested wetland and the riparian vegetation is representative of that. Throughout the LAA, it consisted of shrubs(60%), grasses (22%) and coniferous trees (13%) of the riparian zone either side of this watercourse; mosses and other low lying wetland plant species occupied approximately 5% of cover. Crown closure was 0% and the water course was completely exposed through the assessed corridor. Water temperature was measured to be 13.1°C and dissolved oxygen was 4.4.mg/L, conductivity was 32 µS/cm, pH was 6.1 and turbidity was 0.74 NTU (Table 5.2.4). An electrofishing survey resulted in a catch of brook trout, American eel and nine-spine stickleback.

Photo 5.2.2 WC11 Upstream (left photo) and Downstream (right photo) Views at Transect 3

WC12 Tributary to Beech Hill Lake

Only the electrofishing portion of the assessment was carried out on this watercourse crossing (Figure 5.2.2). Multiple brook trout were captured.

WC13 Tributary to Beech Hill Lake

Only the electrofishing portion of the assessment was carried out on this watercourse crossing (Figure 5.2.2). Multiple brook trout were captured.

WC14 Tributary to Beech Hill Lake

Only the electrofishing portion of the assessment was carried out on this watercourse crossing (Figure 5.2.2). Multiple brook trout were captured.

WC15 Tributary to Beech Hill Lake

Only the electrofishing portion of the assessment was carried out on this watercourse crossing (Figure 5.2.2). No fish were captured or observed.

WC16 Tributary to Ephraim's Lake/New Harbour River NE

Connecting Ephraim's Lake to the New Harbour River (Figure 5.2.2), WC16 is a second order stream (Photo 5.2.3). The channel width and depths of WC16 remained uniform throughout the assessment corridor, with mean measurements of 8.22 m for the channel width and 0.15 m for channel depth (Table 5.2.5). Substrates consisted mostly of cobble (~48%) with the remainder composed of boulders (~12%), large gravel (~20%), gravel (~12%) and organics (~8%). Through the surveyed assessment corridor, the embeddedness of WC16 was low due to the larger-sized substrate composition. Macrophytic algae was evenly distributed and estimated to occupy 25% of the submerged area. Localized communities of submerged aquatic vegetation species were present, but only minimally (5%) throughout the surveyed length of WC16. Shrubs (mean ~46%) and grasses (~15%) were dominant in the riparian zone of the understory of a mixed wood stand (~18% coniferous trees, ~17% deciduous trees) adjacent to WC16, with the remaining area unoccupied and bare (~5%). Due to its relatively large width, WC16 had little (1-20%) crown closure and was largely exposed. Water temperature at the time of the survey was 19.6°C. Conductivity was measured at 27 µS/cm, pH was 5.1 and dissolved oxygen was 7.8 mg/L (Table 5.2.3). Velocity during the assessment period was measured at a mean of 0.104 m/sec. An electrofishing survey was completed and produced multiple American eels.

Photo 5.2.3 WC16 Upstream (left photo) and Downstream (right photo) Views at Transect 3

WC17 Tributary to Lower Stillwater

Only the electrofishing portion of the assessment was carried out on this watercourse crossing (Figure 5.2.2). No fish were captured or observed.

WC18 Tributary to Goal Lake

Only the electrofishing portion of the assessment was carried out on this watercourse crossing (Figure 5.2.2). No fish were captured or observed.

WC19 Tributary to Three Ponds

WC19 crosses the assessment corridor approximately 1.5 km along existing unnamed roads, north of Eight Mile Lake Rd (Figure 5.2.2). This watercourse crossing had a mean channel width of 1.96 m and a mean depth of 0.13 m (Table 5.2.5). The entire length of WC19 in the assessment corridor ran through a wetland and had intermittent, braided channels, often disappearing underground (Photo 5.2.4). Organic materials made up the majority (mean ~78%) of the substrate, with the remainder composed of boulders (~12%), fines (~8%) and cobble (~2%). WC19 had high to very high embeddedness through its assessed length. Floating-leaved and submerged plant species were dominant and present in select stretches of this watercourse. Riparian vegetation had a consistent base of wetland plant species with approximately 47% coverage; the balance consisted of coniferous trees (~32%), deciduous trees (~9%), shrubs (~8%) and grasses (~4%). Crown closure was estimated to be 21% to 40% overall, with more enclosed sections through the coniferous stand, while more open sections were present through the wetland. At the time of the assessment, the water temperature was 14.1°C, dissolved oxygen was 7.1 mg/L, turbidity was 1.02 NTU, conductivity was 27 µS/cm and had a pH of 4.8 (Table 5.2.4). An electrofishing survey found no fish.

Photo 5.2.4 WC19 Upstream (left photo) and Downstream (right photo) Views at Transect 3

<u>WC20 Tributary to the Three Ponds</u>

Approximately 400 m from WC19 (centreline to centreline), WC20 represents the downstream portion of the same tributary (Figure 5.2.2). The mean channel width and depth were 1.34 m and 0.25 m, respectively (Table 5.2.5). The substrate of this channel consisted primarily of fine materials at approximately 43%, cobble (~32%), boulders (~13%), organics (~8%), and minimal large boulders (~3%). Moderate embeddedness was observed through most of this watercourse, with that dropping to low through the existing RoW (Photo 5.2.5). Aquatic vegetation was minimal (5-15%) and consisted equally of emergent and submerged species. Similar to its upstream portion along WC19, WC20's riparian vegetation is composed of wetland species (mean ~13%), coniferous trees (~10%), deciduous trees (~9%) with shrubs (~7%), grasses (~8%) and bare patches (~3%) interspersed throughout.

Water quality measurements were expectedly similar to the upstream measurements at WC19 (Table 5.2.4). The largest differences were a pH of 6.8 (2.0 pH units greater) and a dissolved oxygen level dropping 1.7 mg/L to 5.4 mg/L. The water temperature was the same as that of WC19 (14.1°C). Water conductivity was slightly higher (by 4 µS/cm) at 31 µS/cm. Turbidity was slightly lower (by 0.12 NTU) at 0.9 NTU. Velocity was measured to have a mean speed of approximately 0.024 m^3/sec. No fish were observed or caught during an electrofishing survey.

Photo 5.2.1 WC20 Upstream (left photo) and Downstream (right photo) Views at Transect 3

WC21 Salmon River

The crossing location of the Salmon River is approximately 8.5 km upstream from its mouth in Chedabucto Bay (Figure 5.2.2). The crossing is located within the pending Chedabucto Fault Nature Reserve. This pending nature reserve includes a 1 km section of the Salmon River identified as Atlantic salmon spawning habitat. Within the LAA, WC21 had a mean channel width of 16.7 m and a mean channel depth of 0.29 m (Photo 5.2.6). Substrates throughout the LAA were estimated to consist of approximately 47% cobble, 20% large gravel, 15% fines, 8% gravel, 7% boulder and 3% bedrock (Table 5.2.5). Low embeddedness was observed throughout the LAA. Aquatic vegetation was sparse through WC21, composed of submerged plant species in select groupings. Vegetation covered approximately 90% of the riparian zone and was composed of approximately 53% grass, 33% shrubs and 10% deciduous trees. Water quality measurements were 14.8°C for water temperature, 10.0 mg/L for dissolved oxygen, 28 µS/cm for conductivity, 6.1 for pH, and 0.74 NTU for turbidity (Table 5.2.4). Water velocity was also measured and had a mean of 0.32 m/sec. An electrofishing survey was not completed in 2015 (as described in Section 5.2.4.1). Two salmonid parr were observed during the habitat assessment, although further identification was not achievable. Previous electrofishing surveys noted brook trout, American eel, Atlantic salmon, rainbow trout, and alewife/gaspereau (JWEL 1998).

Photo 5.2.2 WC21 Upstream (left photo) and Downstream (right photo) Views at Transect 3

<u>WC25 Tributary to Skinner Lake</u>

WC25 is located approximately 250 m south of the intersection of the LAA and Tompkinsville Road (Figure 5.2.2). The width of the channel was 5.20 m, with depth averaging 0.5 m (Table 5.2.5). Beaver activity has highly influenced this small crossing throughout the entire assessment corridor, creating multiple flooded areas along with a section of multiple small braided channels with minimal to no visible surface flow (Photo 5.2.7). Downstream of the crossing, the watercourse widened onto an adjacent grassy floodplain, likely due to beaver activity further downstream of surveyed area. Multiple channels meandered through the floodplain, increasing in depth and width, but minimal flow was observed. Substrate along the channel was largely influenced by beaver activity, and minimal flow allowed organic substrates to accumulate. Substrates consisted of approximate mean coverage of 27% for organics, 23% fines, 23% gravel, 12% gravel, 12% large gravel and 3% boulders. Embeddedness was high along most of the surveyed reach, except for an approximately 20 m long stretch through the existing RoW, where embeddedness was low through the riprap. In some of the deeper pools throughout this watercourse, there were sparse (~3%) patches of floating-leaved vegetation, while the remainder of the channel was largely devoid of in-stream vegetation. Vegetation heavily covered (~91%) the riparian zone and was a mix of shrubs (~55%), grasses (~38%) and bare patches (~7%) along the entire length of the LAA. Canopy closure throughout this PDA was heavy (71-90%), excluding the existing RoW and the upstream section from there, which were wide open at 0%. At the time of the survey, the water temperature was 15.2°C, conductivity was 43 μS/cm, dissolved oxygen was 6.5 mg/L, turbidity was 2.02 and pH was 6.1 (Table 5.2.4). An electrofishing survey was conducted with brook trout and American eel caught, as well as multiple instances of both species being observed but evading capture.


Photo 5.2.3 WC25 Upstream (left photo) and Downstream (right photo) Views at Transect 3

WC49 Clam Harbour River

Only the electrofishing portion of the assessment was carried out on this watercourse crossing (Figure 5.2.2). Numerous white sucker were captured.

WC50 Clam Harbour River

Only the electrofishing portion of the assessment was carried out on this watercourse crossing (Figure 5.2.2). Fishing effort was reduced due to assessment corridor access constraints. Both brook trout and American eel were captured.

WC51 Tributary to St. Francis River

Located approximately 230 m northeast of an unnamed logging road, WC51 runs 2 km north from Middletown Road (Figure 5.2.2). Along the LAA, the channel measured 1.72 m in average width and 0.12 m in average depth (Table 5.2.5). Upstream of the centerline, the channel meandered through a mixed wood stand and converged with WC52 prior to crossing the existing RoW (Photo 5.2.8). Downstream of the crossing, the stream was influenced by previous beaver activity. The downstream portion consisted of multiple pools before opening into a wider (mean ~2.5 m), sinuous beaver channel, through a grass field prior to reaching a drained beaver pond and lodge. Organic matter was found throughout this crossing, but was minimal (<10%) until the downstream extent, where it increased to 90% before the drained beaver pond. Cobble (30%) and gravel (45%) were relatively uniform throughout the section upstream of the beaver activity. Embeddedness was low in the sections upstream of the inflow of WC52. However, the downstream beaver activity increased substrate embeddedness. Aquatic vegetation was minimal (<5% coverage) through the surveyed area, with sparse patches of floating-leaved plants (5%) and macrophytic algae (10%). Riparian vegetation in the LAA of WC51 was predominately grasses (~65%), barring a small coniferous (~35%) stand sandwiched by the adjacent existing RoW and the aforementioned downstream beaver channel. Crown closure either side of the existing RoW was low (<20%) and was non-existent in the RoW, as well as the downstream section of beaver channel through the grass field. Water quality measurements recorded during the assessment period were 12.4°C for water temperature, water conductivity was 48 µS/cm, dissolved oxygen was 8.7 mg/L and pH was 6.4 (Table 5.2.4). Turbidity was the highest of all streams assessed at 5.96 NTU. Brook trout and American eel were captured in this watercourse during the electrofishing survey.

Photo 5.2.4 WC51 Upstream (left photo) and Downstream (right photo) Views at Transect 3

WC52 Tributary to St. Francis River

Flowing directly into WC51 (Figure 5.2.2), WC52 dropped 8.8 m in elevation from a beaver pond at the upstream extent, to where it entered WC51 downstream of the assessment corridor (a length of approximately 200 m). At the upstream extent, a small pool (approximately 1.5 m wide by 0.5 m deep) is contained between two beaver dams (Photo 5.2.9). These dams constrict flow before cascading down a series of riffles and runs that rarely deviate from widths of 0.75 m to 1.0 m and depths of 0.1 m (Table 5.2.5). Within the flat section below the series of riffles and runs, WC52 widened to 2 m and averaged 0.07 m in depth before converging with WC51. The substrate throughout the assessment corridor was uniform and consistent at 35% gravel, 35% large gravel, 18% cobble, 5% fines, 5% organics and 2% boulders. Embeddedness was low for the entire surveyed length of the stream. This was likely a result of a combination of both the upstream beaver pond retaining the majority of fine substrates and organic matter, and the steepness of the watercourse gradient. There was an absence of observed aquatic vegetation in the steep section through the middle, with minimal patches of macrophytic algae in the lower, less steep section as well as a small grouping of emergent plants localized in a pool between the beaver dams. The riparian vegetation along this watercourse consisted of a blend of grasses (~64%), shrubs (~13%), coniferous trees (~17%) and deciduous trees (~7%). Crown closure was low (<20%) throughout this LAA. Water temperature (16.7°C) was 4.3°C higher than in the adjacent WC51, likely due to upstream impaction and the pooling created by beaver dams. Water conductivity was measured at 27 µS/cm, dissolved oxygen was 7.8 mg/L, turbidity was 0.82 NTU, and pH was 5.3 (Table 5.2.4). During an electrofishing survey of this watercourse, both brook trout and American eel were caught.


Photo 5.2.5 WC52 Upstream (left photo) and Downstream (right photo) Views at Transect 3

WC53 Tributary to St. Francis River

Only the electrofishing portion of the assessment was carried out on this watercourse crossing (Figure 5.2.2). No fish were captured or observed.

WC54 St. Francis River

Only the electrofishing and water quality portion of the assessment was carried out on this watercourse crossing (Figure 5.2.2). American eel were captured. Water quality measurements included a water temperature of 17.1°C, a conductivity of 25 µS/cm, dissolved oxygen at 8.4 mg/L and a pH of 5.3 (Table 5.2.4).

WC55 St. Francis River

Only the electrofishing and water quality portion of the assessment was carried out on this watercourse crossing (Figure 5.2.2). American eel were captured. Water quality measurements included results of 17.2°C for water temperature, 20 µS/cm for conductivity, 6.9 mg/L for dissolved oxygen and 6.0 for pH (Table 5.2.4).

WC56 Tributary to St. Francis River

No visible channel could be observed during the time of the assessment.

WC57 Tributary to St. Francis River

No visible channel could be observed during the time of the assessment.

WC58 Tributary to St. Francis River

No visible channel could be observed during the time of the assessment.

WC64 Tributary to Carters Lake

Entering Carter's Lake in the northeast. WC64 is a second order stream which first flows through a mixed wood stand and floating bog before joining the lake (Figure 5.2.2). Upstream of the assessment corridor, WC64 was a pool, measuring 8.5 m wide and 0.5 m deep (Table 5.2.5). Through the existing RoW, the watercourse narrows, averaging approximately 1.75 m in width and 0.25 m in depth. Forming another pool (approximately 20 m wide, whose depth could not be safely measured) upon its entrance to the floating bog; the channel was of uniform width (~2 m), of an undetermined depth (due to safety concerns) and meandered through the floating bog before reaching the lake (Photo 5.2.10). Substrate in the upstream portion consisted largely of boulders (35-40%) and cobble (30-45%), once the watercourse widened and deepened the finer substrates were more likely settled and up to 60% was gravel (both small and large). Organics attributed for approximately 30% prior to the floating bog, where safely concerns inhibited the taking of measurements. It is likely that the substrate in the unmeasured section of the bog would consist primarily of organics.

Embeddedness increased as WC64 traversed downstream and became high as it entered the floating bog. A variety of aquatic vegetation species were present throughout, but concentrated mostly through the existing RoW and the assessment corridor upstream of the RoW. The section of stream through the floating bog had a few small patches of floating leaved vegetation, and there was likely little due to the thick organic substrate layer. Upstream of the assessment corridor, tall shrubs are the abundant (50-80%) riparian vegetation with some (<40%) conifers. The downstream section of the existing RoW runs through an immature mixed wood stand (30% coniferous trees, 30% deciduous trees) before becoming a floating bog, consisting mostly (90%) of grasses (including mosses). Crown closure was wide open through most of the assessment corridor, but a section of mixed wood stand through the LAA provided a heavy crown closure, creating an approximate overall coverage range of 21% to 40% . Water temperature was 14.7°C, conductivity was 20 µS/cm, dissolved oxygen was 6.9 mg/L, turbidity was 0.75 NTU and pH was 4.9 (Table 5.2.4). Multiple white suckers were captured during an electrofishing survey of this watercourse. A single stickleback was observed prior to the electrofishing survey, but the species could not be confirmed.

Photo 5.2.6 WC64 Upstream (left photo) and Downstream (right photo) Views at Transect 3

WC65 Tributary to Carters Lake

Flowing into the wetland feeding WC64, and located approximately 750 m to its east (Figure 5.2.2) WC65 is a highly intermittent channel through a forested wetland (Photo 5.2.11). The upstream section of multiple channels had minimal or subterranean flow, but after the confluence of minor tributaries, widened to as much as 1.89 m by 0.53 m in depth; it had mean channel measurements of 0.38 m wide and 0.08 m (Table 5.2.5). Sections of measurable channel consisted primarily of cobble (~45%), with the remainder composed of organics (~40%), large gravel (~10%) and fines (<5%). Progressing from medium to high, embeddedness increased as the watercourse went downstream. Aquatic vegetation, composed solely of submerged species, was patchy and minimal (<10%) throughout this stream. Riparian vegetation was uniformly covered by shrubs (~37%) throughout, with coniferous trees (~20%), grasses (~8%) and deciduous trees (~2%). An abundance of alders throughout most of the surveyed stream combined to create a moderately high crown closure of 41% to 70%. Water temperature was measured to be 15.2°C, conductivity was 21 µS/cm, dissolved oxygen was 5.4 mg/L, turbidity was 0.77 NTU, and pH was 4.3 (Table 5.2.4). A single white sucker was captured in the only suitable location that could be safely and effectively electrofished.

Photo 5.2.7 WC65 Upstream (left photo) and Downstream (right photo) Views at Transect 3

WC66 Tributary to Strait of Canso

No visible channel could be observed at this watercourse during the time of the assessment.

WC67 Tributary to Strait of Canso

Located less than 750 m from the Strait of Canso, the intersection of the assessment corridor centreline and WC67 was approximately 107 m above sea level and had an approximate overall gradient of 11% (Photo 5.2.12). The mean channel width was 1.17 m with a mean depth of approximately 0.04 m (Table 5.2.5). Due to the steepness of the gradient, WC67 substrate downstream of the centreline was composed mostly of boulders (~80%), with some cobble (~20%). Upstream of the centreline, fine substrates measured approximately <90% with organics making up the remaining. Embeddedness was determined to be low throughout the assessed corridor. Aquatic vegetation was not observed in this watercourse. Riparian vegetation was a consistent composition of shrubs (~22%), grasses (~25%), deciduous trees (~10%), coniferous trees (~2%), and bare patches (~40%). Water quality measurements were recorded and found to be indicative of healthy fish habitat, but the steep gradient of this watercourse reduced, or potentially eliminated, its potential to provide fish habitat. Water temperature was 14.7°C, conductivity was 20 µS/cm, dissolved oxygen was 7.4 mg/L, and pH was 6.6 (Table 5.2.4).

Photo 5.2.8 WC67 Upstream (left photo) and Downstream (right photo) Views at Transect 5

A summary of the habitat assessment data collected at a sub-set of sites accessible without traversing private lands is included in Table 5.2.5. Further details regarding sites on private lands surveyed previously can be found in JWEL (1998).

Table 5.2.5 Summary of Aquatic Habitat by Watercourse

Channel Characteristics						Substrate (%)									Water Depth (m)		
Project Site ID	Stream Order	Channel Width (m)	Wetted Width (m)	Channel Depth (m)	Dominant Habitat Type	O	F	G	LG	C	B	LB	Br	E	¼ Stream Width	½ Stream Width	¾ Stream Width
WC10	2	5.10	3.90	0.17	Riffle	2	3	12	12	45	25	2	-	L	0.15	0.20	0.17
WC11	1	5.06	5.06	0.59	Run	17	-	-	10	63	-	10	-	L	0.59	0.62	0.57
WC16	2	8.22	7.28	0.15	Run	8	-	12	20	48	12	-	-	L	0.11	0.15	0.19
WC19	1	1.96	1.46	0.13	Run	78	8	-	-	2	12	-	-	H-VH	0.13	0.14	0.13
WC20	2	1.34	0.98	0.25	Run	8	43	-	-	32	13	3	-	L-M	0.20	0.27	0.27
WC21	4	16.7	12.00	0.29	Run	-	15	8	20	47	7	-	3	L	0.30	0.37	0.2
WC25	2	5.20	3.41	0.19	Run/ Impoundment	27	23	23	12	12	3	-	-	L-VH	0.18	0.21	0.17
WC51	1	1.72	1.69	0.12	Run	10	5	7	45	32	2	-	-	L	0.07	0.13	0.15
WC52	1	2.30	1.43	0.05	Riffle	5	5	35	35	18	2	-	-	L	0.04	0.05	0.05
WC64	2	2.31	2.06	0.62	Run	37	10	13	10	22	8	-	-	L-VH	0.67	0.48	0.71
WC65	1	0.38	0.31	0.08	Interstitial	40	5	-	10	45	-	-	-	M-H	0.05	0.10	0.08
WC67	1	1.17	0.96	0.04	Step pool	2	32	8	22	8	10	18	-	L	0.005	0.007	0.10

Notes:

The data presented in the table are a representation of mean measurements assessed within the potential PDA (Transects 2-4) and may vary based on final RoW alignment.

Stream Order: The position of a watercourse in the hierarchy of tributaries that are a part of drainage system.

Substrate: Br-bedrock, LB- large boulder (>500mm), B – Boulder (256-500 mm), C-cobble (64-255mm), LG-large gravel (32 -64mm), G-Gravel (1-32 mm), f-fines (<1mm), O-Organics, E – Embeddedness L- Low (<25%), M – Moderate (25-50%), High (50-75%) Very High (>75%).

Fish Populations

The assessment corridor passes through four watersheds in Nova Scotia: Country Harbour River, New Harbour/Salmon River, Clam Harbour/St. Francis River and River Inhabitants. During the 2015 aquatic field program, Stantec field crews conducted electrofishing surveys at 28 watercourses in the LAA. In 1998, an environmental assessment was conducted in the same region for a previous iteration of the proposed pipeline (JWEL 1998). Twenty-two watercourses were fished as part of that assessment. A total of 37 watercourses were surveyed in either 1998 and/or 2015 (11 watercourses were fished in both years). Table 5.2.6 summarizes the number of watercourses located and fished in each primary watershed.

Table 5.2.6 Total Number of Watercourses and Number of Watercourses Fished in Each Primary Watershed in 1998 and/or 2015

Primary Watershed	Watershed Area (km^2)	Total Number of Watercourse Crossings	Number of Watercourse Crossings Fished
Country Harbour River	572.4	8	7
New Harbour/Salmon River	1075.8	19	10
Clam Harbour/St. Francis River	526.6	40	20
River Inhabitants	1196.2	2	0
Total		**69**	**37**

Fish were caught in three of the four watersheds located in the LAA (Country Harbour, New Harbour/Salmon River and Clam Harbour/St. Francis River). The two watercourse crossings in River Inhabitants were located on private land and were not accessible to survey teams. Electrofishing identified nine species: brook trout (*Salvelinus fontinalis*), American eel (*Anguilla rostrata*), white sucker (*Catostomus commersoni)*, Atlantic salmon (*Salmo salar*), Alewife (*Alosa pseudoharengus*), rainbow trout (*Oncorhynchus mykiss*), ninespine stickleback (*Pungitius pungitius*), fourspine stickleback (*Apeltes quadracus*) and creek chub (*Semotilus atromaculatus*). Three of these species (ninespine stickleback, fourspine stickleback and creek chub) are small forage fish. All nine species are important in recreational, Aboriginal, and in some cases, commercial fisheries. Table 5.2.7 summarized electrofishing results for both 1998 and 2015.

Table 5.2.7 Fish Species Caught During the 1998 and 2015 Electrofishing Surveys

Watershed	Water Crossings Sampled	Species Caught	
		1998	2015
Country Harbour	WC9	-	None
	WC10	BT	BT, AE
	WC11	BT, FSS	BT, AE, NSS
	WC12	-	BT
	WC13	-	BT
	WC14	-	BT
	WC15	-	None
New Harbour / Salmon River	WC1	-	None
	WC16	BT, AE	AE
	WC17	-	None
	WC18	-	None
	WC19	-	None
	WC20	None	None
	WC21	BT, AE, AS, RT, A	-
	WC24	None	-
	WC25	BT, WS	BT, AE
	WC26	BT, WS	-
Clam Harbour/ St. Francis River	WC36	BT, Euryhaline	-
	WC39	BT	-
	WC42	BT	-
	WC44	BT	-
	WC47	None	-
	WC48*	None	-
	WC49	BT	AE, CRC
	WC50	BT	BT, AE
	WC51	BT, AE	BT, AE
	WC52*	BT, AE	BT, AE
	WC53	BT, AE	BT, AE
	WC54	BT, WS	AE
	WC55*	BT, WS	AE
	WC56	-	None

Table 5.2.7 Fish Species Caught During the 1998 and 2015 Electrofishing Surveys

Watershed	Water Crossings Sampled	Species Caught	
		1998	2015
	WC57	-	None
	WC58	-	None
	WC64	None	WS
	WC65	-	WS
	WC66	-	None
	WC67	-	None

Note:

Species: BT = brook trout, AE = American eel, FSS = fourspine stickleback, NSS = ninespine stickleback, AS = Atlantic salmon, RT = rainbow trout, A = alewife, WS = white sucker, CRC = creek chub.

" - " Indicates that a survey did not take place at that location in that year.

" * " Indicates water crossings which are tributaries of the preceding water crossing. These water crossings were not identified as being separate from the preceding water crossing in 1998 surveys (JWEL 1998). For example, WC52 and WC53 were described as a single water crossing in 1998 (JWEL 1998).

Summary life history descriptions are included for species present in the LAA with the exception of Atlantic salmon and American eel which are discussed in detail in Section 5.2.4.2 below.

White Sucker

White suckers are a freshwater fish found throughout Canada. They live in both lakes and rivers, usually in shallow water. In lakes, white suckers are usually found in the top 20 ft to 30 ft, but have been recorded as deep as 151 ft (Scott & Crossman 1973). Spawning occurs in the spring (May-June) in shallow, gravel-bottom streams or lake margins once the water temperature reaches 10°C (Scott & Crossman 1973). Eggs hatch approximately two weeks after being laid, and the young remain in the gravel for another one to two weeks. Approximately one month after spawning, young white suckers may migrate into accessible lake environments (Scott & Crossman 1973). As adults, this species is a bottom feeder and feeds mainly on invertebrates, including Chironomidae, Trichoptera and Mollusca (Scott & Crossman 1973).

During the 2015 and 1998 electrofishing surveys, white suckers were found at six locations in two watersheds (New Harbour/Salmon River and Clam Harbour/St. Francis River). These fish had fork lengths ranging from 77 mm to 127 mm. This species has some commercial value, although they are not usually fished except for bait (DFO 2010a). White sucker serve as food for other fish species including Atlantic salmon, American eel and brook trout.

Rainbow Trout

Rainbow trout are native to western Canada and the United States and were introduced to New Brunswick and Nova Scotia in 1899 (Scott & Crossman 1973). Rainbow trout spawn in the spring in smaller tributaries of their rivers, or inlet or outlet stream of their lakes. Facultative anadromous, some rainbow trout populations contain individuals that go out to sea to feed and grow. Spawning occurs at sites with a bed of fine gravel in a riffle above a pool, and where water temperature is between 10°C and 15°C (Scott & Crossman 1973). Some fish spawn more than once in their lifetime (DFO 2009). Rainbow trout feed on invertebrates, including plankton, crustaceans, insects, snails and leeches (Scott & Crossman 1973).

Rainbow trout were identified in only one location during the electrofishing surveys. Specifically, they were caught in the Salmon River in 1998, located in the New Harbour/Salmon River watershed. This species is a very popular recreational fish in Nova Scotia.

Alewife

Alewife is an anadromous species indigenous to the lakes and streams of eastern North America. This species spends the majority of their adult life at sea and moves into freshwater to spawn. Spawning occurs on shallow beaches of lakes (DFO n.d.) and quiet stretches of rivers above the influence of the tide (Scott & Crossman 1973). The upstream alewife run generally occurs between April and May. Spawning occurs at night in areas with a sandy or gravelly bottom. After hatching, young alewife remain on the spawning grounds until at least the late larval stage, after which they move towards deeper waters and eventually to sea (with the exception of land locked populations). They typically remain at sea for four to five years before returning to their freshwater spawning grounds. Alewife can spawn annually for several years, although post-spawning mortality is high (40-60%; DFO n.d.).

Alewife have traditionally been a very important commercial species in the Maritime Provinces. They are used both for local subsistence and export (DFO n.d.). During the 1998 electrofishing surveys, this species was found in the Salmon River, located in the New Harbour/Salmon River watershed.

Forage Fish

Small forage fish captured during electrofishing surveys included ninespine stickleback and creek chub. It is possible that other small-bodied fish also inhabit these watercourses that were not encountered during surveys. Both species of stickleback are generally less than three inches long. Creek chub are generally between 51 and 152 mm long, although they can reach up to 305 mm. The creek chub caught in the 2015 electrofishing surveys had fork lengths ranging from 35 mm to 118 mm. Both creek chub and ninespine stickleback are freshwater species. All of these forage fish serve as prey species for larger fish, including brook trout, American eel and Atlantic salmon; therefore, they support the CRA fisheries for these larger species.

Ninespine stickleback and creek chub were each only encountered once in the electrofishing surveys. Both species of stickleback were caught in WC11 (in Country Harbour watershed). Creek chub was caught at WC 49, in the Clam Harbour/ St. Francis River watershed.

5.2.5 Potential Environmental Effects and Project-Related Interactions

The potential environmental effects and Project-related interactions discussed in this section focus on species that are part of a CRA fishery, or Species at Risk. These two groups of species are protected by provisions of the federal Fisheries *Act, the* provincial *Environment Act,* and federal or provincial *Species at Risk Acts*.

Activities and components could potentially interact with the freshwater environment by:

- direct or indirect loss or alteration of habitat during all Project phases resulting from disturbance of watercourses during clearing, grubbing, pipeline construction and maintenance, or watercourse crossing construction and maintenance;
- direct mortality of fish resulting from dewatering, trench excavation and pipeline installation below the waterline during construction, and operation and maintenance; and/or
- destruction or alteration of habitat or direct mortality to freshwater fish resulting from acute changes in nutrient, sediment or contaminant concentrations (water quality) from sedimentation or accidental releases during construction, and operation and maintenance.

In consideration of these potential interactions, the assessment of Project-related environmental effects on the freshwater environment is focused on the following environmental effect:

- change in freshwater populations.

The effect pathways and measurable parameters for the assessment of this environmental effect are provided in Table 5.2.8.

Table 5.2.8 Potential Environmental Effects, Effects Pathways and Measurable Parameters for the Freshwater Environment

Potential Environmental Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in the freshwater populations	• Destruction or alteration of habitat arising from disturbance of the watercourse during clearing, grubbing, pipeline crossing construction and maintenance, or access road crossing construction and maintenance. • Direct mortality of fish resulting from trenching, dewatering or pipeline construction and maintenance within watercourses. • Destruction or alteration of habitat or direct mortality to freshwater fish resulting from acute changes in nutrient, sediment or contaminant concentrations (water quality) from sedimentation, or accidental releases during construction, and operation and maintenance.	• Areal extent of altered or lost CRA fish habitat (m^2). • Mortality to CRA or SAR fish (i.e., number of fish). • Change in water quality (pH (units), dissolved oxygen (mg/L), temperature (°C), turbidity (NTU) and total suspended solids) (mg/L)).

Bear Paw is expected to interact with the freshwater environment during construction, and operation and maintenance and decommissioning.

It is anticipated that site preparation, watercourse crossings, (pipeline and temporary access roads), RoW restoration and vegetation control will directly interact with the freshwater environment. Surface run-off or accidental releases (hazardous material spills and release of drill fluids are covered in Chapter 7 (Accidents and Malfunctions)) from these activities may also interact with the freshwater environment.

Site preparation, especially clearing, has potential to decrease the abundance of riparian vegetation along watercourses, which may alter bank stability and cause erosion, suspended sediment concentrations and nutrient concentrations in the watercourse (DFO 2010b). The loss of stream shading may result in increased stream temperatures during the summer months (Teti 1998). As a result of reduced riparian vegetation, the diversity and abundance of the aquatic food supply may change through the reduction of invertebrates and their food sources (DFO 2010b). Soil may be mobilized by equipment working within 30 m of the watercourses which may cause the sedimentation of the watercourses and alter ecological conditions such as water quality and stream habitat. Sediment entering watercourses may reduce visibility affecting predator or prey awareness or, if concentrations of sediment are high enough, damage gill structures (DFO 2010c). The crossing of watercourses by clearing equipment and crews raises the potential for the physical alteration of watercourse bed and banks.

There are three watercourse crossing methods proposed for the freshwater crossings: isolated (trenched), Horizontal Directional Drill (HDD) and open cut. An isolated crossing is the primary option for the majority of the watercourses in the freshwater environment (66 of 67), with HDD proposed for the Salmon River. At the 66 crossings where the primary option is an isolated crossing, an alternate method was identified. An open cut method will be used where a dry channel is observed, or the isolated crossing method is not suitable due to engineering, environmental or site constraints. For the HDD crossing at the Salmon River, the alternate option of an isolated crossing would be conducted only in the event that geotechnical conditions do not allow the HDD or if the HDD operation fails. The area of the Salmon River within the Salmon River is known to be a spawning location for Atlantic salmon; alterations to the streambed of the Salmon River will be minimized.

The potential environmental effects from each of these three crossing methods are described below with mitigation outlined in Section 5.2.6 and shown in the crossing descriptions vetted by DFO in Section 2.3.1.

Trenched watercourse crossing methods, such as the proposed isolated crossings, can alter streambed habitat if inappropriately sized material is used to backfill the trench. The use of backfill material as substrate which is larger than what was present during baseline may result in interstitial flow or a reduction in viable or usable water levels. Alternatively material with a high proportion of fines may lead to smothering effects on substrate at the crossing and substrate or organisms downstream.

Trenchless crossing methods, such as HDD, generally decrease the interaction between construction activities and the streambed. The accidental seepage of drill fluids through hydraulic fractures is similar to effects from erosion and sedimentation and may result in increased fines in the substrate and altered fish habitat. The assessment on the release of drill fluids via spills or hydraulic fractures is included in Chapter 7 (Accidents and Malfunctions).

Open cut crossing methods are generally the crossing method with the shortest duration; this method can be used in dry streambeds with minimal environmental effects on the freshwater environment. Open cut crossings in flowing watercourses generally increase the quantity of sediment released to the water column as compared to isolated or HDD crossings. If open cut crossings cannot be infilled, the open cut can lead to erosion and decreases in bank stabilization. Similar to isolated crossings, heavy equipment is required within 30 m of the watercourse and can result in decreased bank stabilization, loss of riparian vegetation, erosion, and sedimentation.

During RoW restoration, the use of hydraulically applied seed mixes (hydro-seeding) adjacent to a watercourse may change water quality by increasing nutrient concentrations in runoff. An increase in nutrient concentration may lead to eutrophication of watercourses which is generally evident by increased growth of aquatic plants and algae. Eutrophication can reduce water quality through increases in turbidity and decreasing dissolved oxygen concentrations (DFO 2010c). These changes to water quality can degrade the quality of fish habitat if left to persist.

Herbicides will be selectively used to control vegetation in areas surrounding above ground pipeline facilities. Herbicides have the potential to enter watercourses from direct application or runoff or herbicide drift during aerial application. Upon entering watercourses herbicide toxicity to fish varies based on the chemical compound and can lead to effects from stress to mortality (DFO 2010d). The use of carefully selected herbicides are not anticipated to interact with the freshwater environment.

During pipeline operation, vegetation will be mechanically maintained within the RoW. The use of equipment within 30 m of watercourse crossings for vegetation control may result in increased suspended sediment concentrations and the physical alteration of watercourse habitats and adverse effects to fish (DFO 2010c). Direct conduits to the watercourse may be created from equipment rutting; these ruts may create a pathway for sediment or contaminants to enter the watercourse. The alteration of bed and banks may reduce fish habitat quality and the suitability for life processes (DFO 2010c).

5.2.6 Mitigation

The following section outlines regulations, (i.e., Nova Scotia *Activities Designation Regulations)* codified measures (DFO Measures to Avoid Harm, Nova Scotia Watercourse Alteration Standards), proven mitigation and industry best management practices. The following measures will be implemented, to the extent practical to reduce the environmental effects of the interactions between Bear Paw and the freshwater environment during all stages of the Project. Typical crossing methods are described in Section 2.3.1 with standard mitigation described in Section 2.5.3. Mitigation measures specific to the freshwater environment VC are outlined in Table 5.2.9.

Table 5.2.9 Mitigation for the Freshwater Environment

Potential Environmental Effect	Mitigation
Change in Freshwater Populations	• Instream construction will be limited to the lower biological risk period between June 1 – September 30 when feasible. • HDD is the primary method of crossing for the Salmon River, an isolated crossing may be used in case of an HDD failure. • An NS Watercourse Alteration Approval will be obtained for all pipeline watercourse crossings (isolated or HDD). • A notification will be made to NSE via the Watercourse Alteration Program for each temporary watercourse crossing. • A Certified Watercourse Alteration Installer will carry out or directly supervise all pipeline watercourse crossings. • Fish rescues will be carried out before in-water work occurs during watercourse crossings. • All pipeline crossings will be constructed according to NSE Watercourse Alteration Standards, including but not limited to: o Pipeline crossings will cross perpendicular to the watercourse. o The pipeline will be installed at least 1 m below the thalweg of the watercourse. o All activities below the high-water mark (bankfull) will be carried out in isolation of flow, where feasible. o Cofferdams will be of sufficient height to hold back a 1:2 year return rainfall event. o Cofferdams will be manufactured cofferdam systems or constructed of bags filled with pea gravel faced with plastic. o Turbidity and TSS levels downstream will not exceed levels directly upstream by more than 25 mg/L or 10% of background, whichever is greater. • Silt plume management for open cut crossings. • If rutting is observed leading up to a watercourse crossing, brush matting or log corduroy will be installed at the approaches. • All temporary vehicle crossings will be constructed outside the banks of the watercourse and will not impact the streambed. • No washing, fuelling or maintenance of vehicles or equipment will occur in the vicinity of a watercourse or wetland without secondary containment. • The HDD operations will be monitored for release of drill fluids (Chapter 7 (Accidents and Malfunctions)). • Hydraulically applied seed mixes will include a tackifier to reduce nutrients and seeds in site runoff prior to re-vegetation. • Stream crossings will be assessed for erosion, with areas of erosion stabilized. • Herbicides will not be used along the RoW or in the vicinity of a watercourse or wetland.

5.2.7 Residual Environmental Effects and Significance Determination

5.2.7.1 Change in Freshwater Populations

Residual Project-related environmental effects on the freshwater environment may occur during initial site preparation, construction of watercourse pipeline crossings and vegetation control during operation. These environmental effects will occur once during construction and periodically during operation as needed for vegetation control.

Construction

Clearing during site preparation may result in a change in water quality via an increase in stream temperature and a change in the diversity and abundance of aquatic food supply from the loss of riparian vegetation.

Freshwater aquatic species such as fish are cold-blooded and have preferred temperature ranges, if temperatures exceed these ranges additional stress is put on that species (DFO 2013a). For fish species water temperature is the primary factor that regulates their metabolism; increased water temperature will decrease energy reserves and create stress on fish (Sauter 2001). Additionally, water warming decreases the saturation of dissolved oxygen and increases algae growth (Ducharne 2008), both of which may increase stress on aquatic species.

In 1st and 2nd order streams shade provided by riparian vegetation and groundwater inputs are the most important stream characteristics to influence water temperature outside of air temperature (EPA 2001). The increase in summertime (June to September) stream temperature from the loss of riparian vegetation quantified in several studies. The stream temperature increases ranged from +1°C to +6°C [1°C to 3°C in Oregon (Cole 2013), 4°C to 5°C in coastal BC (Burton and Likens 1973), 3.6°C in Idaho (Gravelle and Link 2007), up to 6°C in interior BC (Rex et al. 2012) and 1.4°C to 4.4°C in Maine (Wilkerson et al. 2006)]. The data generated by Wilkerson et al. (2006) is closest in proximity to the LAA and best compares to the meteorological conditions expected. This data suggests an increase in stream temperatures of 1.4°C to 4.4°C can be expected during stages of the Project where riparian vegetation is removed. Initially an approximately 35 m wide corridor will be cut to construct the pipeline. During operation, the periodic control of vegetation along the transmission line corridor will mechanically remove vegetation along this corridor including a section of riparian stream habitat. The area of vegetation removal along the corridor is narrower than the 250 m to 400 m wide sections of clear-cut studied by Wilkerson et al. (2006). Based on the more northern conditions and the lesser amount of riparian vegetation lost, it can be expected that the increase in stream temperature will be on the lower end of the temperature range published, approximately 1°C to 2°C . Blann et al. (2002) found the narrower the stream reach the lower the height of the vegetation required to achieve shade. Blann et al. (2002) noted little difference in stream water temperatures in Minnesota streams where grasses completely cover the channel. This is relevant to Bear Paw as grass and shrub vegetation will regenerate between rounds of vegetation control and is expected to provide shade for the narrow 1st order watercourses (49 of 69 crossings). The thermal regimes for these 1st order watercourses are expected to be less effected and will more quickly return to baseline conditions.

Watercourse crossings have the potential to alter fish habitat directly through changes in streambed material at the crossing location or downstream as a result of increased sediment loads. The proposed isolated crossing method reduces the potential for environmental effects on the freshwater environment downstream of the crossing. Given the narrow footprint of a dry crossing, and the use of appropriately sized backfill material which is clean, non-ore bearing and non-toxic, there is anticipated to be minimal disturbance to the freshwater environment from a change in substrate. With the implementation of the NSE Watercourse Alteration Standards, fish rescues and the mitigation measures outlined in Section 2.5.3 and Table 5.2.9, the likelihood of watercourse crossing construction permanently altering the freshwater environment in the LAA to a point where freshwater habitats are marginalized is low.

Fish eggs and larvae have been shown to be the most sensitive to increased sedimentation through the reduction of water flow and oxygen to eggs (DFO 2000; Baxter and Hauer 2000; Sedell et al. 1990). The freshwater fish encountered during the baseline assessments (1998 and 2015) were predominantly salmonids (brook trout, Atlantic salmon and rainbow trout) and American eel. Of these fish, American eel are known to spawn in the marine environment with the salmonid species spawning in spring or fall. Conducting the watercourse crossings outside the spawning periods and within DFO's lower biological risk period of June 1 to September 30, is anticipated to reduce effects on spawning salmonids and their offspring. There were three species (creek chub, fourspine and ninespine stickleback) which were observed within the LAA which spawn during the summer months, when Bear Paw activities could potentially interact with spawning. The summer spawners present in the LAA are batch spawners which spawn multiple times in a spawning season and their spawn have short incubation periods of approximately two weeks (McMahon 1982; Holm et al. 2009). Based on the in-water construction activities occurring during the lower biological risk period combined with the reproductive properties of summer spawners, the spawning success of local fish populations is anticipated to be sustained during construction and potential maintenance activities.

While the excavations required for the isolated watercourse crossings will be temporary and localized, some potential exists for adverse effects on surface water quality downstream of the activity during construction. Conducting the stream crossing in the dry, while maintaining streamflow around the site, will limit the transmission of sediment laden water. The use of erosion and sediment control techniques such as filtering (i.e., filter bags) or dispersing (i.e., upland header pipe) sediment laden water from the trench or water crossing work site will reduce sediment loads to the watercourse. Implementing the NSE Watercourse Alteration Standards and the mitigation measures outlined in Section 2.5.3 and 5.2.9, it is unlikely that lethal effects to fish would be caused as a result of watercourse crossings. Sublethal effects of sediment, such as avoidance, displacement or reduced feeding are anticipated to be temporary. The likelihood of watercourse crossing construction altering water quality enough to result in an increase in fish mortality is low.

A trenchless crossing using HDD is planned for the Salmon River. The HDD crossing will not alter the watercourse substrate and changes to the riparian zone will be limited to a survey cut line. The HDD entry and exit pads located on each side of the river will be set back sufficient distance from Salmon River to avoid bank alteration. Sedimentation and erosion control measures will be implemented to reduce or eliminate sedimentation to the watercourse. An isolated crossing using coffer dams may be used in case HDD is not stable given geotechnical conditions or in the case of an HDD failure.

The alternate crossing method for the 66 isolated crossings is to perform an open cut. This method has limited effects to the freshwater environment in watercourses which have no flow at the time of construction. Where the watercourse is dry at the time of construction, effects to the freshwater environment will be similar to the environmental effects from isolated crossings. At watercourses where flowing water is present, fish rescues will be conducted prior to instream work; this will reduce direct mortality from crushing by equipment use instream. Increased sediment is expected to be released to the water column during excavation for the crossing. This sediment will be mitigated through the management of sediment plume. The details of the management plan will be outlined in the EPP. Management options include floating silt berms, pumping sediment laden water to settling ponds or vegetated areas, minimizing work during high flows and expediting work to decrease the instream construction duration.

Operation

Environmental effects from the operation of Bear Paw could interact with the freshwater environment through vegetation maintenance. Vegetation maintenance will be conducted with the select use of herbicides (at above ground pipeline facilities) mechanical harvesters, and hand tools (along the RoW).

Herbicides will be selected to be of low persistence and low ecological toxicity with no application within 30 m of watercourses or wetlands. The application will be conducted as per the *Activities Designation Regulations* and no aerial application will occur to reduce drift during application. Based on the mitigation measures described and the setback distances to watercourses it is not anticipated that the application of herbicides will interact with the freshwater environment.

Vegetation control along the RoW will be conducted with the use of mechanical harvesters with riparian vegetation in the 30 m riparian zone allowed to regenerate. Where it is not feasible to allow unchecked growth of riparian vegetation, clearing will be conducted using hand tools. No ground disturbance is anticipated from this activity and low lying vegetation is anticipated to remain. The use of hand tools will reduce the potential for erosion and sedimentation of the watercourse from the operation of heavy equipment. Grasses and shrubs will regenerate in the riparian zone between vegetation control programs and provide shade and low cover for the watercourse and fish within. Vegetation control is anticipated to produce effects similar to the initial clearing though lower in magnitude due to limited ground disturbance. Vegetation control will not permanently alter the freshwater environment to a point where freshwater habitats in the LAA are marginalized.

Summary for Change in Freshwater Population

In summary, the Project has the potential to result in a change in freshwater population from the construction of pipeline watercourse crossings resulting in effects on water quality, fish habitat and fish mortality. Potential effects on the freshwater environment could also result from vegetation clearing during operation and maintenance. These effects will be reduced through implementation of mitigation such as constructing pipeline crossings according to NSE Watercourse Alteration Standards. Potential effects would be localized and temporary. It is anticipated that freshwater habitats will return to near baseline conditions following construction. With the application of recommended mitigation, residual effects of the Project on freshwater populations are predicted to be not significant.

5.2.8 Monitoring and Follow-up

Follow-up work will include applicable permitting applications for the construction in or around water. These applications will be made to the required authorities such as Nova Scotia Environment and DFO. A Request for Review has been completed and submitted to DFO for the construction of watercourse crossings. Should DFO determine Bear Paw results in 'Serious harm' to the CRA fisheries, a *Fisheries Act* Authorization and offsetting plan will be submitted for review and acceptance prior to construction.

To monitor the implementation of the EPP during construction an Environmental Inspector will be onsite to evaluate mitigation measures such as:

- the effectiveness of erosion and sediment controls;
- fish rescues;
- water quality sampling during watercourse crossings;
- discharges of sediment laden water; and
- clean-up of accidental releases.

Post-construction monitoring will occur following the construction phase of Bear Paw. A monitoring program will be developed to assess fish habitat along the RoW and downstream. Specifically the program will evaluate the stability of the channel and the ability to provide fish passage at fish bearing crossings. Follow-up and monitoring proposed are included to validate the predicted residual environmental effects.

5.3 GROUNDWATER RESOURCES

Groundwater resources has been chosen as a VC because Bear Paw has potential to interact with shallow, fresh groundwater that could be used for potable or process purposes. Groundwater provides a potable water supply to approximately half of the total population of Nova Scotia, and the majority of the population in rural areas.

The area of influence, or "capture area", of an individual well extends up-gradient from the well a distance proportional to the pumping rate of the well(s). For individual domestic water wells in Nova Scotia, this distance rarely exceeds a few hundred metres (m). For high-capacity industrial or municipal wells, the capture area could extend several kilometers.

Activities and components associated with construction and operation of Bear Paw have potential to interact with the environment in such a way that directly or indirectly adversely affects groundwater quantity and groundwater quality. The specialized mitigation measures prescribed in Section 5.3.6 will be implemented to reduce potential effects on groundwater resources, in addition to the more generalized standard mitigation measures outlined in Section 2.5.3.

As explained in the assessment below, with the application of these mitigation measures, residual Project-related environmental effects on groundwater resources are predicted to be localized, temporary and reversible. The number of wells in the construction area is small and can be easily monitored. The assessment concludes that, with the application of the mitigation proposed herein, the residual environmental effects of Bear Paw on groundwater resources are predicted to be not significant.

The groundwater resource VC has linkages to other VCs including Freshwater Environment (Section 5.2), Vegetation and Wetlands (Section 5.5) and Land and Resource Use (Section 5.8).

5.3.1 Regulatory and Policy Overview

Provincial regulations and standards that relate to groundwater resources are described below.

- ***Water Resources Protection Act***: this Act was developed to protect the water resources in Nova Scotia for the greatest benefit to the population.
- ***Well Construction Regulations:*** made under Sections 66 and 110 of the Nova Scotia *Environment Act*, these regulations stipulate requirements for proper water supply well construction, testing and abandonment.
- **Nova Scotia Groundwater Under the Direct Influence (GUDI) Standards (NSE 2012):** This standard applies to Municipal Groundwater Supplies and outlines the methods used to assess and remediate wells in direct or indirect interaction with surface water.

- **Groundwater Withdrawal Approval Process (NSE 2010a):** Under the *Environment Act*, the *Activities Designation Regulations* (Division I) require a water withdrawal approval ("Water Approval") if a groundwater withdrawal exceeds 23,000 litres (L) per day for a period of more than two weeks.
- **Nova Scotia Source Water Protection Planning:** Under section 106 of the Nova Scotia *Environment Act*, in areas that have been formally designated as a Protected Water Area, municipalities and/or utilities can develop regulations with the aim of protecting source water quality. This regulation can limit activities within designated watersheds, or well field protection areas, and can require monitoring of specific activities within these protected areas.

The following federal guidelines are also relevant to the protection of groundwater resources:

- Canadian Environmental Quality Guidelines (CCME 1999); and
- Guidelines for Canadian Drinking Water Quality (Health Canada 2014).

5.3.2 Boundaries

5.3.2.1 Spatial Boundaries

The assessment of potential environmental effects on groundwater resources encompasses three spatial boundaries Project Development Area (PDA), Local Assessment Area (LAA), and Regional Assessment Area (RAA). The PDA is defined within Section 2.1. Spatial boundaries are presented below.

Local Assessment Area (LAA)

The LAA is the maximum area within which Project-related environmental effects can be predicted to occur or measured with a reasonable degree of accuracy and confidence, and encompasses the likely zone of influence. For groundwater resources, the zone of influence is based on a combination of the type and locations of the known aquifers, aquifer hydraulic properties, expected groundwater flow directions, and the distance between Bear Paw and water supply wells that may be affected by Project activities. The LAA for groundwater resources is therefore an area extending 500 m from the PDA, which conservatively accounts for the various zones of influence.

Regional Assessment Area (RAA)

The RAA is the area within which Project- related environmental effects may overlap or accumulate with the environmental effects of other projects or activities that have been, or will be carried out. For groundwater resources this area is the same as the LAA, which is an area extending 500 m from the PDA.

5.3.2.2 Temporal Boundaries

The temporal boundaries for the assessment of the potential environmental effects of Bear Paw on groundwater resources include construction, and operation and maintenance. Construction is currently scheduled to begin in 2017 and continue over a period of two years. Operation will follow construction and continue for the life of Bear Paw.

Most physical or chemical effects on groundwater resources are likely to be temporary, occur during the two years construction phase.

5.3.3 Significance Definition

The residual environmental effect on groundwater resources from Project-related interactions is considered to be significant if one or more of the following occurs:

- yield from an otherwise adequate well or spring water supply decreases to the point where it is inadequate for the intended use;
- the quality of groundwater from an otherwise adequate well or spring water supply deteriorates to the point where it becomes non-potable or cannot meet the Guidelines for Canadian Drinking Water Quality (Health Canada 2014); or
- the aquifer is physically or chemically altered to the extent that interaction with local surface water results in obvious stream flow or chemistry changes that adversely affect aquatic life or surface water supply.

5.3.4 Description of Existing Conditions

5.3.4.1 Approach and Methods

Background information on groundwater for Bear Paw was obtained from published resource materials, maps and hydrogeological databases including:

- previous studies along the existing pipeline RoW (SOEI 1996, JWEL 1998);
- topographical and air photo mapping along the assessment corridor;
- Nova Scotia Groundwater Atlas (NSDNR 2015b, c) which includes:
    - NS Well Log Database (1960 to present); and
    - NS Pumping Test Database (1975 to present);
- Surficial Geology Map (Stea & Fowler 1979);
- Bedrock Geology Map (Keppie 2000); and
- Groundwater Resources (Strait of Canso Environment Committee - SCEC 1975).

5.3.4.2 Summary of Existing Conditions

This assessment of existing conditions is based on an update of the hydrogeology and groundwater resources study that was presented for the SOEP NPS 8 NGL pipeline from the SOEP Gas Plant in Goldboro, Guysborough County to the Fractionation Facilities in Point Tupper, Cape Breton (JWEL 1998, SOEI 1996). The 1996 work provided a detailed inventory and discussion of five major bedrock types comprising 10 geological units along the existing SOEP NPS 8 NGL pipeline. Bear Paw crosses the same geological terrain as described in 1996. The main difference is in terminology, where portions of the Horton and Fountain Lake terrestrial sandstone groups have been re-defined by NSDNR in the high resolution 1:50,000 scale maps as the Guysborough Group, and the Riversdale Group sandstone has been incorporated within the Cumberland Group (baseline physical conditions and geological conditions are likely the same as in the1996 SOEP assessment). The 1996 study examined the proposed ROW, with the exception of three deviations from the existing pipeline RoW (a small segment from KP 23.5 to 25.3 near the Salmon River crossing north of Roachville, the Milford Haven River crossing from KP 32.2 to 39.0 at Lesterdale-North Riverside to Highway 16, and the segment east of the Strait of Canso from KP 57.7 to 61.7 (Bedrock Geology Mapbook, Maps 1-8, Appendix D).

An updated description of the groundwater resource potential of each hydrogeological unit traversed by Bear Paw is presented below. The 1996 SOEP assessment covered the easement from Goldboro to the Strait of Canso, but did not address the segment from landfall on Cape Breton Island to Bear Head; this information is included in the update below.

Hydrogeological Setting

The assessment corridor originates in the hard metacrystalline bedrock of the Late Cambrian to Ordovician aged Meguma terrain, which underlies the southern portion of Nova Scotia from Yarmouth to Canso, and passes through Late Devonian to Carboniferous aged lowlands from Roachvale to Bear Head. This area is characterized by a humid temperate climate moderated by proximity to the Atlantic Ocean. Approximately 15% to 21% of the estimated 1,475 mm average annual precipitation infiltrates to the groundwater system (Kennedy et al. 2010) depending on topography, overburden cover and bedrock hydraulic properties. The two main types of aquifers tapped for residential water supply wells are overburden aquifers using dug wells, springs or screened wells, and the underlying bedrock aquifers using drilled wells.

As described below, the assessment corridor intersects three distinct hydrostratigraphic units (HU):

- Glacial deposits HU;
- Crystalline bedrock HU; and
- Sedimentary bedrock HU.

Glacial Deposits

The surficial geology of the assessment corridor is illustrated on Maps 1-8, Appendix D, based on maps provided by NSDNR (Stea & Fowler 1979; Stea et al. 1992). Seven surficial geological units are identified, of which four are classified as glacial till. Glacial tills are typically poor aquifers, but can provide sufficient water supply for single family dwellings where sufficient saturated thickness occurs.

Over 70% of the assessment corridor is overlain by glacial till, which is subdivided into stoney glacial till plain (40.9%), silty glacial till plain (24.7%), hummocky ground moraine (4.6%) and drumlin terrain (about 4%). Glacial till thicknesses typically range from 3 m to 5 m, but can reach greater depths in bedrock depressions and in the vicinity of drumlin fields (25 m to 30 m depth). A large drumlin field is noted approximately between KP 49.0 and 54.0 on the eastern end of the assessment corridor.

A notable area of the assessment corridor (about 26%) is characterized by very thin and likely permeable glacial till and boulders associated with numerous bedrock outcrops. These regolith deposits typically develop on bedrock ridges such as those located between KP 27.6 to KP 39.6 and KP 51.3 to KP 57.6. Bedrock is expected to be close to the surface in these areas.

Minor areas of sand and gravel (kame and esker complex) are indicated at the Salmon River crossing near KP 23.0. Minor (<1%) areas of peatland or organic deposits are noted near KP 4.0, 17.5 and 55.0.

Many rural residents rely on shallow groundwater from glacial till. The glacial till units, where sufficient saturated thickness is present, can typically provide yields of 1.0 L/min to 4.5 L/min to dug wells ranging in depth from 3 m to 10 m and averaging 4.5 m deep (NSDNR 2015). Field truthing of the SOEP existing RoW in 1998 indicated that dug wells comprised 63% of the 30 wells investigated, with depths ranging from 0.5 to 5.4 m, mean 3.0 m, and diameters ranging from 0.9 to 2.4 m (mean 1.1 m.). Static water levels ranged from 0.0 m to 4.4 m below grade, with a mean water level of 1.1 m below grade (JWEL 1998). The water quality from glacial till can be expected to be good, naturally soft and dilute in thin sandy till areas, hard in thick silty till areas, and may have elevated concentrations of iron and manganese when in proximity to wetlands.

Localized areas of saturated sand and gravel may provide several 100s to 1000s L/min to screened wells. These deposits of typically coarse grained and permeable sands and gravels would be expected to provide moderate to good yields to screened wells and dug wells. The water quality is generally suitable for most potable uses. Glacio-fluvial sand and gravel deposits with groundwater development potential are indicated at the Salmon River crossing near KP 23.0, and in the Boylston area around Guysborough Harbour (SCEC 1975). Although not mapped, additional deposits may occur along streams and near lakes. These highly permeable deposits can result in groundwater inflow to trenches that are below the water table, and can act as transport pathways for contamination.

Bedrock Aquifers

Bedrock Geology Maps 1-8, Appendix D illustrates the bedrock geology underlying the assessment corridor. The locations and approximate percentage of the assessment corridor traversing each bedrock unit is shown on Table 5.3.1.

Terrestrial sedimentary bedrock of the Cumberland, Windsor, Horton and Guysborough Groups cover the greater portion (63%) of the assessment corridor, followed by the metacrystalline bedrock of the Goldenville Formation quartzite (27.7%) and Halifax Formation slate (9.7%) of the Meguma Group.

The assessment corridor will cross two bedrock types (crystalline and sedimentary), each with distinctive well construction and hydrogeological properties, as described below.

Table 5.3.1 Summary of Bedrock Formations Traversed by Bear Paw

Geologic Formation (Fm)	Map ID	Chainage (KP)	km	% of Easement	Known Environmental Issues
Cumberland Group (sedimentary bedrock)					
Port Hood Fm, Margarie Member	CCphm	57.9-62.5	4.6	7.5%	Low probability of acidic drainage from minor coal seams.
Windsor Group (sedimentary bedrock)					
Macumber & Gays River Fms	CWm	57.8-57.9	0.1	0.2%	Possible sinkholes.
Horton Group (sedimentary bedrock)					
Steep Creek Fm	CHsc	57.23-57.8	0.6	0.9%	
Tracadie Road Fm, Halfmoon Lake Member	CHthr	47.9-48.2	0.3	0.5%	
Clam Harbour River Fm, Goose Harbour Lake Member	CHCRg, CHCHr	36.36-47.9; 48.2-57.23	20.6	33.3%	
Guysborough Group (sedimentary bedrock)					
Roman Valley Fm	DGRva	34.16-35.36	1.2	2.0%	
Glenkeen Fm	DGG	29.1-31.2; 33.4-34.16	2.9	4.7%	
Sunnyville Fm	DGSb	27.9-29.1; 31.2-32.27	2.3	3.7%	
Sunnyville Fm	DGSc	24.5-27.9; 32.3-33.4	4.5	7.3%	
Minstrel Brook Fm	DGMB	23.0-23.6	0.6	1.0%	
Chedabucto Fault Complex	DCFc	23.6-24.5	0.9	1.5%	

Table 5.3.1 Summary of Bedrock Formations Traversed by Bear Paw

Geologic Formation (Fm)	Map ID	Chainage (KP)	km	% of Easement	Known Environmental Issues
Meguma Group (crystalline bedrock)					
Halifax Fm	COMh, COHa	1.4-1.9; 5.9-6.3;12.45-17.5;	6.0	9.7%	Acidic drainage, blasting.
Goldenville Fm	COMg; COGa	0-1.4; 1.9-5.9; 6.3-12.45; 17.5-23.0;	17.1	27.7%	Blasting, acidic drainage on anticlines.

Crystalline Bedrock

The southwesterly portion of the assessment corridor from KP 0.0 to 23.0 is underlain by a northeast to southwest trending series of tight anticline and syncline folds, locally intruded by fractured granite. No granite is noted; however, it could occur at depth below the indicated bedrock. This rock is extremely hard and typically requires blasting during excavation work.

The younger Halifax Formation slate typically exhibits extensive sulfide mineralization disseminated throughout the rock mass and is considered to have a high potential to generate acidic rock drainage (ARD) that could affect surface water and groundwater resources. Based on experience throughout southeast Nova Scotia, the greatest risk of ARD occurs in the basal members of the slate where it contacts the underlying Goldenville Formation metawackes; these fine-grained basal units can have a greater proportion of sulfide mineralization than the upper units. Sulfide mineralization developed along the crests of folds in the Goldenville Formation quartzite units can also be a local acid drainage risk; however, because the sulfide mineralization generally occurs in massive veins and is less disseminated throughout the rock mass than the slate units, it is rarely a source of ARD.

Sedimentary Bedrock

The remainder of the alignment from Roachvale to the terminating point on Cape Breton is underlain by relatively soft to moderately hard sedimentary bedrock of the Horton, Guysborough, Cumberland and Windsor Groups. Sandstone and shale of the Horton and/or Guysborough Groups underlie the eastern portion of the assessment corridor from KP 23.0 to the Strait of Canso. Sandstone and shale of the Cumberland Group underlies the east side of the Strait between the landfall and Bear Head.

Windsor Group shale and evaporites underlie about 0.2% of the assessment corridor near the west shore of the Strait of Canso. The evaporites, if encountered, could have a small potential for sinkholes to form within this area. This is a small portion of the overall assessment corridor; the potential will be considered in this area during geotechnical investigations prior to pipeline construction.

While several geologic formations are identified within this hydrostratigraphic unit (Table 5.3.1), this bedrock is typically more easily excavated than crystalline bedrock and exhibits natural properties that tend to dampen blasting energy more than the crystalline terrain. Sedimentary bedrock typically contains a greater proportion of calcium minerals that have the potential to attenuate ARD.

Groundwater Quantity

Residential water supplies along the assessment corridor are derived from individual drilled wells in bedrock, dug wells or drive points in overburden, or shallow springs in overburden. Potential well yields were determined from drill log reports and constant rate pumping tests conducted throughout Nova Scotia for each hydrostratigraphic unit, based on the NS pumping test inventory (NSDNR 2015). Drilled wells typically yield 0.8 L/s to 5.0 L/s from wells ranging in depth from 76 m to 156 m (SOEI 1996). Dug wells typically yield less than a few L/min.

Table 5.3.2 summarizes the hydraulic properties of drilled and dug wells in the identified hydrostratigraphic and geological units. This information was taken from the NS pumping test inventory and provides the geometric means of various well and aquifer hydraulic properties for each identified HU using provincial scale data ("NS" in table). A geometric mean is used in consideration of the wide range of values. A comparison is also made for pumping tests performed within about 40 km of the assessment corridor ("Local" in table). Due to the limited local data, the provincial mean is assumed to provide a better indication of likely conditions.

Table 5.3.2 Summary of Mean Aquifer Hydraulic Properties

Hydro-stratigraphic Unit	Well Depth (m)		Casing (m)		Water Level (m)		Yield (L/min)		Apparent Well Transmissivity (m^2/d)		No. wells		Aquifer Properties		
	Local	NS	Local	NS	Local	NS	Local	NS	Local	NS	Local	NS	T	S	N
Crystalline Bedrock															
Goldenville Formation	96.4	65.6	9.1	12.0	3.7	3.1	15.0	18.6	0.5	1.1	9	98	5.8	3.3E-05	3
Halifax Formation	68.0	73.9	-	13.8	2.7	4.5	34.5	22.7	1.6	1.3	2	96	3.5	3.2E-05	12
Sedimentary Bedrock															
Horton/ Guysborough Group	85.0	79.8	15.0	15.2	9.8	7.3	25.9	100.5	4.7	6.0	10	28	34.4	1.1E-03	17
Cumberland Group	84.3	62.8	15.2	13.0	6.1	4.5	277.3	149.1	16.0	8.7	19	76	48.5	8.2E-04	4

Table 5.3.2 Summary of Mean Aquifer Hydraulic Properties

Hydro-stratigraphic Unit	Well Depth (m)		Casing (m)		Water Level (m)		Yield (L/min)		Apparent Well Transmissivity (m²/d)		No. wells		Aquifer Properties		
	Local	NS	Local	NS	Local	NS	Local	NS	Local	NS	Local	NS	T	S	N
Windsor Group	36.0	48.7	4.9	20.9	11.8	5.1	19.5	66.8	3.7	6.1	2	29	21.2	9.6E-04	3
Glacial Deposits															
Sand & Gravel	21.6	15.1	20.8	11.4	4.1	3.3	388.2	300.5	162.9	108.6	3	99	629.2	1.0E-02	25
Glacial Till	-	4.1	-	4.1	-	1.4	-	9.1	-	12.6	0	10	-	-	0

Notes:

m - metres; L/min - litres per minute; T_a - apparent well transmissivity; T - Transmissivity; S - Storage Coefficient; N - number pumping tests; m^2/d - cubic metres per day per meter of drawdown; WL - Static Water Level

Source: NS Pumping Test Inventory (NSDNR 2015)

Drilled well yields are typically low in this area of the province and are therefore more susceptible to damage and consequent loss of yield than other areas in similar bedrock. Based on numerous pumping tests performed on wells completed into Halifax Formation slate and Goldenville Formation quartzite through Nova Scotia, the crystalline rock units have a lower mean transmissivity and potential well yield than the sedimentary rocks. Although data is limited, the local pumping tests within 40 km of the assessment corridor exhibit similar properties as the provincial mean.

Sand and gravel deposits (e.g., near Salmon River and Boylston) can provide good quality groundwater at yields in excess of 300 L/min to screened wells and dug wells. In comparison, the silty glacial till exhibits a very low mean well yield potential (about 9 L/min); however, this is sufficient for single family dwellings. Drilled wells completed into the calcareous shale and limestone of the Windsor Group can produce moderate yields (geometric mean 67 L/min); however the quality of the water is usually the limiting factor (Table 5.3.2).

Groundwater Quality

Water quality potential is determined from known water quality characteristics for each unit, including naturally occurring water quality concerns such as hardness and presence of arsenic and iron. Except for Windsor Group gypsum and salt deposits and localized mineralized zones in the Carboniferous and Meguma terrain, most aquifers identified along the assessment corridor provide water quality that falls within acceptable drinking water guidelines. The most common naturally occurring water quality complaint is elevated iron and manganese in excess of respective aesthetic guidelines of 0.3 mg/L and 0.05 mg/L. Arsenic in excess of the 0.025 mg/L health guideline can occur in the Goldenville bedrock aquifer, typically in association with anticlinal crests common in gold mining districts where mineralized zones (arsenopyrite) can occur. The assessment corridor follows the existing pipeline RoW through the Upper Seal Harbour Gold District No. 63 located on an anticline north of Goldboro. Arsenic, uranium and radon can occur in excess of guidelines in granitic terrain; while no granite is indicated, it could occur at depth in the Meguma terrain. Hard water can be encountered in the Canso Group (Port Hawkesbury) and Windsor Group bedrock, which is limited within the assessment corridor.

Based on the residential well survey conducted for the SOEP NPS 8 NGL pipeline (JWEL 1998), the groundwater quality in residential water wells along the existing pipeline RoW was found to be of good chemical quality with no evidence of significant impacts by agriculture, acidic drainage or road salt. Dug wells and springs tend to produce more dilute and more naturally acidic water quality than the drilled wells. Shallow groundwater from dug wells is typically described as a naturally corrosive (mean calcite saturation index -3.1), dilute (mean TDS 61 mg/L), and soft (mean hardness 33 mg/L) sodium-chloride groundwater type, typical of shallow sand aquifers, springs and streams in the respective terrains. Some dug wells in clayey terrains exhibit hard calcium bicarbonate water types. Springs resemble dug wells in overall chemistry, but often have lower dissolved solids (mean 40 mg/L), lower hardness (mean 19 mg/L) and higher average pH. In comparison, the drilled wells typically provide a harder (mean hardness 101 mg/L, mean TDS 215 mg/L), less corrosive (mean Langelier calcite saturation index -0.4) sodium to calcium bicarbonate water type. With the exception of occasional manganese, colour, turbidity and pH, the reported water quality parameters fall within Guidelines for Canadian Drinking Water Quality (Health Canada 2014). Many dug wells had a history of going dry in the summer period, and all but one of the 30 wells sampled exhibited detectable coliform bacteria, with nine wells (30%) having detectable fecal coliform bacteria (JWEL 1998).

Locations of Water Wells

Table 5.3.3 presents a preliminary summary of domestic wells at distances of 500 m, 200 m and 30 m from the centerline of the assessment corridor. The varying distances are intended to illustrate the development density in the LAA. This table was generated through review of detailed topography maps, and photographic and satellite imagery at major road crossings. Field verification has yet to be completed to confirm the location of wells. Very few domestic wells (approximately 33) were identified within 500 m of the assessment corridor; approximately13 were identified within 200 m; and one is present within 30 m.

Table 5.3.3 Summary of Potential Water Supply Wells by Location

Surficial Geology Map No.	Community	Location	500 m	200 m	30 m
1	Goldboro	Gas Plant	2	2	0
		Goldbrook Road	0	0	0
2	Undeveloped		0	0	0
3	Undeveloped	8 Mile Lake Road	0	0	0
		Loon Lake Road	0	0	0
		3 Ponds	2	1	0
4	Roachville	S River Lake Road	9	2	0
		Roachville-Tompkinsville Road	2	1	0
		Tompinsville Road	1	1	0
5	Nickerson Lake		2	1	0
	Lestervale	Antigonish-Guysborough Road	4	2	0
	North Riverside	North Riverside Road	3	1	1
6	Tracadie Road	Highway 16	4	1	0
		Pirate Harbour Road	1	0	0
		Clam Harbour River	0		
7	Undeveloped	Goose Harbour Lake	0	0	0
8	West Side of Strait	Highway 344	3	1	0
	East Side of Strait	Bear Head Road	0	0	0
		Total	**33**	**13**	**1**

The greatest concentration of residential water wells appear to be in the vicinity of South River Lake Road (nine residential wells within 500 m and two within 200 m of the assessment corridor); Milford Haven River crossing at Antigonish-Guysborough Road and North Riverside Road (seven residential wells within 500 m and three within 200 m); Highway 16 (four wells within 500 m and one within 200 m), and Highway 344 west of the Strait (three wells within 500 m, one within 200 m).

No major public supply groundwater supply systems are known to be present within the RAA. The closest public supply wells to the assessment corridor, but still outside the RAA, appear to be several industrial or commercial well water supplies located at Point Tupper that may still be in use (SOEI 1996) and two 100 L/min Boylston Park wells completed in sand and gravel located about 2.44 km south of the assessment corridor (Map 5).

The above observations are consistent with a site reconnaissance carried out in July 1998 to identify, inspect and sample residential water supplies located within 500 m distance of the SOEP NPS 8 NGL pipeline (JWEL 1998). Of the thirty residential properties with onsite well or spring water supplies, nineteen (63%) were dug wells, five (17%) were drilled wells, and six (20%) were shallow springs. The wells were located between 70 m to more than 750 m from the existing pipeline RoW; fourteen of the identified wells are situated hydraulically up-gradient of the existing pipeline RoW, and sixteen wells are situated down-gradient. With the exception of the SOEP Gas Plant supply well, none of the wells are expected to occur in crystalline rock terrain (e.g., Halifax Formation slate or Goldenville Formation quartzite) that may require significant bedrock excavation by blasting. No well appear to be located within the identified Halifax Slate bedrock units, so ARD risk should be minimal.

Updated Alignment Segments

Segments of the assessment corridor near the Milford Haven River, and from landfall on Cape Breton Island to Bear Head, were not examined in previous groundwater resource studies. Additional information on those two segments is provided below. These segments will require field confirmation for the presence of wells.

<u>Milford Haven River Segment</u>

The portion of the assessment corridor near the Milford Haven River crossing deviates north from the existing pipeline RoW from KP 32.2 to KP 39.0 at Highway 16. The bedrock is comprised of sandstone and shale of the Horton Group (west of the river) and Guysborough formation (east of the river). The overburden cover is expected to be thin from KP 32.0 to 35.0 and thicker near the river. Excavation into sandstone and shale bedrock may be required; however, blasting should be limited due to assumed rip-ability. Preliminary assessment suggests that there are four possible residential wells within the RAA and two possible residential wells within the LAA at Antigonish-Guysborough Road; three possible wells within 500 m and one possible well within 200 m at North Riverside Road), and four possible wells within 500 m and one possible well within 200 m at Highway 16. Field confirmation is required.

<u>Bear Head Segment</u>

The assessment corridor from the Strait to the Bear Head traverses approximately 2.5 km in an area characterized by clayey glacial till overlying conglomerate, sandstone and shale of the Upper Carboniferous Aged Cumberland Group (Port Hood formation)of bedrock. No environmental concerns are identified in this unit, although minor coal seams with possible pyrite mineralization are identified six km to the southeast at Inhabitants Bay. Five potential buildings with wells are identified north of the west landfall; however, no wells are identified within 500 m of the assessment corridor between the west landfall and Bear Head (Table 5.3.3), as most of the assessment corridor traverses an industrial area.

There are several municipal and industrial production wells in the Port Hawkesbury and Point Tupper areas. A cursory review of the NSE well log database for Point Tupper indicates 15 industrial water supply wells at the following locations: Nova Scotia Department of Transportation and Infrastructure Renewal; New Star Terminal (formally known as Gulf Oil); Nova Scotia Forest Industry; Strait Homes; Atomic Energy of Canada Limited; Canadian National Railway; and Nova Scotia Power Inc. sites drilled between 1965 and 1989 (NSE 2015b, c). Several older (pre-1965) residential wells are indicated, but appear likely to be situated along Bear Head Road to the south of the assessment corridor.

Point Tupper industries and the town of Port Hawkesbury are currently supplied by the water treatment plant at Landry Lake. Water supply for Stora Industries is augmented by a surface water supply from Goose Harbour and Grant Lakes west of the Strait. No active municipal or industrial pumping wells are currently believed to be present; however, this will be confirmed by field truthing work during detailing engineering.

5.3.5 Potential Environmental Effects and Project-Related Interactions

Activities and components could potentially interact with groundwater resources resulting in a change to groundwater quantity or quality. In consideration of these potential interactions, the assessment of Project-related environmental effects on groundwater resources is focused on the following potential environmental effects:

- change in groundwater quantity; and
- change in groundwater quality.

The effect pathways and measurable parameters used for the assessment of these environmental effects are provided in Table 5.3.4.

Table 5.3.4 Potential Environmental Effects, Effects Pathways and Measurable Parameters for Groundwater Resources

Potential Environmental Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in Groundwater Quantity	• Construction activities may alter or interrupt groundwater flow to a well, such that the well yield or water level in the wells is altered.	• Potentiometric Head (measured in m above sea level).
Change in Groundwater Quality	• Construction activities may alter the groundwater chemistry that enters a well by altering groundwater flow paths and therefore the interactions with the geologic units through which the groundwater flows.	• Various water quality parameters (variable units of measure, including aqueous concentration, pH units, conductivity, and others).

A change in groundwater quantity and change in groundwater quality from Project-related activities on groundwater resources may occur, primarily during construction activities.

With respect to groundwater quantity, the main impacts related to pipeline development are:

- loss of well yield or lowered water level during excavation from an interruption of groundwater flow, interruption of recharge to well, and dewatering drawdown of water table (construction); and
- possible damage to or loss of wells during blasting operation (construction).

Water quantity concerns during construction are expected to be temporary (minor changes to groundwater flow paths or rates may occur because of differences between the hydraulic properties of the backfill material compared to the native material; however, these effects are anticipated to be minimal once groundwater levels equilibrate following construction). There are no concerns during operation, since Bear Paw is not expected to interact with groundwater resources as no groundwater production is required to support Bear Paw.

With respect to groundwater quality, the main issues related to pipeline development are:

- temporary chemistry changes in down-gradient aquifers or wells due to uncontrolled acidic drainage (all phases).

Accidental releases of dangerous goods are addressed in Chapter 7 (Accidents and Malfunctions).

Changes to groundwater quality are expected to be minimal during the construction activities. No changes are anticipated during the operational period after the pipeline trenches have been stabilized. The effects of accidental releases on groundwater quality are discussed in Chapter 7.

5.3.6 Mitigation

The potential effects on groundwater resources are minimal and can be further reduced and managed through implementation of mitigation and groundwater monitoring programs. Standard mitigation proposed for Bear Paw are included in Section 2.5.3, with specific measures for groundwater resources provided in Table 5.3.5.

Table 5.3.5 Mitigation for Groundwater Resources

Effect	Mitigation
Change in Groundwater Quantity	• Identify and as required monitor water quantity in wells within 500 m of an excavation. • Dewater excavations only where necessary. • Develop a protocol for investigating any complaints. • In the unlikely event of loss of well yield that is attributed to construction that renders the well non-usable, develop a suitable corrective-action plan to provide water to the affected resident.
Change in Groundwater Quality	• Identify and as required monitor water quality in wells within 500 m of an excavation. • Develop a protocol for complaints investigation. • Employ best management practices during HDD crossing construction to minimize potential groundwater quality effects. • In the unlikely event of changes to water quality that is attributed to construction that renders the well non-usable, develop a suitable corrective-action plan. • Manage excavations in areas of potentially acid generating bedrock according to an ARD management plan to be developed for Bear Paw. • Mitigation for accidental releases is detailed in Chapter 7.

5.3.7 Residual Environmental Effects and Significance Determination

5.3.7.1 Change in Groundwater Quantity

Construction

Potential adverse effects on groundwater resources during the construction phase are primarily associated with changes in groundwater quantity in nearby or down-gradient water wells. Physical changes in groundwater flow may be caused by trench excavation, dewatering, or blasting operation in areas of shallow water table or shallow bedrock depth respectively.

During construction, the pipeline trench will typically be excavated to average depths ranging from 1.5 m to 2 m. While much of the excavation will occur in unconsolidated overburden deposits, some areas of thin overburden or exposed bedrock may require ripping or blasting of bedrock. Depth to water table in Nova Scotia is typically deeper than 3 m (Table 5.3.2); it is deeper in upland areas and closer to the surface in lowland areas and near stream crossings. Local, shallow, and temporary subsurface dewatering may be required to support construction. The need for temporary construction dewatering will be determined based on local water table conditions and will be evaluated during the preconstruction stage.

Dewatering, if required, will be done at a local scale and is not expected to be required outside the PDA during construction. Where dewatering occurs, local water table elevations will be temporarily lowered during construction. Thus a temporary and localized interaction between

Bear Paw and groundwater resources will occur. The effects of local dewatering in general cannot be mitigated, since dewatering deliberately seeks to create an effect (i.e., temporary lowering of groundwater levels). No aquifer dewatering is anticipated to occur during operation; however, long-term diversion of groundwater along the pipeline could occur unless the mitigation discussed below is implemented.

Shallow water supplies from springs located close to and hydraulically down-gradient may be temporarily or permanently affected by the presence of a pipeline. Changes in the local aquifer permeability caused by equipment compaction or use of fill materials of lower permeability than the natural surrounding aquifer could reduce or intercept flow to some springs. The excavated material is expected to be comprised of clean, natural fill material, so the permeability should not be substantially different.

Groundwater contributions to local surface waters may be affected. Baseflow quantity effects are expected to be minimal. Since pipeline trenches are shallow and oriented perpendicular to most streams, deeper unaffected groundwater will still contribute to stream flow, and typical streams are supplied over a much larger area than that affected by a typical pipeline footprint.

Blasting, if required (particularly in the crystalline bedrock terrain), has potential to interact with groundwater resources. Any blasting will be localized and conducted in accordance with regulatory requirements and best management practices to limit ground vibration. Although unlikely, vibrations from blasting in bedrock may alter the fracture geometry, open new fractures, change the aperture of existing fractures, or permanently change the local groundwater flow patterns. Changes in fracture geometry could increase or decrease groundwater yields of a nearby well. The degree of effect on groundwater flow patterns on a nearby well user depends on many factors, such as separation distance, seismic properties of the intervening bedrock, strength of the charge and the yield, age and condition of the well. The relationships between blast charge weight, distance and ground vibration are well known; if practical, the blast will be designed to protect wells near the PDA from damage, when wells are present in the vicinity of the blast area.

Operation and Maintenance

During normal operation, interactions between the Bear Paw and water quantity are not expected. No groundwater production is required to support Bear Paw and ongoing dewatering is not anticipated. Ongoing requirements for blasting during operation are not expected.

Summary of Change in Groundwater Quantity

In summary, the Project has a small potential to result in a change in groundwater quantity through interruption or alteration of groundwater flow to a well. These effects will be reduced through implementation of mitigation such as the identification and monitoring of water quantity in wells within 500 m of an excavation. Potential effects would be localized and temporary and are anticipated to be reversible following construction activities. With the application of recommended mitigation and groundwater monitoring, residual effects of the Project on groundwater quantity are predicted to be not significant.

5.3.7.2 Change in Groundwater Quality

Construction

Groundwater quality may be degraded in areas downgradient of bedrock formations containing sulphide mineralization that can potentially produce ARD when exposed to the atmosphere or oxygenated water. Groundwater downgradient of areas of high ARD potential may be degraded by decreased pH or increased concentrations of sulphate, hardness and dissolved metals. Potential effects depend on the sulphide mineral content of the bedrock, the distribution of the mineralization within the rock, the size of the excavation, the time that the material is exposed, the hydraulic properties, the presence of naturally occurring buffering materials (such as calcite within the rock mass or the associated overburden), and groundwater flow pathways relative to the exposure and receptor wells.

Watercourse crossings will occur during pipeline construction. Where trenchless crossings (e.g., HDD) are employed, the potential exists for interactions between Bear Paw and groundwater resources due to the possible introduction of a preferential pathway for groundwater flow or changes in water levels due to drilling. The use of drilling muds to circulate drill cuttings would also serve to hydraulically isolate the borehole by caking of the borehole annulus, which is an effective mitigation method. Best management practices will be employed during trenchless crossings to reduce the potential for loss of mud circulation. This potential interaction would only occur during the construction phase; equilibrium between groundwater and surface water is expected to be restored after completion of the pipeline emplacement.

Operation and Maintenance

During normal operation and maintenance, interactions between Bear Paw and water quality are not expected.

Summary of Change in Groundwater Quality

In summary, the Project has a small potential to result in a change in groundwater quality; effects on well users could arise through alterations in groundwater chemistry and pathways in areas downgradient of bedrock formations containing sulphide mineralization that can produce acid rock drainage. These effects will be reduced through implementation of mitigation such as the identification and monitoring of water quality in wells within 500 m of an excavation. Potential effects would be localized and temporary and are anticipated to be reversible following Project completion. With the application of recommended mitigation and groundwater monitoring, residual effects of the Project on groundwater quality are predicted to be not significant.

5.3.8 Monitoring and Follow-up

A pre-construction monitoring program will be developed in consultation with NSE, and will be conducted to collect baseline groundwater data for wells potentially affected by trench excavation and dewatering, and blasting. The monitoring program will generally consist of the following considerations:

- inspection and inventory of wells proximate to the RoW (e.g., within approximately 500 m), where trench excavation and dewatering will occur;
- baseline water quality samples will be collected and tested (e.g., general chemistry, metals, total coliform and *E.coli*); and
- a monitoring program for water supply wells or springs located in the vicinity of the pipeline excavation.

During the pipeline construction phase, field verification, if necessary, will be performed to locate any new properties with wells that may have been constructed since 1998.

5.4 MARINE ENVIRONMENT

The marine environment has been selected as a VC because of specific regulatory requirements of the *Fisheries Act*, the potential interaction between marine populations (including marine mammals) and Bear Paw activities, and the intrinsic importance of marine populations and commercial, recreational and Aboriginal (CRA) fishery resources. The marine environment VC focuses on sediment and water quality as well as marine fish and fish habitat likely found in the two marine pipeline crossings at Milford Haven River and the Strait of Canso. There is no impact to the compressor station

Activities and components associated with construction and operation of Bear Paw have potential to interact with the environment in such a way that directly or indirectly adversely affects marine populations through impacts to marine habitat, water quality, sediment quality and the acoustic environment. In addition to the more generalized standard mitigation measures outlined in Section 2.5.3.

The specialized mitigation measures prescribed in Section 5.4.6 will be implemented to reduce potential effects on the marine environment As explained in the assessment below, with the application of these mitigation measures, residual Project-related environmental effects on the marine environment are predicted to be localized and temporary, and are not expected to result in changes to populations of marine organisms or cause serious harm to CRA fish.

The assessment concludes that, with the application of the mitigation proposed herein, the residual environmental effects of Bear Paw on the marine environment are predicted to be not significant.

Key linkages between the marine environment VC and other VCs include commercial and recreational fishing addressed in Land and Resource Use (Section 5.8), Traditional Land and Resource Use (Section 5.7), the Freshwater Environment (Section 5.2), and Wildlife and Wildlife Habitat (which includes seabirds and coastal waterfowl) (Section 5.6).

5.4.1 Regulatory and Policy Overview

Marine fish, fish habitat, water quality and sediment quality are protected primarily through federal and provincial legislation. With respect to federal legislation, fish and fish habitat are protected under the *Fisheries Act* and by the DFO *Fisheries Protection Policy Statement* (DFO 2013a). The federal *Fisheries Act* defines "fish" to represent all fish, shellfish, crustaceans, marine animals and any parts of shellfish, crustaceans or marine animals, and the eggs, sperm, spawn, larvae, spat and juvenile stages of fish, shellfish, crustaceans and marine animals.

The *Fisheries Act* defines "fish habitat" as spawning grounds, nursery, rearing, food supply and migration areas on which fish depend directly or indirectly. Fish habitat includes physical (e.g., substrate, temperature, flow velocity and volumes, water depth), chemical (e.g., dissolved oxygen, pH, nutrients) and biological (e.g., fish, benthic invertebrates, plankton, aquatic plants) attributes of the environment that are required by fish to carry out life cycle processes (e.g., spawning, rearing, feeding, overwintering, migration).

CRA fisheries resources in Canada are managed by DFO, the regulatory agency that is responsible for implementing the requirements of the *Fisheries Act*. Key sections of the *Fisheries Act* that apply to the Bear Paw marine watercourse crossing activities for marine fish and fish habitat of CRA fisheries include:

- Section 35, which addresses serious harm to fish and fish habitat; and
- Section 36, which addresses deposition of deleterious substances in waters frequented by fish.

Sub-section 35(1) of the *Fisheries Act* states:

> *"No person shall carry on any work, undertaking or activity that results in serious harm to fish that are part of a commercial, recreational or Aboriginal fishery, or to fish that support such a fishery."*

Sub-section 35(2) of the *Fisheries Act* also states that a person may carry on a work, undertaking or activity without contravening sub-section 35 (1) if the serious harm is produced as a result of doing anything that is authorized, otherwise permitted or required under this Act.

"*Serious harm to fish*" is defined in the *Fisheries Act as "the death of fish or any permanent alteration to, or destruction of, fish habitat*". In the Fisheries Protection Policy Statement, DFO interprets serious harm to CRA fisheries and supporting marine animals as:

- *the death of fish;*
- *a **permanent alteration** to fish habitat of a spatial scale, duration or intensity that limits or diminishes the ability of fish to use such habitats as spawning grounds, or as nursery, rearing, or food supply areas, or as a migration corridor, or any other area in order to carry out one or more of their life processes; and*
- *the **destruction** of fish habitat of a spatial scale, duration, or intensity that fish can no longer rely upon such habitats for use as spawning grounds, or as nursery, rearing, or food supply areas, or as a migration corridor, or any other area in order to carry out one or more of their life processes.*

There are two criteria that must be satisfied to establish the requirement for a *Fisheries Act* Authorization:

- a CRA fishery must be present in the area; and

- where it is determined that a CRA fishery is present that could be affected by a given project, the activity must be likely to result in localized serious harm to fish populations as described above.

Federal legislation that also protects fish habitat indirectly includes the *Canadian Environmental Protection Act* (*CEPA*) and specifically the *Disposal at Sea Regulations* (DAS Regulations). These regulations, administered by Environment Canada, stipulate that dredging and disposal or side casting in the marine environment requires a permit and that sediment be screened for potential chemical contaminants.

Species of marine fish that are *extirpated*, *endangered* or *threatened* as well as the residences and critical habitats of those species are protected under the federal *Species at Risk Act* (*SARA*), as coordinated by DFO, and the Nova Scotia *Endangered Species Act* (NS *ESA*), as coordinated by the Wildlife Division of the Nova Scotia Department of Natural Resources (NSDNR).

Species of conservation interest (SOCI) are species that are not formally protected under *SARA*, but that have been identified by other agencies (e.g., Committee on the Status of Endangered Wildlife in Canada, COSEWIC) as being sensitive or rare. Aquatic organisms in general, including SOCI, are protected federally under the *Fisheries Act*.

The Nova Scotia *Beaches Act,* administered by the Parks Division at NSDNR, recognizes the value and significance of beaches in the province. The intent of this Act is the "protection of beaches and associated dune systems as significant and sensitive environmental and recreational resources". For Bear Paw under the *Beaches Act*, a beach permit is likely required from the Minster of Natural Resources prior to:

- undertaking construction activities such as backfilling below the ordinary high water mark;
- having or using a vehicle on a beach;
- removing, defacing or injuring any natural object, tree, shrub, plant or grass; and
- removing or displacing any rock, mineral, fossil, sand, gravel or other aggregate or object of natural curiosity or interest.

5.4.2 Boundaries

5.4.2.1 Spatial Boundaries

The assessment of potential environmental effects on marine environment encompasses three spatial boundaries: Project Development Area (PDA), Local Assessment Area (LAA), and Regional Assessment Area (RAA). Spatial boundaries are presented below and in Figure 5.4.1.

Project Development Area (PDA)

The marine project development area (PDA) is the area of physical disturbance that will occur during marine construction and pipeline installation or in-water marine activities during construction or pipeline operation. If the bottom lay pipeline construction method is selected for the Strait of Canso with the installation of protective rip-rap and concrete mats, the PDA is anticipated to be 6.8 m wide (possibly up to 10 m) by 1,340 m long (9,112 m^2). If trenching and reburying for the open cut pipeline construction method is selected for the east crossing of the Milford Haven River watercourse, the PDA would range from 7 m to up to 20 m, depending on subsurface conditions, by 100 m long (700 m^2 to 2,000 m^2). If trenchless pipeline installation methods (i.e., horizontal directional drilling (HDD) or micro tunneling) are selected for the two marine watercourse crossings, physical disturbance to the seafloor or marine environment is not anticipated.

Local Assessment Area (LAA)

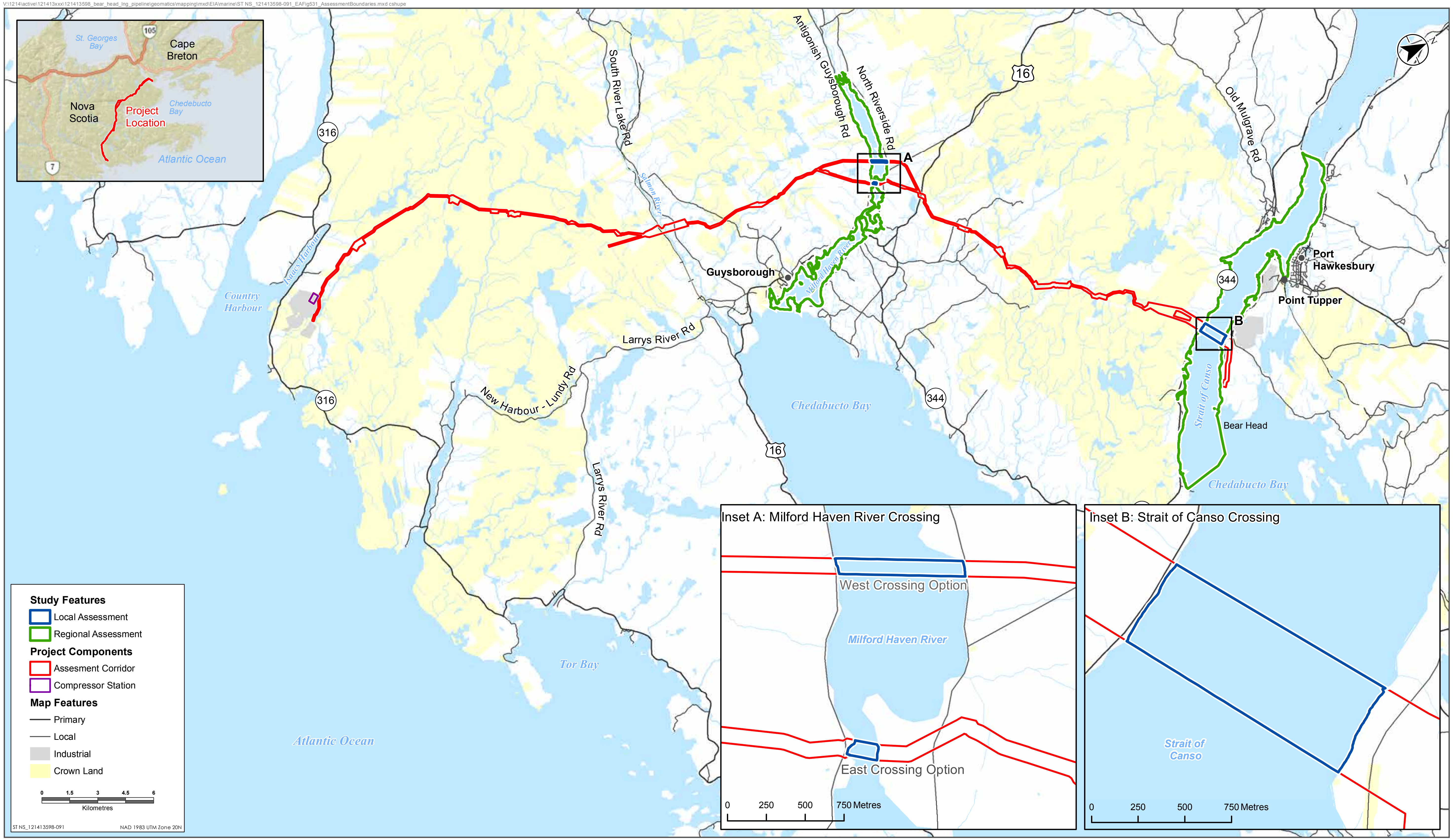
The local assessment area (LAA) boundary includes the PDA and the marine environment within a 500 m wide assessment corridor in the Strait of Canso that interacts directly and indirectly with Bear Paw and the construction methods being considered for the pipeline crossing of this watercourse (i.e., HDD or bottom lay). The LAA for the narrower Milford Haven River crossing is a 100 m wide assessment corridor for both the west and east crossing options. This LAA includes the PDA and encompasses the area for the construction methods under consideration for the west crossing option (i.e., HDD) and the east crossing option (i.e., HDD, open cut, or micro tunneling).

Regional Assessment Area (RAA)

The regional assessment area (RAA) is the area within which Project-related environmental effects may overlap or accumulate with the environmental effects of other projects or activities that have been or will be carried out, and encompasses the PDA and LAA. The RAA for the Strait of Canso pipeline crossing extends from the Canso Causeway to the opening of the Strait into Chedabucto Bay. The RAA for the Milford Haven River pipeline crossing extends from the head of the river to the opening of the river into Chedabucto Bay. The RAA includes potentially sensitive marine ecosystems and habitat requirements of species at risk (SAR) or SOCI.

5.4.2.2 Temporal Boundaries

The temporal boundaries for the assessment of potential effects of Bear Paw on the marine environment include construction, and operation and maintenance. Construction is currently scheduled to begin as early as 2017 and continue over a period of two years. Operation will follow construction and continue for the life of Bear Paw. Maintenance and monitoring of the pipeline section in the marine environment during operation, although not frequently required, will also be necessary. Most potential environmental effects on the marine environment will begin and peak during construction, and diminish during operation.



Sources: Base data provided by the Government of Canada and Nova Scotia.

Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

Marine Environment - Spatial Boundaries for the Strait of Canso and Milford Haven River Pipeline Crossings

Bear Paw Pipeline

Stantec

BEAR PAW PIPELINE PROJECT

Figure 5.4.1

The HDD pipeline construction method, if chosen, is below the seabed and is anticipated to take approximately five months to construct for the crossing of the Strait of Canso and approximately seven months for the crossing of the west option (wider river section) of the Milford Haven River.

5.4.3 Significance Definition

A significant adverse residual environmental effect on the marine environment is defined as one that affects marine populations in such a way as to cause a decline in abundance or change in distribution such that the populations in the assessment area will not be sustainable.

All applicable legislation and regulations (i.e., *Fisheries Act*, *SARA* and NS *ESA*) were also considered to be an essential part of the framework for the assessment of residual effects on the marine environment.

5.4.4 Description of Existing Conditions

This section provides an overview of the approach and methods used for data collection and analysis, and a summary of the results of the 2015 field program conducted by Stantec. Supplementary information is also provided, where available. The objective for the field surveys was to collect baseline data in the assessment corridor for the marine pipeline crossings and to identify fish habitat within the LAA. The habitat assessment information was also to inform water crossing design options and to identify potential mitigation measures to avoid permanent alteration of fish habitat.

A Request for Review application to determine the potential requirement for a *Fisheries Act* Authorization has been submitted to DFO. This Request for Review application includes detailed information resulting from the 2015 field surveys as well as further baseline data for the marine environment in the area of Bear Paw, which is also referenced throughout this chapter.

5.4.4.1 Approach and Methods

A field program was conducted in 2015 to characterize the assessment corridor for the two marine watercourse crossings for Bear Paw in the Strait of Canso and the Milford Haven River (Figure 5.4.2 and Figure 5.4.3, respectively). Other baseline data and information collected during literature reviews by JWEL (2004) and SNC (2015), in addition to the 2015 field studies, by Stantec on behalf of Bear Paw Pipeline, are used to support potential effects assessment according to the measureable parameters described in Section 5.4.5.

Field data collected included Acoustic Doppler Current Profiler (ADCP) transects to measure water currents in each of the marine watercourses, water quality profiling, and water grab sampling to characterize the water column. A benthic field program was also conducted to characterize the benthic habitat for each watercourse and assessment corridor. This program consisted of collecting underwater video with a remotely operated vehicle (ROV) in the assessment corridor and collecting sediment samples for chemical and physical analyses and for the identification and enumeration of benthic invertebrates.

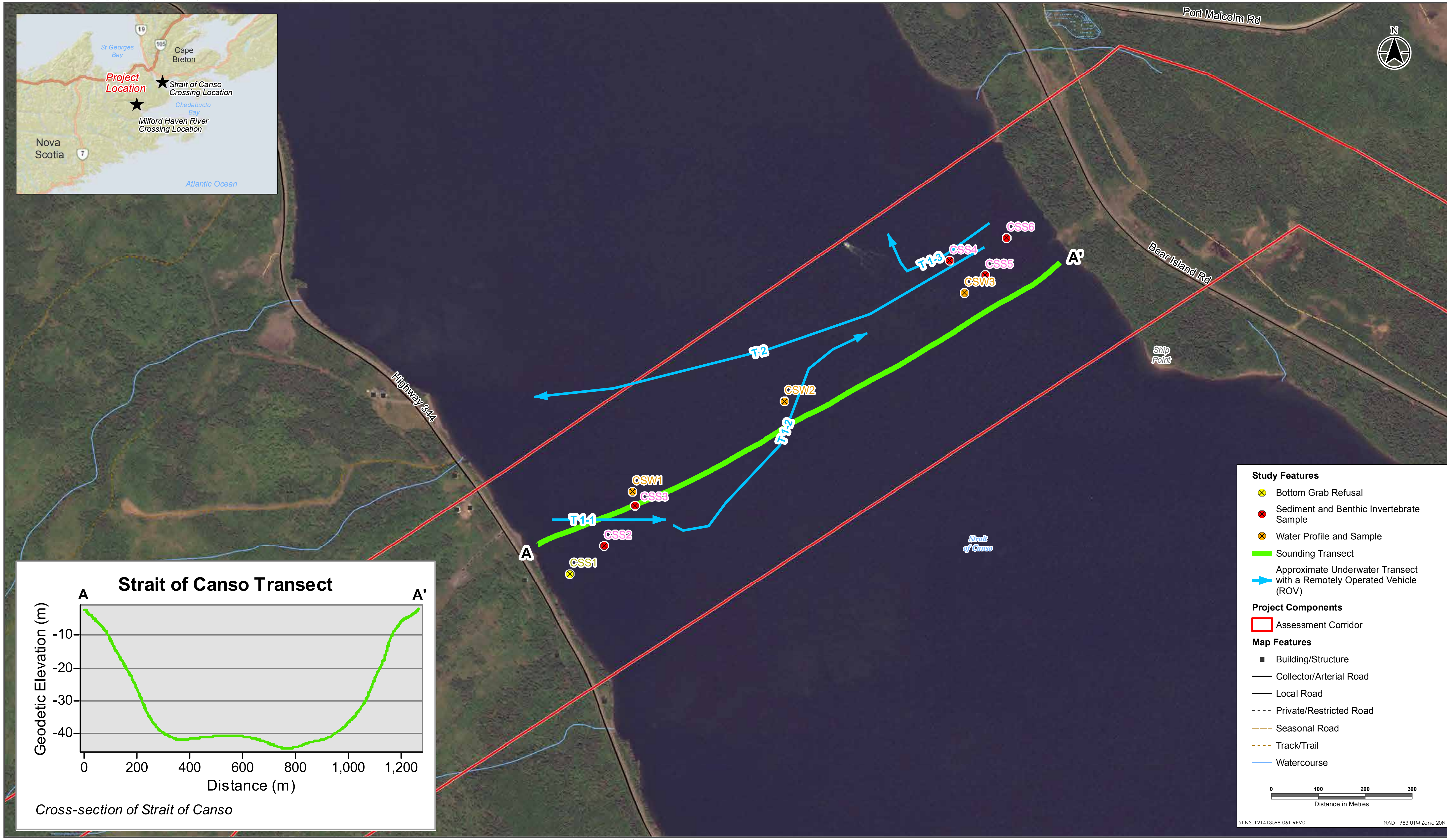
5.4.4.2 Summary of Existing Conditions

Oceanographic Conditions

The Environment Canada weather station closest to both the Strait of Canso and Milford Haven River is Eddy Point (southeast point of the Strait of Canso and 8 km away from the assessment corridor in the Strait and 24 km away from that for Milford Haven River). Based on a 13-year time series (1971 to 1985) the prevailing wind direction is northwesterly with peak wind speeds in the range of 40 km/h to 60 km/h (CBCL 2015). At Eddy Point, the strongest winds occur during the months of November through February and are predominantly from the west and northwest, with speeds from 54 km/h to 72 km/h observed more than 10% of the time (SNC 2015). Winds diminish during the months of June, July and August seldom exceeding 54 km/h and are predominantly from the southwest (nearly 40% of the time). Intermediate wind directions and speeds are observed in the spring and fall.

The local wave climate is predominantly wind-driven as the Strait of Canso is well sheltered from long-period swells (CBCL 2015). The peak wave height measured during the 2005 to 2006 winter season was 0.87 m during a storm event with maximum wind speeds of 90 km/h (CBCL 2015). The majority of wave peak periods are 2 to 4 seconds, accounting for approximately 71% of the wave observations that were recorded (CBCL 2015).

Wave data for Milford Haven River are not available. Waves that are likely to be present would be wind-generated with the direction of the wind aligned with the river and blowing from the northwest or southeast. However, because of the short length of water available for the fetch, wave heights and wave periods are likely to be small. Currents in the Strait of Canso southeast of the Canso Causeway are generally weak and are predominantly wind-driven (McCracken 1979). The direction of the current is aligned with the length of the Strait; the average current speed is 0.1 m/sec to 0.2 m/sec, and the peak velocity (0.3 m/sec to 0.6 m/sec) at a depth of 8 m (CBCL 2015). Currents are weaker at depth (0.05 m/sec to 0.1 m/sec) compared to those at the surface, where the peak current observed was 0.65 m/sec (CBCL 2015). The currents measured by Stantec on September 30, 2015 in the assessment corridor in the Strait of Canso during a large spring tide were also weak. The prevailing direction of the surface and bottom currents when the tide is flooding is northwesterly, with the strongest currents (0.41 m/sec to 0.50 m/sec) measured only on the surface along the Cape Breton side of the Strait (Figure 5.4.4). During the ebbing tide, the strongest currents are also on the surface, but flowing primarily in a southeasterly direction (velocities in the range of 0.1 m/s to 0.4 m/s), with much weaker bottom currents primarily in a northeastern and opposite direction to the surface currents (Figure 5.4.5).



Sources: Base data provided by the Government of Canada and Nova Scotia. Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency. Not intended for navigation or detailed engineering/build purposes.
Note: Depth soundings reduced to chart datum using measured on-site water levels during survey on Sept 29, 2015 and CHS observed tidal data for Station 0575 in Port Hawkesbury, NS for vertical reference.

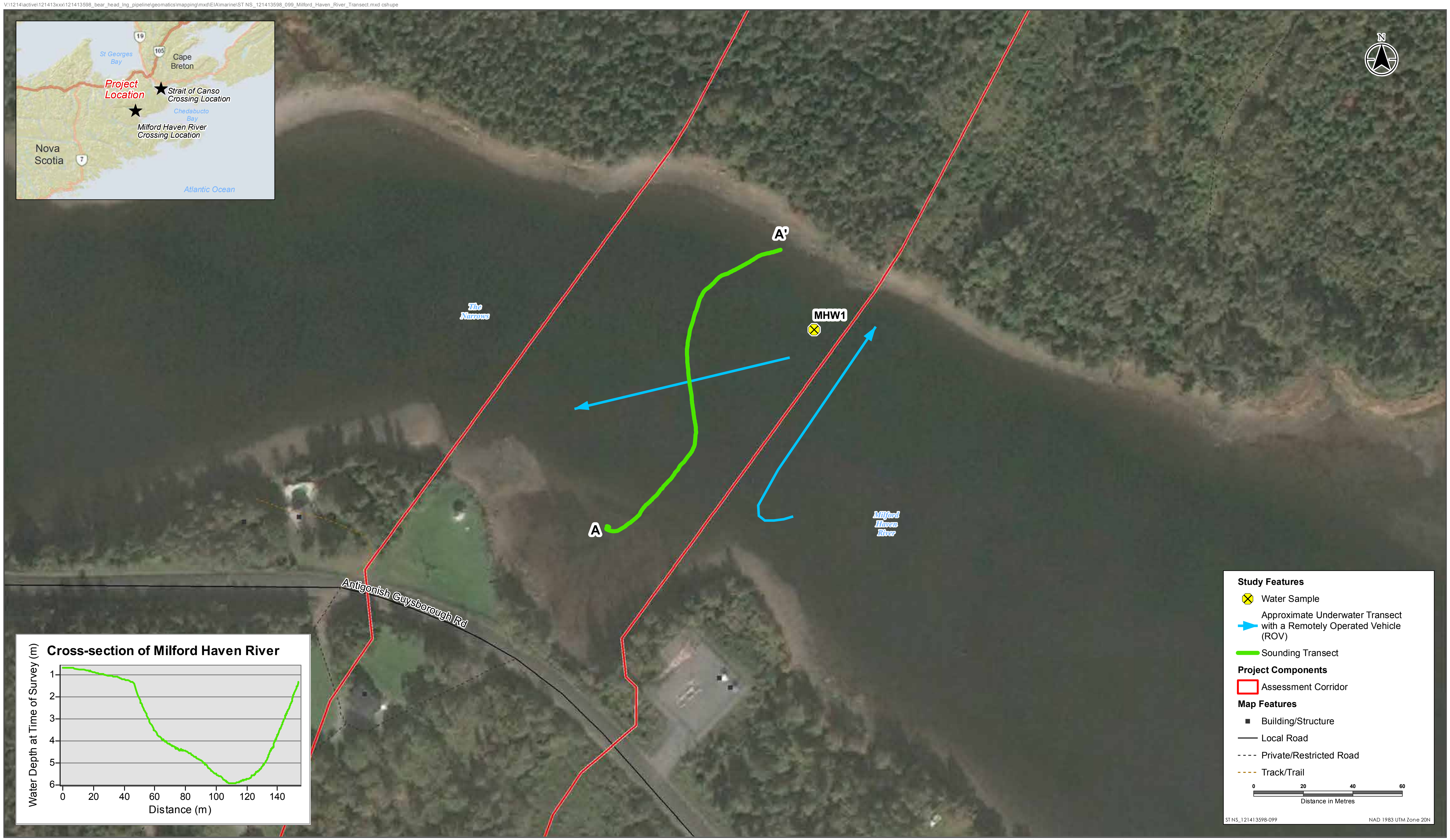
Bear Paw Pipeline

Stantec

BEAR PAW PIPELINE PROJECT

Sampling Locations for the Strait of Canso Watercourse Crossing

Figure 5.4.2



Sources: Base data provided by the Government of Canada and Nova Scotia. Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency. Not intended for navigation or detailed engineering/build purposes.
Note: Water depth at time of survey (not corrected to any vertical benchmark, reference or datum).

Stantec

BEAR PAW PIPELINE PROJECT

Sampling Locations for Milford Haven River East Crossing Option

Figure 5.4.3

Current profiles for Milford Haven River during a flood tide on October 2, 2015 determined that the predominant direction of water flow was north-easterly, consistent with heading up river. Current speeds measured were in the range of 0.9 m/sec to 1.2 m/sec across the width and depth of the river with the exception of shallower, nearshore regions (<2.0 m depth) where speeds ranged from 0.3 m/sec to 0.6 m/sec.

Water Column Properties

Strait of Canso

Warmer and fresher surface water tends to accumulate near the causeway end of the Strait of Canso and is periodically replaced by more saline and colder ocean waters which replenish the bottom waters (McCracken 1979). Salinity ranges from approximately 29 practical salinity units (psu) at the surface to 31 psu near the bottom (McCracken 1979). Water column profiles at three stations were conducted by Stantec during a large high tide in the Strait of Canso on September 30, 2015 (water sample locations provided in Figure 5.4.2). The highest temperature recorded was 16.4°C near the surface, which decreased to 6.6°C at a depth of 42 m near the bottom. The temperature was generally above 15°C in the top 10 m of the water column, decreasing steadily to approximately 8°C at 40 m; temperatures dropped another 2°C before maximum depth. Salinity increased more evenly from the surface to the bottom and ranged between 29.7 psu near the surface, to 31.8 psu below 40 m. Turbidity measurements increased from 5.2 nephelometric turbidity units (NTU) near the surface to 6.0 NTU around 30 m, where it was largely consistent to the bottom. Turbidity measurements are often used as an indicator of water quality based on clarity and estimated total suspended solids in water. However, turbidity is not a direct measurement of the total suspended materials in water. Instead, as a measure of relative clarity, turbidity is often used to indicate changes in the total suspended solids concentration in water without providing an exact measurement of solids (Kemker 2014). The depth at which peak turbidity was measured was the depth selected for sampling total suspended solids (TSS) in the water column. These were collected at 30 m, 38 m and 20 m water depths for stations CSW1, CSW2 and CSW3, respectively (Figure 5.4.2). The TSS concentrations at each of these stations were 1.0 mg/L, 3.2 mg/L and <1.0 mg/L (not detected), respectively.

Milford Haven

Two temperature and salinity profiles were also conducted at Milford Haven River for the east crossing location, with a peak temperature of 17.2°C at the surface and 17.1°C at a depth of 4.6 m. Salinity was fairly consistent throughout the water column and measured 29.5 psu near the surface and 29.6 psu towards the bottom at 5.6 m. In general, the water mass was homogenous for Milford Haven River. The maximum turbidity measured was 10.5 NTU at a depth of 0.91 m below the surface. TSS measurements were obtained from two water samples collected mid-channel at the surface and 2.0 m below the surface. Both samples had TSS values of 3.2 mg/L.

Sediment Quality

Strait of Canso

A sediment sampling program in the assessment corridor was conducted in the Strait of Canso by Stantec in September 2015 (Figure 5.4.2). Six sediment stations were originally planned, however only five samples were collected successfully.

The sediment collected in the assessment corridor for the Strait of Canso was primarily silty sand in the deeper areas and for majority of the cross section of the Strait, with coarser sand and gravel sediments found closer inshore. The sediment chemistry results for the Strait of Canso samples, presented in Table 5.4.1, were compared to *CEPA* Disposal at Sea Lower Level Screening Criteria and the Canadian Council of Ministers of the Environment (CCME) Sediment Probable Effect Levels for the Protection of Marine Aquatic Life, 2012. The analytical results of the five surficial samples collected from the assessment corridor indicate exceedances above guidelines for polychlorinated biphenyls (PCBs) and cadmium for sample CSS5 and above PCB guidelines for sample CSS4. Both of these samples are located closer to the Cape Breton side of the Strait of Canso.

Table 5.4.1 Summary of Sediment Analysis Data for Strait of Canso Assessment Corridor

Analytical Parameter	Units	*CEPA* Disposal at Sea[1]	CCME Sediment Quality Guidelines[2]							
			Marine PEL	CSS2	CSS2 Lab-Dup	CSS3	CSS4	CSS5	CSS5 Lab-Dup	CSS6
Sampling Date (dd-mmm-yyyy)				**29-Sep-2015**						
Particle Size Analysis										
Moisture	%	ng	ng	37	N/A	64	67	52	N/A	25
Gravel	%	ng	ng	27	21	7.0	3.8	4.3	N/A	19
Sand	%	ng	ng	38	39	9.8	21	39	N/A	67
Silt	%	ng	ng	18	20	38	32	26	N/A	7.6
Clay	%	ng	ng	17	20	45	43	30	N/A	6.4
Total Organic Carbon	g/kg	ng	ng	11	11	24	34	34	N/A	8
Polycyclic Aromatic Hydrocarbons (PAH)										
1-Methylnaphthalene	mg/kg	ng	ng	<0.010	N/A	<0.010	<0.010	<0.010	<0.010	<0.010
2-Methylnaphthalene	mg/kg	ng	0.201	<0.010	N/A	<0.010	<0.010	<0.010	<0.010	<0.010
Acenaphthene	mg/kg	ng	0.0889	<0.010	N/A	<0.010	<0.010	<0.010	<0.010	<0.010
Acenaphthylene	mg/kg	ng	0.128	<0.010	N/A	<0.010	<0.010	<0.010	<0.010	<0.010
Anthracene	mg/kg	ng	0.245	<0.010	N/A	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(a)anthracene	mg/kg	ng	0.693	<0.010	N/A	<0.010	0.041	0.041	0.037	<0.010
Benzo(a)pyrene	mg/kg	ng	0.763	<0.010	N/A	<0.010	0.041	0.032	0.037	<0.010
Benzo(b)fluoranthene	mg/kg	ng	ng	<0.010	N/A	0.028	0.056	0.036	0.039	<0.010
Benzo(g,h,i)perylene	mg/kg	ng	ng	<0.010	N/A	<0.010	0.037	0.023	0.020	<0.010
Benzo(j)fluoranthene	mg/kg	ng	ng	<0.010	N/A	<0.010	0.032	<0.010	<0.010	<0.010

Table 5.4.1 Summary of Sediment Analysis Data for Strait of Canso Assessment Corridor

Analytical Parameter	Units	*CEPA* Disposal at Sea[1]	CCME Sediment Quality Guidelines[2]							
			Marine PEL	CSS2	CSS2 Lab-Dup	CSS3	CSS4	CSS5	CSS5 Lab-Dup	CSS6
Benzo(k)fluoranthene	mg/kg	ng	ng	<0.010	N/A	<0.010	0.042	<0.010	<0.010	<0.010
Chrysene	mg/kg	ng	0.846	<0.010	N/A	<0.010	0.060	0.055	0.043	<0.010
Dibenz(a,h)anthracene	mg/kg	ng	0.135	<0.010	N/A	<0.010	<0.010	<0.010	<0.010	<0.010
Fluoranthene	mg/kg	ng	1.494	0.021	N/A	0.053	0.11	0.10	0.084	0.020
Fluorene	mg/kg	ng	0.144	<0.010	N/A	<0.010	<0.010	<0.010	<0.010	<0.010
Indeno(1,2,3-cd)pyrene	mg/kg	ng	ng	<0.010	N/A	<0.010	<0.010	<0.010	<0.010	<0.010
Naphthalene	mg/kg	ng	0.391	<0.010	N/A	<0.010	<0.010	<0.010	<0.010	<0.010
Perylene	mg/kg	ng	ng	<0.010	N/A	0.067	0.051	0.026	0.026	<0.010
Phenanthrene	mg/kg	ng	0.544	<0.010	N/A	0.030	0.066	0.075	0.053	0.016
Pyrene	mg/kg	ng	1.398	0.019	N/A	0.046	0.086	0.086	0.069	0.015
Total PAH[3]	mg/kg	2.5	ng	0.130	N/A	0.299	0.667	0.529	0.463	0.136
Polychlorinated Biphenyls (PCB)										
Aroclor 1016	µg/g	ng	ng	<0.050	<0.050	<0.050	<0.050	<0.050	N/A	<0.050
Aroclor 1221	µg/g	ng	ng	<0.050	<0.050	<0.050	<0.050	<0.050	N/A	<0.050
Aroclor 1232	µg/g	ng	ng	<0.050	<0.050	<0.050	<0.050	<0.050	N/A	<0.050
Aroclor 1248	µg/g	ng	ng	<0.050	<0.050	<0.050	<0.050	<0.050	N/A	<0.050
Aroclor 1242	µg/g	ng	ng	<0.050	<0.050	<0.050	<0.050	<0.050	N/A	<0.050
Aroclor 1254	µg/g	ng	0.709	<0.050	<0.050	<0.050	<0.050	<0.050	N/A	<0.050

Table 5.4.1 Summary of Sediment Analysis Data for Strait of Canso Assessment Corridor

Analytical Parameter	Units	*CEPA* Disposal at Sea[1]	CCME Sediment Quality Guidelines[2]							
			Marine PEL	CSS2	CSS2 Lab-Dup	CSS3	CSS4	CSS5	CSS5 Lab-Dup	CSS6
Aroclor 1260	µg/g	ng	ng	<0.050	<0.050	<0.050	0.29	0.38	N/A	<0.050
Total PCB	µg/g	0.1	0.189	<0.050	N/A	<0.050	**0.29**	**0.38**	N/A	<0.050
Metals (acid extractable)										
Aluminum (Al)	mg/kg	ng	ng	10000	N/A	16000	15000	12000	N/A	7500
Antimony (Sb)	mg/kg	ng	ng	<2.0	N/A	<2.0	<2.0	<2.0	N/A	<2.0
Arsenic (As)	mg/kg	ng	41.6	7.7	N/A	15	15	12	N/A	6.4
Barium (Ba)	mg/kg	ng	ng	74	N/A	100	97	74	N/A	38
Beryllium (Be)	mg/kg	ng	ng	<2.0	N/A	<2.0	<2.0	<2.0	N/A	<2.0
Bismuth (Bi)	mg/kg	ng	ng	<2.0	N/A	<2.0	<2.0	<2.0	N/A	<2.0
Boron (B)	mg/kg	ng	ng	<50	N/A	<50	<50	<50	N/A	<50
Cadmium (Cd)	mg/kg	0.6	4.2	<0.30	N/A	0.55	0.40	**0.69**	N/A	0.43
Chromium (Cr)	mg/kg	ng	160	19	N/A	28	29	24	N/A	13
Cobalt (Co)	mg/kg	ng	ng	8.7	N/A	13	11	9.6	N/A	6.6
Copper (Cu)	mg/kg	ng	108	11	N/A	23	26	19	N/A	12
Iron (Fe)	mg/kg	ng	ng	21000	N/A	32000	29000	25000	N/A	16000
Lead (Pb)	mg/kg	ng	112	19	N/A	88	36	28	N/A	14
Lithium (Li)	mg/kg	ng	ng	26	N/A	37	34	29	N/A	21
Manganese (Mn)	mg/kg	ng	ng	260	N/A	370	320	310	N/A	260
Mercury (Hg)	mg/kg	0.75	0.7	<0.10	N/A	<0.10	<0.10	<0.10	N/A	<0.10

Table 5.4.1 Summary of Sediment Analysis Data for Strait of Canso Assessment Corridor

Analytical Parameter	Units	*CEPA* Disposal at Sea[1]	CCME Sediment Quality Guidelines[2]							
			Marine PEL	CSS2	CSS2 Lab-Dup	CSS3	CSS4	CSS5	CSS5 Lab-Dup	CSS6
Molybdenum (Mo)	mg/kg	ng	ng	<2.0	N/A	<2.0	2.2	3.3	N/A	<2.0
Nickel (Ni)	mg/kg	ng	ng	20	N/A	32	29	25	N/A	15
Rubidium (Rb)	mg/kg	ng	ng	9.5	N/A	15	15	11	N/A	6.8
Selenium (Se)	mg/kg	ng	ng	<1.0	N/A	<1.0	<1.0	<1.0	N/A	<1.0
Silver (Ag)	mg/kg	ng	ng	<0.50	N/A	<0.50	<0.50	<0.50	N/A	<0.50
Strontium (Sr)	mg/kg	ng	ng	110	N/A	53	50	49	N/A	28
Thallium (Tl)	mg/kg	ng	ng	0.14	N/A	0.13	0.15	0.17	N/A	<0.10
Tin (Sn)	mg/kg	ng	ng	<2.0	N/A	<2.0	<2.0	<2.0	N/A	<2.0
Uranium (U)	mg/kg	ng	ng	0.88	N/A	1.4	1.3	1.6	N/A	0.76
Vanadium (V)	mg/kg	ng	ng	29	N/A	52	52	43	N/A	21
Zinc (Zn)	mg/kg	ng	271	66	N/A	220	140	200	N/A	160

Notes:

1 *Canadian Environmental Protection Act*, DAS Regulations sediment screening criteria.

2 Canadian Sediment Quality Guidelines for the Protection of Aquatic Life, Council of Ministers of the Environment (CCME).

3 Sum of polycyclic aromatic hydrocarbons (PAH) analyzed in the sample; for samples where PAH were below the reporting limit, the reporting limit divided by 2 was used in calculating the sum as a conservative estimate.

* Refer to Figure 5.4.2 for the location of sampling stations in the pipeline marine assessment corridor.

ng No guideline available.

N/A Not applicable.

Bold value exceeds CEPA Disposal at Sea Guideline.

Value exceeds CCME Sediment Quality Guideline for Marine Probable Effect Level (PEL).

Milford Haven

No sediment samples could be obtained for the east crossing option for the Milford Haven River because of the hard substrate present in the crossing location. Sediment sampling was not attempted for the west crossing option for Milford Haven River since only HDD or micro tunneling pipeline construction methods are being considered and therefore no sediment disturbance would occur.

Benthic Fish Habitat Characterization

Strait of Canso – Intertidal

The Strait of Canso has a very narrow intertidal zone covered with coarse sediment comprised of gravel, cobble and rubble along both sides of the waterway (Photo 5.4.1).

(A) Cape Breton side of the crossing near existing pipeline.

(B) Nova Scotia side of the crossing near existing pipeline.

Photo 5.4.1 Intertidal Regions of the Strait of Canso in the Assessment Corridor

Strait of Canso – Subtidal

On September 29, 2015 two transects were surveyed of the benthic habitat by Stantec using a ROV. These transects were located across the Strait of Canso in the assessment corridor (Figure 5.4.2). Transect T1 was completed in three (3) stages and therefore labelled as such in Figure 5.4.2 (T1-1, T1-2, and T1-3).

Transect T1 (Photo 5.4.2) had a depth range of 7.5 m to 42.9 m in the Strait of Canso, and the sediment composition observed varied from predominantly silt and sand to rubble and gravel . Macrofauna encountered included brittle stars (*Ophiura* sp.*)*, occasional sea star (*Asterias* sp.), rock crab (*Cancer irroratus)*, unidentified fish and shrimp species, barnacles, and sea anemones. Macroflora observed included: *Saccharina latissima*, *Fucus* sp., wireweed, unidentified brown and red algae, and encrusting organisms (possibly crustose algae and bryophytes) on rubble and cobble. Empty shells and fragments were also observed along the transect survey.

Photo 5.4.2 Benthic Habitat and Macroflora Coverage on Transect T1 in 11 m

Transect T2 had a depth range of less than 1 m to 44.3 m. The substrate consisted of silt, cobble, rubble, boulders, gravel and shell hash. Macrofauna observed along the transect included: brittle stars (*Ophiura* sp.)(Photo 5.4.3), occasional sea star (*Asterias* sp.), rock crab, unidentified fish, and a vase sponge. Macroflora observed, included *Saccharina latissima*, *Fucus* sp., wireweed, unidentified brown and red algae, and smooth cord weed.

Photo 5.4.3 Brittle Stars and Unidentified Shrimp on Silty Sediment in 41 m along Transect T2 in the Strait of Canso Assessment Corridor

Milford Haven River – Intertidal

The intertidal region of Milford Haven River (Photo 5.4.4) had a shallower slope and was also covered with coarse sediment comprised of gravel, cobble and rubble along both sides of the waterway, as well as having dense mats of rock weed (*Fucus* sp.).

Photo 5.4.4 Intertidal Region of Milford Haven River in the Assessment Corridor for the East Crossing Option

Milford Haven River – Subtidal

On October 1, 2015 two ROV transect surveys were conducted across the Milford Haven River west and east crossing options. The east crossing option transect was approximately 141 m long with a depth range of less than 1 m to 6.7 m. The substrate was primarily gravel and cobbles with some sand and silt interbedded (Photos 5.4.5 and 5.4.6). Macrofauna observed along the transect included sea star (*Asterias* sp.) and rock crab. Macroflora observed included *Fucus* sp., whipweed, wireweed, cordweed, and unidentified brown and red algae (Photo 5.4.5).

The benthic transect for the Milford Haven River west crossing option was approximately 420 m long with a maximum depth of 12.5 m. Substrate types observed included: silt, sand cobble, gravel and rubble (Photo 5.4.6). Macrofauna observed along the transect survey included gastropods, sea stars (*Asterias* sp.) and a rock crab. Macroflora observed include *Saccharina latissima*, *Fucus* sp., whipweed, unidentified brown and red algae, and encrusting organisms (possibly crustose algae and bryophytes) on rubble and cobbles. Empty shells and fragments were also observed along the surveyed transect.

Photo 5.4.5 Hard Substrate and Unidentified Red Algae in 5 m Depth at the East Crossing Option, Milford Haven River

Photo 5.4.6 Soft Sediment and Drifted Macroflora and Debris in 2 m Depth at Milford Haven River West Option

Benthic Invertebrates

Strait of Canso

Six benthic sampling stations were sampled with a bottom grab in the assessment corridor for the Strait of Canso (Figure 5.4.2). At station CSS1, no sediment sample was collected due to grab refusal because of cobble and rubble substrate, as observed in underwater video.

For the Strait of Canso, organism density at the benthic sampling stations ranged between 237 organisms/m^2 at Station CSS4 to 9,914 organisms/m^2 at Station CSS6. The relatively high density observed at Station CSS6 was due to large numbers of nematodes and polychaetes (*Capitella capitata*, *Prionospio steenstrupi* and *Protodriloides symbioticus*). Dominance of a benthic community by few taxa can indicate stress from environmental impacts. Densities found within the assessment corridor do not suggest toxic effects of sediment or water at any station.

Taxa richness among the benthic stations ranged between three distinct taxa at Station CSS4 and 29 taxa at Station CSS6. Nearshore, shallower stations (CSS2, CSS5 and CSS6) tended to have higher taxa richness than deeper stations in the Strait (CSS3 and CSS4). The deeper stations had relatively homogeneous substrates, simple soft-sediment habitats, primarily stable environmental conditions and low light levels. One factor that might limit diversity in these deeper areas of the Strait is the potential rate of sediment deposition. Since the causeway was constructed in the Strait of Canso, north of the assessment corridor, deposition of fine sediments within the mid-channel has increased by 1 mm to 2 mm per year (Parrott et al. 2005). Reductions in the density and richness of benthic communities here may be a result of continual smothering of communities with new sediment, before they can become fully established.

Diversity was greatest at Stations CSS2 and CSS6 and lowest at Stations CSS3 and CSS4. It should be noted that sediment from Stations CSS4 and CSS5 exceeded DAS and CCME sediment guidelines for PCBs. General reductions in diversity in the deeper mid-channel stations compared to the nearshore stations in the Strait also reflect their lower habitat complexity, reduced light penetration and higher sediment deposition rates.

An analysis of the relative abundance of taxonomic groups among stations showed that the benthic communities in the Strait of Canso assessment corridor were generally dominated by annelids (primarily polychaetes). Polychaetes accounted for between 65% and 100% of the communities at CSS2, CSS4, CSS5 and CSS6. CSS3 was dominated by foraminifera taxa which accounted for 75% of organisms found. Nearshore stations contained the most evenly distributed communities among stations assessed, with no one taxon representing more than 65% of the organisms found, suggesting that these communities were more stable, complex and less impacted by environmental stressors.

An analysis of the benthic communities by functional feeding group showed that the benthic communities within the assessment corridor that were sampled were dominated by deposit feeders and predators. Nearshore area communities had more evenly distributed relative abundances of species within each feeding group in comparison to the deeper-water stations. CSS3 was dominated by deposit feeders (primarily foraminifera) which comprised greater than 90% of the organisms found. CSS4 was dominated by predators, which similarly comprised greater than 90% of the community.

Milford Haven River

Sediment sampling with a grab was attempted for the east crossing option for Milford Haven River but samples could not be obtained because of the hard substrate present at this crossing location (Photo 5.4.5). Sediment sampling for the west crossing option was not attempted because no sediment disturbance would occur at this crossing location with either HDD or micro tunneling pipeline construction methods.

Fish Populations

The Strait of Canso and Milford Haven River have the potential for fish species similar to those in the adjacent waters of Chedabucto Bay and the Nova Scotia coast. Marine waters of the inshore Scotian Shelf (shoreline to 90 m water depth) support populations of summer flounder (*Paralichthys dentatus*), winter flounder (*Pseudopleuronectes americanus*), Atlantic wolffish (*Anarhichas lupus*), spiny dogfish (*Squalus acanthias*), cod (*Gadus morhua*), haddock (*Melanogrammus aeglefinus*), pollock (*Pollachius virens*), halibut (*Hippoglossus hippoglossus*), American lobster (*Homarus americanus*), rock crab (*Cancer irroratus*), and scallop (*Placopectin magellanicus*) (DFO 2007b). These species also support commercial fisheries. Particularly important fisheries in the region of Chedabucto Bay include lobster, shrimp (*Pandalus borealis*), halibut, cod, haddock, pollock, white hake, Atlantic herring (*Clupea harengus*) and mackerel (*Scomber scombrus*) (AMEC 2008).

The waters in the RAA also provide habitat for other fish species including hake (*Merluccius bilinearis*), smelt (*Osmerus mordax*), capelin (*Mallotus villosus*), thorny skate (*Raja radiata*), vahl's eelpout (*Lycodes vahlii*), daubed shanny (*Lumpenus maculatus*), turbot, mailed sculpin (*Triglops ommatistius*) (AMEC 2008), as well as invertebrate species including sea urchin (*Strongylocentrotus droebachiensis*), snow crab (*Chionoecetes opilio*), and toad crab *(Hyus araneus*) (DFO 2007b). The waters in the RAA and vicinity of Chedabucto Bay could also be transited by migratory species such as the American eel (*Anguilla rostrata*) that are not currently listed under *SARA,* but are listed as *threatened* by COSEWIC (COSEWIC 2012).

Commercial, Recreational, and Aboriginal (CRA) Fisheries

Fish that are part of CRA fisheries are interpreted within the Fisheries Protection Policy Statement to be those fish that fall within the scope of applicable federal or provincial fisheries regulations as well as those that can be fished by Aboriginal persons for food, social or ceremonial purposes, or for purposes set out in a land claims agreement. "Fish that support" these fisheries in the *Fisheries Act* are those fish that contribute to the productivity of a fishery (often, but not exclusively, as prey species).

Chedabucto Bay, which is located outside the RAA, supports fisheries species that include American lobster, shrimp and eastern oyster (AMEC 2008; Kenchington 2014), in addition to finfish fisheries species that include halibut, cod, haddock, pollock, white hake, Atlantic herring and mackerel (AMEC 2008). There is no evidence of a large-scale fishery in the Strait of Canso (SNC 2015), including prior to the installation of the causeway (McCracken 1979). No commercial fisheries occur in the Strait of Canso assessment corridor or in the narrow section that comprises the majority of the Strait because this area is used for shipping and has been extensively industrialized (SNC 2015). The water in the confines of the Strait deepens quickly given the deep narrow structure of the Strait; the narrow shoreline provides limited habitat for many commercial species, such as lobster. A valued lobster fishery is active outside the Strait and nearshore areas. Recreational fishing for mackerel, however, occurs from the Canso Causeway, local wharves and piers around Port Hawkesbury, as well as the southeast tip of Bear Head. Two mackerel traps are registered in the wider area of the Strait (i.e., in the RAA) where it opens to Chedabucto Bay (SNC 2015).

There are two key fisheries-related features of Chedabucto Bay including a larger overwintering population of herring that can be fished according to the current management plan by large seiners and a trap shrimp fishery operating just inshore of Cape Chedabucto. The major species caught for commercial and aboriginal fisheries in the deeper offshore water in the approaches to the Strait include snow crab and shrimp. There is little potential for seaweed, scallop and urchin harvesting and aquaculture in the Strait; these are important beyond the RAA in the outer Bay and around Isle Madame. CRA fisheries species that may be present in the LAA and RAA for the marine environment of the Strait of Canso are summarized in Table 5.4.2.

Milford Haven River is used for recreational fisheries only; however, the same populations of marine fish found in Milford Haven River may be commercially fished when they are in different regions. Bivalve fisheries species in the Milford Haven River RAA have included bar clams, soft shell clams, bay quahogs, razor shells, clams, mussels and oysters; however, there is at present a DFO order prohibiting fishing for these species because of contamination (DFO 2014). Recreational fisheries in the freshwater environment of the upper reaches of Milford Haven River take place for small mouth bass, brown trout, and speckled trout (DFO 2015; Nova Scotia 2014).

Table 5.4.2 CRA Fisheries Species Potentially Present in the LAA and RAA for the Strait of Canso Assessment Corridor

Species	Commercial		Recreational		Aboriginal		Abundance*
	Fishery Present	Supporting Species	Fishery Present	Supporting Species	Fishery Present	Supporting Species	Relative Abundance in the LAA
American Eel	✓	-	✓	-	✓	-	Low
American Lobster	✓	-	-	-	✓	-	Moderate
Rock Crab	✓	✓	-	-	✓	✓	Moderate
Atlantic Sea Scallop	✓	-	-	-	✓	-	Low

Table 5.4.2 CRA Fisheries Species Potentially Present in the LAA and RAA for the Strait of Canso Assessment Corridor

Species	Commercial		Recreational		Aboriginal		Abundance*
	Fishery Present	Supporting Species	Fishery Present	Supporting Species	Fishery Present	Supporting Species	Relative Abundance in the LAA
Atlantic Herring	✓	✓	✓	✓	✓	✓	Low
Atlantic Mackerel	✓	✓	✓	✓	✓	✓	Low
Atlantic Halibut	✓	-	-	-	✓	-	Low
Haddock	✓	-	-	-	✓	-	Low
Summer Flounder	✓	-	-	-	✓	-	Low
White Hake	✓	-	-	-	✓	-	Low
Winter Flounder	✓	-	-	-	✓	-	Low
Note: * Based on information in SNC (2015) and the 2015 benthic field survey by Stantec.							

Marine Mammals

Marine mammals in the region are predominantly harbour seals (*Phoca vitulina*) and grey seals (*Halichoerus grypus*) that are present year-round (JWEL 2004). Nearshore waters off the coast of Nova Scotia are also inhabited by white-sided dolphins (*Lagenorgynchus acutus*) and harbour porpoises (*Phocoena phocoena*). Harbour porpoises are listed as *threatened* on Schedule 2 of *SARA* and as special concern by COSEWIC (2006a). Migratory whales, including fin whales (*Balaenoptera physalus*), humpback whales (*Megaptera novaeangliae*) and right whales (*Eubalaena glacialis*) are also present during spring, summer and fall (SNC 2015). The Atlantic population of fin whales is listed as *special concern* under Schedule 1 of *SARA* and by COSEWIC (2005). The North Atlantic right whale is listed as *endangered* on Schedule 1 of *SARA* and as *endangered* by COSEWIC (2013). These marine mammals, however, are not known to be present in the Strait of Canso.

Species of Conservation Interest (SOCI)

SOCI includes those species federally listed under *SARA* or species listed as *endangered*, *threatened* or of *special concern* by COSEWIC. No marine fish or marine mammals potentially present in the RAA for the Strait of Canso and Milford Haven River pipeline crossings are listed under the NS *ESA*.

A search of the Atlantic Canada Conservation Data Centre (AC CDC) database was conducted to identify sensitive areas, species and habitats near the Strait of Canso assessment corridor (SNC 2015). The AC CDC search provided a list of rare and sensitive species within a 5 km radius (standard AC CDC procedure) of the Project. The search did not identify aquatic SAR within the 5 km buffered area.

Table 5.4.3 lists the eight fish species and their respective COSEWIC and *SARA* status which could be encountered in the RAA. The Atlantic wolfish is the only SOCI identified as potentially present in the RAA and listed under Schedule 1 of *SARA*. Only species listed under Schedule 1 as *endangered* or *threatened* are protected under *SARA*.

Table 5.4.3 Species of Conservation Interest Potentially Present in the RAA for the Strait of Canso and Milford Haven River Assessment Corridor

Species	COSEWIC Status	*SARA* Status	*SARA* Schedule
American eel (*Anguilla rostrata*)	Threatened	No status	No schedule
Atlantic cod (Laurentian South Population) (*Gadus morhua*)	Endangered	No status	No schedule
Atlantic salmon (Nova Scotia Southern Upland and Eastern Cape Breton Populations) (*Salmo salar* L.)	Endangered	No status	No schedule
Atlantic Wolffish (*Anarhichas lupus*)	Special Concern	Special Concern	Schedule 1
Spiny Dogfish (Atlantic Population) (*Squalus acanthias*)	Special Concern	No Status	No schedule
Thorny skate (*Amblyraja radiata*)	Special Concern	No status	No schedule
White hake (Atlantic and Northern Gulf of St. Lawrence Population) *(Urophycis tenuis)*	Threatened	No status	No schedule
Winter skate (*Leucoroja ocellata*)	Threatened	No status	No schedule

5.4.5 Potential Environmental Effects and Project-Related Interactions

The assessment of potential environmental effects on the marine environment focuses on key components for the marine watercourse crossing methods for the pipeline construction and installation under consideration (i.e., open cut (trench), bottom lay, HDD and micro tunneling – Section 2.3) that may interact with the marine environment and for the operation of the pipeline. Effective planning and design and the application of proven mitigation measures during construction and operation will reduce adverse effects on the marine environment.

Aspects of the marine environment that could be affected by activities and components include marine habitat, water quality, sediment quality, and the acoustic environment. Changes of these aspects of the marine environment, if unmitigated, have the potential to change marine populations (e.g., adult fish, eggs and larvae, invertebrates, and marine mammals) through direct mortality or indirectly through alteration or destruction of habitat. Considering the value placed on marine populations by regulatory agencies, stakeholders, and the public, the environmental assessment of the marine environment is focused on the following environmental effect:

- change in marine populations.

No potential effects on the marine environment and change in marine populations are anticipated with the HDD or micro tunneling construction methods that may be used across and below the seabed in the Strait of Canso or Milford Haven River pipeline crossings (except in the case of accidents or malfunctions – Chapter 7) and are therefore not carried forward in the assessment of routine effects. The only environmental effects with the potential for a change in marine populations would result from open cut or bottom lay pipeline construction methods; these are discussed further below.

The effect pathways and measurable parameters for the assessment for this environmental effect are provided in Table 5.4.4.

Table 5.4.4 Potential Environmental Effects, Effects Pathways and Measurable Parameters for the Marine Environment

Potential Environmental Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in Marine Populations	• Mortality (loss of individuals attributable to the Project). • Destruction or alteration of habitat as a result of disturbance of the marine environment during pipeline construction and watercourse crossing.	• Number of fish or marine mammals accidentally killed as a result of the Project. Underwater sound where increased levels could cause physical injury or mortality to fish and marine mammals. • Direct or temporary change in fish habitat in area (m^2), water quality (pH, dissolved oxygen (mg/L), temperature (°C), turbidity (NTU) and TSS), or sediment quality (including trace metals, PAHs, PCBs in mg/kg) measured against CCME aquatic and sediment quality Guidelines and *CEPA* DAS Guidelines.

Construction of marine-based infrastructure may affect marine habitat and the populations they support through a change in available substrate and size distribution, change in water and sediment quality, or change in the acoustic qualities of the marine environment. The process of installing pipelines (i.e., open cut and bottom lay) has an effect on the benthic environment; compared to other activities such as bottom trawling, anchoring, and dredging, the effects are reduced as they are not repetitive in nature.

During marine construction, fish may experience direct mortality or functional impairment, resulting in eventual mortality. Mortality may result from direct interaction with the components, including the pipeline. The placement of in-water infrastructure, including concrete mats (for the bottom lay option in the Strait of Canso) would have a direct impact on sessile or slow moving demersal fish and invertebrates as they would be unlikely to avoid construction activities within the footprint of marine infrastructure and would suffer mortality as a result of smothering or crushing.

Construction of the pipeline and associated works will include on-land clearing and site preparation at the shoreline. These activities, as well as routine operations such as vegetation maintenance, have the potential to lead to sedimentation, and run-off to enter the marine environment, potentially affecting marine water quality.

In-water marine activities in the Strait of Canso may also result in a change in sediment contaminant concentrations by disturbing contaminated sediments. The disturbance of sediment may temporarily increase the concentrations of TSS in the water column as well as temporarily elevate levels of contaminated sediment detected in the Strait of Canso assessment corridor. Suspended solids can reduce feeding and growth rates, and alters migration patterns of salmon in near-shore habitats (Robinson and Cuthbert 1996). Similarly, reduced feeding rates, avoidance behaviour and suffocation due to effects on gill function have been demonstrated in herring as a result of suspended sediments (Robinson and Cuthbert 1996). There may be indirect effects on fish through alterations within localized food web structures. The severity of the effect of suspended sediments increases as a function of sediment concentration and duration of exposure (Newcombe and Jensen 1996).

During the construction and operation phase, vessel noise will be concentrated in the area of the assessment corridor. The majority of anthropogenic sound in the marine environment generated through construction will originate from trenching, pipe laying and infilling as no pile driving or marine blasting is required. Although the specific sound levels or estimates are not available for the vessels that will be used, it is expected that the most continuous noise source during construction of the pipeline and associated works will be from tugs and barges. Some fish and marine mammals are more sensitive to sound above their hearing threshold and may be affected when exposed to high intensity sounds (Popper 2003) immediately adjacent to vessels or infilling activity. The sound emitted to the marine environment during construction activities could therefore temporarily reduce the quality of fish habitat in the PDA although this effect would be similar to that caused by existing vessel traffic in the Strait.

5.4.6 Mitigation

Several mitigation measures are recommended during the installation of the pipeline in the marine environment to reduce impacts on marine fish and fish habitat. Mitigation measures have been identified from DFO's *Measures to Avoid Harm to Fish and Fish Habitat* and will be incorporated, as required. These are related to timing, site selection, contaminant and spill management, erosion and sediment control, fish protection, and operation of machinery. Standard mitigation, including erosion and sedimentation control and pipe activities was included in Section 2.5.3. Table 5.4.5 outlines additional mitigation measures specific to the marine environment VC. Additional mitigation measures may be recommended under the *Fisheries Act* Authorization, if required.

Table 5.4.5 Mitigation for the Marine Environment

Effect	Mitigation
Change in Marine Populations	• The work will be conducted in proximity to an existing submarine pipeline corridor (Strait of Canso and Milford Haven River); this will likely limit the work to areas of previously disturbed marine habitat. • The work will be scheduled to the extent practicable to avoid periods of adverse weather (e.g., heavy wind or rain) or spring tides that may increase the transport of sediment (for the east crossing option for Milford Haven River if the open cut construction method is selected and if bottom laying is selected for the Strait of Canso). • Duration of in-water work will be managed to the shortest time practical. • An Erosion and Sediment Control Plan will be developed for the site that reduces risk of sedimentation to the marine environment. See Section 2.5.3 for general mitigation related to erosion and sediment control. • For installation of rip-rap along bottom lay sections of the pipeline, appropriately-sized rock will be used, and that rock will be installed at a similar slope to maintain a uniform bank/shoreline and natural shoreline alignment. • All rock material that will be used must be free of excessive fines, non-toxic material (i.e., free of fuel, oil, grease and other contaminants) from a provincially-approved, non-watercourse source, and approved for use in marine infilling projects. • Wherever possible, the machinery used will operate on land or above the high water mark or from a floating barge in a manner that reduces disturbance to the shoreline. • Machinery used on site will arrive in a clean condition free of fluid leaks, invasive species and noxious weeds. • HDD will be considered for pipeline installation if, and where, technically and economically suitable (i.e., given geophysical and geotechnical conditions, and safety, financial and practical constraints), HDD would reduce the environmental effect on marine habitatsMachinery will not access dunes, or coastal wetlands unless permitted. Such areas will not be used as staging areas. • All construction materials will be removed from site upon completion of construction. • Visual monitoring in the vicinity of Bear Paw to confirm that the turbidity is limited. If excessive change occurs in the turbidity that differs from the existing conditions of the surrounding water body (i.e., distinct colour difference) as a result of the activities, an investigation will be performed to determine root cause and accordingly revise and implement additional mitigation measures as needed. • Displaced substrate will be recovered to bury portions of the pipeline, wherever practical. • The implementation of timing windows to prevent harm during sensitive life stages will be considered for the open cut crossing method (such as during salmon run times) through consultation with DFO.

5.4.7 Residual Environmental Effects and Significance Determination

5.4.7.1 Change in Marine Populations

Residual Project-related environmental effects on the marine environment may occur during initial site preparation, the construction of marine watercourse pipeline crossings, and may occur during pipeline maintenance activities. At the Strait of Canso and Milford Haven River marine crossing locations for Bear Paw, habitat alteration and destruction will be avoided if either the HDD or micro tunneling construction methods are used.

Construction

Strait of Canso

The risk of mortality to fish will be increased through bottom lay construction methods for the pipeline and associated infrastructure at the Strait of Canso marine water crossing. This would occur within a highly localized area adjacent to existing marine infrastructure and areas of sediment deposition. The installation of concrete mats at the Strait of Canso may result in the direct loss of fish. However, serious harm to fish and mobile invertebrates, such as lobsters, crabs and shrimp, due to physical disturbances is unlikely, as these species are highly mobile and are typically able to avoid burial or crushing. Slow-moving and sessile invertebrates, such as sea stars and sea anemones, are the most vulnerable to harm from physical disturbances because they are unable to avoid burial or crushing. Setting of anchors to support the vessels involved with construction activities may also result in the mortality of sessile or slow moving demersal fish or invertebrates. An infilling of a previously altered and heavily disturbed site (such as the Cape Breton side of the Strait of Canso) may not be considered serious harm, particularly where the infill material can be re-colonized by benthic organisms.

Consideration of serious harm to CRA and supporting fish guides the potential requirement for an authorization under the *Fisheries Act.* Alteration of fish habitat must be considered permanent to require an authorization. Bottom lay construction at the Strait of Canso will result in a permanent alteration from a soft-bottomed benthic community to a hard-bottomed benthic community in the PDA, which will likely result in higher biodiversity of species and overall productivity. Therefore, this work should not result in serious harm to CRA species.

Elevated concentrations of suspended sediments associated with bottom lay pipeline construction will likely be localized within the footprint of marine activities. In particular, the weak currents in the Strait of Canso assessment corridor would limit the dispersion of re-suspended sediment, thereby reducing residual effects on marine populations. Once construction is complete, concentrations of TSS in the water column is expected to return to background levels. Analytical results of two sediment samples collected from the assessment corridor indicate exceedances above CCME Marine Sediment Quality Guidelines for PCBs and cadmium on the Cape Breton side of the Strait of Canso. Given the low baseline levels for all samples collected, there is a reduced risk of marine populations being exposed to acute or chronic toxicity of re-suspended sediments.

Initially, the construction phase is likely to result in a net loss of productivity of the marine environment (if the bottom lay method is used), including habitat-forming marine vegetation, with potential for residual adverse effects on fish species including those associated with CRA fisheries. The addition of material from bottom lay construction will result in the loss of benthic habitat in the footprint of the pipeline. The total area of lost benthic habitat in soft sediment as a result of the footprint of marine infrastructure will be offset by the creation of additional habitat on the hard infrastructure surfaces in the assessment corridor.

The loss and alteration of soft-bottom habitat due to bottom laying in the Strait of Canso may in turn result in the displacement of marine species, localized changes in species composition, a loss of breeding and foraging habitat, and a modification of predator-prey interactions. The total soft-bottom benthic habitat area lost due to the bottom lay option at the Strait of Canso is estimated to be 9,112 m^2. The total area of hard-bottom habitat created as a result of new infrastructure for the bottom lay option in the Strait of Canso is approximately 10,077 m^2, which is a net positive gain of 965 m^2 over the habitat lost.

Physical disturbances to the seabed are typically followed by a temporary reduction in species abundance, population density, and biomass of benthic organisms in the affected area (Gilkinson et al. 2005; Newell et al.1998). The vertical and benthic habitat created by new infrastructure including concrete mats and riprap for the bottom lay construction method in the Strait of Canso will also provide hard substrate for colonization of epiphytic marine organisms and macrophytes and will result in a change in benthic community assemblage in a localized area. Habitat-forming marine vegetation is expected to benefit from activities that increase availability of solid substrate within the photic zone since the substrate introduced with the bottom lay construction method is suitable for growth of kelps and other seaweeds and re-colonization by benthic invertebrates (Newell et al. 1998).

Numerous sessile organisms that do not exist on fine-grained sediment such as anemones, tunicates, sponges and other species will colonize the underwater structures. Marine seaweeds, which are important components of habitat for lobster and other commercially valuable marine organisms, will also quickly colonize the hard substrate of in-water structures. The re-colonization will attract other mobile species (e.g., fish) for feeding and refuge, ultimately creating a "reef effect", thereby increasing fish biomass (Stantec 2012b).

The recovery rate of benthic communities following cessation of physical disturbance to the seabed is highly variable and depends on the type of community affected and the extent to which the affected community is naturally adapted to sediment disturbance and suspended particle load. The impact of pipeline construction on the destruction and natural restoration of benthic invertebrate communities has been described by Lewis et al. (2002). The latter investigation noted that the re-colonization and restoration of benthic invertebrates in the impacted area occurred six months after pipeline construction.

The area immediately around installation of marine infrastructure, such as concrete mats and rip-rap, is subject to sound levels that would have the potential to cause physiological harm to fish. However, the brief period of in-water marine works, the localized area of potential environmental effects, and the ability of fish to actively move away from intense sounds reduce the risk of adverse effects on fish populations.

Milford Haven River

The risk of mortality to fish will be greater with the open cut pipeline construction method at the Milford haven River marine water crossing. This would occur within a highly localized area adjacent to areas previously disturbed for the installation of existing marine infrastructure. Backfilling for the open cut option at Milford Haven River may result in the direct loss of fish. However, serious harm to fish and mobile invertebrates, such as shellfish, due to physical disturbances is unlikely, as these species are highly mobile and are typically able to avoid burial or crushing. Slow-moving and sessile invertebrates, such as sea stars and sea anemones, are the most vulnerable to harm from physical disturbances because they are unable to avoid burial or crushing. Setting of anchors to support the vessels involved with construction activities may also result in the mortality of sessile or slow moving demersal fish or invertebrates. An infilling of a previously altered and heavily disturbed site may not be considered serious harm, particularly where the infill material can be re-colonized by benthic organisms.

Consideration of serious harm to CRA and supporting fish guides the potential requirement for an authorization under the *Fisheries Act.* Alteration must be considered permanent to require an authorization. Open cut construction at the Milford Haven River east water crossing option will result in a temporary alteration of fish habitat, that will be restored and species will be able to recolonize the PDA.

Water quality will be affected from the introduction or re-suspension of sediments in the water column resulting from excavation and backfilling required for the open cut method at the Milford Haven River east water crossing option. At elevated TSS concentrations or during extended periods of exposure, environmental effects of suspended sediments on fish can include: decreased feeding success, reduced ability to see and avoid predators, damaged gills, reduced growth rates, decreased resistance to disease or impaired development of embryos (Newcombe and Jensen 1996). Adult fish and highly mobile invertebrates typically avoid areas with elevated TSS levels and exposure durations are generally limited to minutes or hours (Newcombe and Jensen 1996; Wilber and Clarke 2001). Sessile invertebrates and the egg and larval stages of fish can tolerate exposure to elevated TSS levels for periods of three to four days (Wilber and Clarke 2001).

Elevated concentrations of suspended sediments associated with marine pipeline construction will likely be localized within the footprint of marine activities. The substrate at the east crossing at Milford Haven River is coarse which would also reduce the concentration of re-suspended material as a result of the open cut construction method. Once construction is complete, concentrations of TSS in the water column is expected to return to background levels.

Initially, the construction phase is likely to result in a net loss of productivity of the marine environment (if the open cut method is used), including habitat-forming marine vegetation, with potential for residual adverse effects on fish species including those associated with CRA fisheries.

There will be a temporary removal of fish habitat as a result of backfilling if the open cut construction method is selected for the eastern corridor crossing option for Milford Haven River. There is no anticipated disposal at sea of any construction material. At full build-out, the marine area lost due to the open cut method at the east Milford Haven River crossing is estimated to be between 700 m^2 and 2,000 m^2.

Physical disturbances to the seabed are typically followed by a temporary reduction in species abundance, population density, and biomass of benthic organisms in the affected area (Gilkinson et al. 2005; Newell et al.1998). The recovery rate of benthic communities following cessation of physical disturbance to the seabed is highly variable and depends on the type of community affected and the extent to which the affected community is naturally adapted to sediment disturbance and suspended particle load. The impact of pipeline construction on the destruction and natural restoration of benthic invertebrate communities has been described by Lewis et al. (2002). The latter investigation noted that the re-colonization and restoration of benthic invertebrates in the impacted area occurred six months after pipeline construction.

Re-colonization and restoration of the benthic habitat is likely to occur for the open cut pipeline construction method for the Milford Haven River east crossing option within no more than one to two years. It is noted that temporary habitat alterations are no longer subject to the provisions of Section 35(1) of the *Fisheries Act*; only permanent alteration or destruction of fish or fish habitat is subject to the Act.

The area immediately around installation of marine infrastructure is subject to sound levels that would have the potential to cause physiological harm to fish. However, the brief period of in-water marine works, the localized area of potential environmental effects, and the ability of fish to actively move away from intense sounds reduce the risk of adverse effects on fish populations.

Operation and Maintenance

Infrastructure inspection (e.g., ROV surveys of the pipeline) will occur as needed, likely on an annual schedule at the onset of operation and decreasing thereafter. Any increase in ship traffic related to maintenance of the pipeline will be negligible compared to current activity in the Strait of Canso. Noise emissions from vessels during operation activities may cause fish to move out of the affected areas close to the source; it is generally accepted, however, that low level underwater sound has little to no likelihood of causing any significant physical effects on marine fauna.

Summary of Change in Marine Populations

In summary, the Project has the potential to result in a change in marine populations, specifically with respect to fish mortality, benthic habitat, and water and sediment quality near the construction activities of the two marine pipeline crossings. Potential effects on the marine populations would occur only in those cases where bottom lay and open cut construction methods are used primarily. However, these effects will be reduced through implementation of mitigation such as those mitigation measures identified from DFO's *Measures to Avoid Harm to Fish and Fish Habitat*, where required. Potential effects would be localized and temporary and not result in changes to populations of marine organisms. Serious harm to CRA fish is also not anticipated. With the application of recommended mitigation, residual effects of the Project on marine populations are predicted to be not significant.

5.4.8 Monitoring and Follow-up

Visual monitoring of turbidity in the marine environment will be required in the vicinity of Bear Paw to confirm that the turbidity is limited during construction. If excessive change occurs in the turbidity that differs from the existing conditions in the surrounding water body as a result of the activities, an investigation will be performed to determine root cause and accordingly revise and implement additional mitigation measures as needed.

Follow-up work will include applicable permitting applications for the construction in or around waterbodies. These applications will be made to the required authorities such as NSE, NSDNR, and DFO. A Request for Review has been completed and submitted to DFO for the construction of marine pipeline crossings.

5.5 VEGETATION AND WETLANDS

Vegetation and wetlands is selected as a VC because of the potential for interactions between Bear Paw activities and vegetation and wetlands. Vegetation and wetlands have environmental, aesthetic, recreational, and socio-economic value to the people of Nova Scotia. This VC will focus on loss of wetland habitat and plant Species of Conservation Interest (SOCI). SOCI provide a gauge of the effects of a project on the vegetated environment due to the sensitivity of many of these plants to disturbance, and because of the intrinsic value of these plants and their habitats (vegetation communities) for biodiversity. SOCI are often associated with rare or unusual microsites.

Activities and components associated with construction and operation of Bear Paw have potential to interact with the environment in such a way that directly or indirectly adversely affects SOCI, wetland area and/or wetland function. The specialized mitigation prescribed in Section 5.5.6 will be implemented to reduce potential effects on vegetation and wetlands, in addition to the more generalized standard mitigation outlined in Section 2.5.3.

As explained in the assessment below, with the application of these mitigation measures, residual Project-related environmental effects on vegetation and wetlands are predicted to be localized (i.e., occurring primarily within an approximately 35 m wide RoW along the length of the new pipeline and at the location of the compressor station). Bear Paw is not expected to threaten the ability of SOCI or other plant species to exist over the long-term; Bear Paw activities will also be conducted in accordance with the provincial wetland policy. The assessment concludes that, with the application of the mitigation proposed herein, the residual environmental effects of Bear Paw on vegetation and wetlands are anticipated to be not significant.

The vegetation and wetlands VC is closely linked to other VCs, including Wildlife and Wildlife Habitat (Section 5.6), Land and Resource Use (Section 5.8), and Traditional Land and Resource Use (Section 5.7).

5.5.1 Regulatory and Policy Overview

SOCI are defined in this report to refer to plant species that are:

- listed under the Nova Scotia *Endangered Species Act* (NS *ESA*) or the federal *Species at Risk Act* (*SARA*) as being either *endangered*, *threatened*, *vulnerable*, or of *special concern* (i.e., Species at Risk or "SAR");
- not yet listed under provincial or federal legislations, but identified by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as being either *endangered*, *threatened*, or of *special concern*;
- listed by the Nova Scotia Department of Natural Resources (NSDNR 2014) to be *at risk*, *may be at risk*, or *sensitive* to human activities or natural events; or

- ranked as *S1*, *S2*, or *S3* by the Atlantic Canada Conservation Data Center (AC CDC 2014).

There are regulations under the provincial *Forest Act*, the *Wilderness Areas Protection Act* and the *Wildlife Act* that provide protection for some vegetation communities, either directly or indirectly. The regulatory framework relevant to the potential effects on vegetation and wetlands focuses specifically on SAR and wetland function.

Plant species that are protected federally under *SARA* are listed in Schedule 1 of the Act. The purpose of *SARA* is to protect SAR and their critical habitat. *SARA* is administered by Environment Canada, Parks Canada and the Department of Fisheries and Ocean (DFO). Those species listed as *endangered* or *threatened* in Schedule 2 or 3 of *SARA* may also be considered as SAR, pending regulatory consultation.

Certain plant species are also protected under the NS *ESA*. Species identified as seriously at risk of extinction in Nova Scotia are identified by a provincial status assessment process through the Nova Scotia Endangered Species Working Group. Once identified, they are protected under the NS *ESA*. The conservation and recovery of species assessed and legally listed under the NS *ESA* is coordinated by the Wildlife Division of the NSDNR. There is also a provincial General Status assessment process that serves as a first alert tool for identifying species in the province that are potentially at risk. Under this process, species are assigned to one of four categories that designate their population status in Nova Scotia. These include *secure, sensitive*, *may be at risk*, and *at risk*. Although species assessed under this process are not granted legislative protection, the presence of species ranked as *sensitive, may be at risk*, and *at risk* is an indication of concern by provincial regulators, as are those ranked as *S1, S2*, or *S3* by the AC CDC. The occurrence of rare plant species within wetlands is also of concern with respect to provincial wetland policy and the permitting process.

Wetlands in Nova Scotia are protected by the Nova Scotia *Environmental Act*, where "wetland" is defined as:

> *"…land commonly referred to as a marsh, swamp, fen or bog that either periodically or permanently has a water table at, near or above the land's surface or that is saturated with water, and sustains aquatic processes as indicated by the presence of poorly-drained soils, hydrophytic vegetation and biological activities adapted to wet conditions."*

The Nova Scotia Wetland Conservation Policy provides context to legislation, regulations and operational policies designed to protect and guide management of wetlands in Nova Scotia. Most importantly, the policy establishes a specific goal of no loss of Wetlands of Special Significance and no net loss in area and function for other wetlands. The government considers the following to be Wetlands of Special Significance (WSS) (NSE 2011a):

- all salt marshes;

- wetlands that are within or partially within a designated Ramsar site per the Ramsar Convention;
- Provincial Wildlife Management Area (Crown and Provincial lands only), Provincial Park, Nature Reserve, Wilderness Area or lands owned or legally protected by non-government charitable conservation land trusts;
- intact or restored wetlands that are project sites under the North American Waterfowl Management Plan and secured for conservation through the Nova Scotia Eastern Habitat Joint Venture;
- wetlands known to support at-risk species as designated under *SARA* or the NS *ESA*; and
- wetlands in designated protected water areas as described within Section 106 of the *Environment Act*.

Any project with the potential to alter a wetland (filling, draining, flooding or excavating), including direct and indirect effects, requires a Water Approval (for wetland alteration) from NSE, pursuant to the *Activities Designation Regulations* prior to starting the work. If alterations to a wetland exceed two hectares of an area, a project is also subject to registration under the *Environmental Assessment Regulations*.

Applications for a Water Approval for wetland alteration must be supported with details of the unavoidable nature of the proposed wetland alterations, the measures to reduce or compensate for wetland alteration, and the character and function of wetlands to be affected. These applications are evaluated in the context of the mitigation sequence: avoidance, minimization and compensation. Loss of wetland habitat, either through direct or indirect project effects, requires compensation to replace the wetland functions lost as a result of the wetland alterations. In this respect, area is used as a surrogate for function, and compensation is required as a ratio of the area lost.

Wetland conservation federally is directed by the Federal Policy on Wetland Conservation (Environment Canada 1991) which sets a conservation goal of no net loss of wetland function. This policy is applied to federal land or federal programs in areas where wetland loss has reached critical levels; it is not applicable to Bear Paw. There are no federal (terrestrial) lands crossed by Bear Paw.

5.5.2 Boundaries

5.5.2.1 Spatial Boundaries

The assessment of potential environmental effects on vegetation and wetlands encompasses three spatial boundaries: Project Development Area (PDA), Local Assessment Area (LAA), and Regional Assessment Area (RAA). The PDA is defined within Section 2.1. Spatial boundaries are presented below.

Local Assessment Area (LAA)

The LAA is the maximum area within which Project-related environmental effects can be predicted to occur or be measured with a reasonable degree of accuracy and confidence, and encompasses the likely zone of influence. For this VC, the LAA is the same as the assessment corridor, and is generally defined as a 100 m corridor centered on the pipeline centerline, though it is wider in many locations to accommodate certain construction activities (e.g., large water crossings) (Maps 1-21, Appendix E).

Regional Assessment Area (RAA)

The RAA includes the Eastern Shore, Eastern Interior, Mulgrave Plateau, and Cape Breton Coastal Ecodistricts as described in the *Ecological land Classification for Nova Scotia* (Neily et al. 2003). The RAA is used to provide context to the assessment of population effects on plant SOCI (Figure 5.5.1).

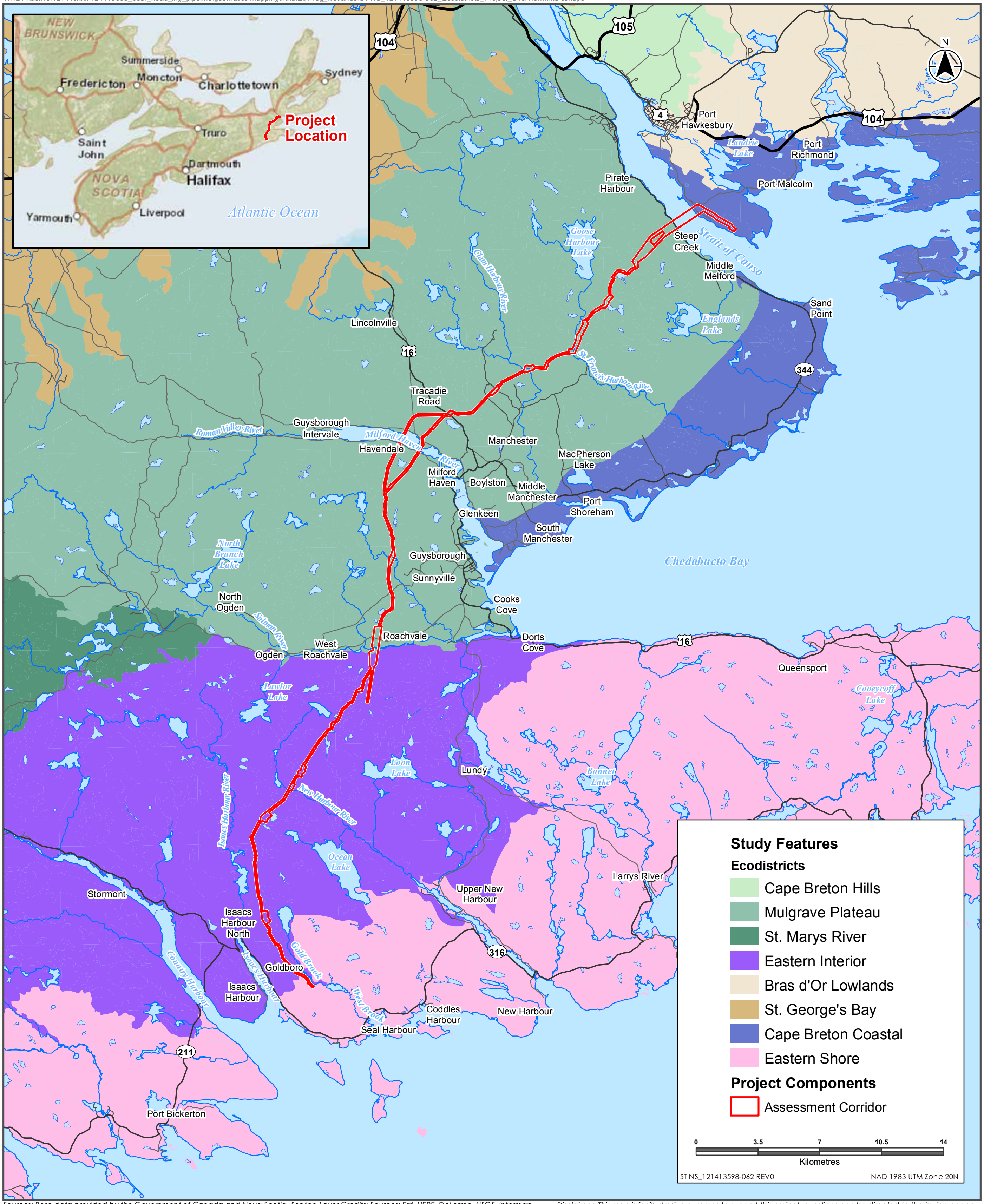
5.5.2.2 Temporal Boundaries

The temporal boundaries for the assessment of the potential environmental effects of Bear Paw on vegetation and wetlands include construction, and operation and maintenance. Construction is currently scheduled to begin in 2017 and continue over a period of two years. Operation will follow construction and continue for the life of Bear Paw.

5.5.3 Significance Definition

This assessment considers residual effects on vegetation and wetlands (i.e., after mitigation is implemented). A significant adverse residual environmental effect on vegetation and wetlands is defined as:

- one that results in a non-permitted contravention of any of the prohibitions stated in Sections 32-36 of the federal *SARA*, or in contravention of any of the prohibitions stated in Section 3 of the NS *ESA*;
- one that threatens the long-term sustainability of a plant species within the RAA; or
- one that results in an unauthorized permanent net loss of wetland area.



Sources: Base data provided by the Government of Canada and Nova Scotia. Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

Ecodistricts Crossed by Bear Paw

Bear Paw Pipeline

Stantec

BEAR PAW PIPELINE PROJECT

Figure 5.5.1

5.5.4 Description of Existing Conditions

5.5.4.1 Approach and Methods

Desktop Information Sources

Baseline vegetation and wetlands data for the LAA and surrounding area used to describe existing conditions include:

- AC CDC records of SOCI within 5 km of the Project (AC CDC 2015a);
- NSDNR forest data (NSDNR 2015a);
- NSDNR wetland data (NSDNR 2015b);
- wetlands of Special Significance (NSE 2013);
- high-resolution orthophotography (provided by Altus Geomatics);
- digital elevation models, including a digital surface model and a digital terrain model (created by Leading Edge, using LiDAR [Light Detecting and Ranging] data from Altus Geomatics); and
- NSDNR Boreal felt lichen habitat model (NSE 2010b).

These data were used in planning field surveys, analyzing field-collected data, and determining the potential presence of SOCI.

Field Surveys

Land within accessible portions of the LAA (i.e., crown land) was surveyed for plant SOCI, vegetation types, wetlands, and boreal felt lichen (*Erioderma pedicellatum*).

Plants surveys were conducted between September 9 and September 25, 2015; wetland surveys were completed between September 9 and November 4, 2015. All portions of the LAA on crown land were surveyed for vegetation and wetlands, except for two small isolated crown land properties that could not be accessed by a public RoW. Vegetation and wetland surveys were typically conducted concurrently; however, in order for vegetation surveys to be completed prior to heavy frost the latter were completed before the wetland surveys.

Floristic habitat sampling (described in Newmaster et al. 2005) was completed by meandering, throughout vegetation communities. Vegetation types present within the LAA were sampled; however, more survey effort was extended in habitats able to support SOCI known to occur in the RAA (AC CDC 2015a; JWEL 1998). Aerial imagery was consulted in the field to search for additional appropriate habitat for SOCI known to occur in the area. The location of the first encountered occurrence of all vascular plant species and all locations of SOCI were recorded. Details on the occurrence of any SOCI encountered, including population size and associated vegetation communities, were also recorded.

Areas meeting the definition of a wetland as outlined by Nova Scotia's *Environment Act* were delineated in the field following principles outlined by the US Army Corps of Engineers (1987) and classified according to the Canadian Wetland Classification System (CWCS; NWWG 1997). This system classifies wetlands to three levels: class, form/subform, and type. The wetland class places a wetland into one of five categories based on the overall nature of the wetland environment, such as whether the wetland soils are primarily mineral or organic (i.e., peat), their association with groundwater, and whether or not they are dominated by woody plants over 1 m in height. Wetland classes include bog, fen, swamp, marsh, and shallow water. Form and subform indicate the physical morphology and hydrological characteristics of the wetland. Wetland type distinguishes wetland communities based on one of eight groups of dominant vegetation (NWWG 1997). Geographic coordinates were recorded for wetland boundaries.

Information on the functional characteristics of wetlands in the LAA was obtained during field surveys using a simplified variation of the NovaWET method developed by NSE (2011b). An example of this form is shown in Appendix E. The full NovaWET method consists of a field component and a desktop component of analysis for each wetland. The approach focused on collecting information that is obtained through a site visit, such as dominant species and the potential for the wetland to provide habitat for SAR or other SOCI. These preliminary forms will contribute to full NovaWET assessments for each wetland to be disturbed as a part of permitting prior to construction. Field surveys for these functional assessments were conducted for wetlands that were considered to have potential to be affected by the construction (hereafter referred to as the "assessed wetlands"). The actual number of wetlands affected will be lower than those assessed pending the final arrangement of the PDA. Data collected during field surveys were used to determine whether the wetlands in the LAA provided key hydrogeological, water quality and wildlife-related functions, as well as their social value, and to evaluate their importance. This information will assist in positioning the final PDA in such a way as to reduce effects on wetlands within the constraints of design and other environmental and social considerations.

Vegetation descriptions were recorded for new or distinct habitats encountered during surveys. These descriptions included the dominant species in each of three strata: tree, shrub and ground vegetation. Trees are defined as tree species greater than 5 cm in diameter at breast height (DBH). Shrubs are tree species less than 5 cm DBH, or woody vegetation greater than 50 cm in height. Ground vegetation species are defined as woody plants less than 50 cm in height, or non-woody species.

The provincial boreal felt lichen model (NSE 2010b) indicated the potential for boreal felt lichen habitat within the LAA. Targeted boreal felt lichen surveys were conducted on October 6 and 7, 2015. Areas identified by the province's model on crown land were visited by experienced lichenologists to evaluate the appropriateness of the habitat to support boreal felt lichen and document the occurrence of this species and other cyanolichens.

Analysis

Wetlands within non-surveyed portions of the LAA (i.e., private land) were mapped and classified using high-resolution orthophotography and digital elevation models, including a digital surface model (i.e., a representation of the earth surface including objects on it, such as vegetation) and a digital terrain model (i.e., a representation of the earth surface without any objects, i.e., bare earth). The dominant wetland class (and for swamps, type) according to the CWCS was identified for the interpreted wetlands; the results are presented in Section 5.5.4.2.3.

For non-wetland areas within the LAA, data from the NSDNR forest inventory (NSDNR 2015a) were used to classify forest stands into several land cover classes, including hardwood, mixedwood, and softwood forest vegetation types of four age classes: regeneration-young, immature-pole, mature-overmature, and uneven. Other, non-wetland, non-forest land cover classes include: barren, beach, corridor (i.e., linear RoW features), open water, other non-forest, and urban/industrial.

The dominant species in the vegetation community descriptions, including those collected in wetlands as part of the functional assessment, were run through a dichotomous key within the Forest Ecosystem Classification (FEC) document (Neily et al. 2011). This exercise was completed to identify the FEC vegetation types present within surveyed areas of the LAA. Within the FEC document, vegetation types are nested in broader Forest Groups. FEC descriptions are also region-specific, based on the most dominant and abundant species recorded during field site descriptions (i.e., FEC type descriptions presented in this document differ slightly from FEC type descriptions in the FEC document). Plant community descriptions follows nomenclature used by the AC CDC (2014) and do not necessarily conform to that use in the FEC manual.

5.5.4.2 Summary of Existing Conditions

Ecological Land Classification

The majority of Bear Paw falls within the Eastern Interior Ecodistrict of the Eastern Ecoregion and the Mulgrave Plateau Ecodistrict of the Nova Scotia Uplands Ecoregion, as described by the *Ecological Land classification for Nova Scotia* (Neily et al. 2003). However, the southern and northern limits of Bear Paw extend into the Atlantic Coastal Ecoregion, including the Eastern Shore Ecodistrict in the south and the Cape Breton Coastal Ecodistrict in the north (Figure 5.5.1).

<u>Eastern Ecoregion</u>

The Eastern Interior Ecodistrict is within the Eastern Ecoregion, which is characterized as a south sloping upland interior that has relatively warm summers and cool winters (Neily et al. 2003). The ecodistrict has an undulating to gently rolling topography and is removed from the immediate climatic influence of the Atlantic Ocean. The dominant natural disturbances affecting the forests within the ecodistrict are wildfires and hurricanes, but the effects of forest management practices are pronounced (Neily et al. 2003). Forest stands within the Eastern Interior Ecodistrict are predominantly coniferous, with red spruce (*Picea rubens*) prominent in relatively well-drained areas, and black spruce (*Picea mariana*) dominating stands with poorly-drained soils. However, the natural forest composition throughout the ecodistrict is varied and reflects the depth of the soil profile and other factors (Neily et al. 2003). For example, shade-intolerant hardwoods such as red maple (*Acer rubrum*) and paper birch (*Betula papyrifera*), along with scattered white pine (*Pinus strobus*) and an understory dominated by ericaceous shrubs, are prominent on shallow soils. Shade-tolerant species, including eastern hemlock (*Tsuga canadensis*) and American beech (*Fagus grandifolia*), may be found on deeper, well-drained sites such as those located on the crests and upper slopes of hills or drumlins (Neily et al. 2003).

Nova Scotia Uplands Ecoregion

The Mulgrave Plateau Ecodistrict is within the Nova Scotia Uplands Ecoregion, which is characterized by warm summers and long cold winters (Neily et al. 2003). The Mulgrave Plateau is comprised of extensive areas of imperfectly-drained level to hummocky topography. The steep slopes of this ecodistrict are well-drained and support a mixture of tolerant hardwoods and softwoods. Wetter areas are dominated by black spruce and red maple, whereas tolerant hardwoods, red spruce and white pine occur on relatively well-drained soils. Where drumlins are found, red maple and yellow birch (*Betula alleghaniensis*) are often dominant and sugar maple (*Acer saccharum*) is scattered on the lower slopes. Red spruce and hemlock are often prevalent in sheltered ravines and along streams and steep slopes. Balsam fir (*Abies balsamea*) usually regenerates on the better-drained land and much of the area is used for Christmas tree production (Neily et al. 2003). The ecodistrict is bordered by the waters of the Strait of Canso and because this area is subject to strong coastal winds, forests within this area of the ecodistrict are often similar to those within the Atlantic Coastal Ecoregion. Hardwood forests within the Uplands Ecoregion are typically of uneven age as a result of gap disturbances caused by insects, disease, blowdown, old age, or physical damage due to wind, snow, ice, or lightning. Stand-level disturbances due to fire, insect, and blowdown are common in association with the softwood forests of this ecoregion, and result in even-aged forests (Neily et al. 2003).

Atlantic Coastal Ecoregion

The Atlantic Coastal Ecoregion comprises a relatively narrow swath along the coastline of the Atlantic and its vegetation and climate are strongly influenced by this location (Neily et al. 2003). The most notable influence is that the ecoregion has the longest frost-free period in the Maritimes. It experiences the mildest winters in the province, but has relatively cool springs and the lowest number of growing degree days. As a result of the moderating effect of the ocean, this ecoregion receives most of its precipitation as rainfall. The area is exposed to high winds, high humidity, salt spray and fog during the summer and fall. It experiences considerable variation in yearly weather patterns because of ocean currents (Neily et al. 2003). Unlike most of the province, red spruce is largely absent from this ecoregion, but white spruce (*Picea glauca*) is common in close proximity to exposed coastal features. Hardwood species comprise a relatively minor component of the coastal forests, but red maple and paper birch are common understory elements in stands otherwise dominated by black spruce and balsam fir. Most of the ecoregion is susceptible to windthrow, and the area has experienced significant forest losses from hurricanes (Neily et al. 2003).

The dominant forest of the Cape Breton Coastal Ecodistrict is formed by a mix of white spruce, balsam fir and black spruce (Neily et al. 2003). Red maple and paper birch dominate the hardwood component of the coastal forests, but some stands of tolerant hardwood are present on drumlins. Wind plays an important role in the structure and successional development of these forests by being a primary cause of both stand level and small gap disturbances (Neily et al. 2003).

The forests of the Eastern Shore Ecodistrict are primarily coniferous and dominated by balsam fir and black spruce (Neily et al. 2003). Balsam fir dominates in relatively sheltered sites with deeper soil. Although white spruce is typically scattered within the forests of this ecodistrict, it is dominant in areas having high coastal exposure. Hardwoods typically do not dominate the overstory, but paper birch and red maple are often present (Neily et al. 2003). Forests within this ecodistrict are typically short-lived (usually less than 100 years) and stand initiating disturbances from blowdown, disease, insects and occasional fires is ongoing. Because the moist climate is conducive to regeneration establishment, most stands have a well-developed understory of balsam fir and black spruce prior to disturbance (Neily et al. 2003).

Upland Vegetation Types

Forests dominate the land cover classes within the LAA, accounting for approximately 71.1% of the area (Table 5.5.1). The majority of forests within the LAA are softwood, and the immature-pole and regeneration-young age classes are particularly abundant (14.9% and 11.6%, respectively). Wetlands, discussed further in Section 5.5.4.2.3, make up 18.2% of the LAA, and are primarily treed swamps. Several non-forested, non-wetland land cover classes are also found within the LAA, including barren (described in Section 5.5.4.2.2), beach (i.e., rocky, sandy, or gravelly coastal areas), corridor (i.e., existing linear developments including pipeline RoWs), open water (i.e., lakes and larger rivers), other non-forest (i.e., additional non-forested, non-wetland areas that do not fit into other categories), and urban/industrial (i.e., developed lands, including gravel pits).

Table 5.5.1 Land Cover Class Area (ha) and Percent within the LAA

Land Cover Class		LAA	
		Area (ha)	Percent (%)
Forest	Regeneration-Young Unknown	91.1	8.3
	Regeneration-Young Mixedwood	49.4	4.5
	Regeneration-Young Softwood	128.0	11.6
	Immature-Pole Hardwood	78.0	7.1
	Immature-Pole Mixedwood	57.7	5.2
	Immature-Pole Softwood	164.5	14.9
	Mature-Overmature Hardwood	25.4	2.3
	Mature-Overmature Mixedwood	48.8	4.4
	Mature-Overmature Softwood	29.7	2.7
	Uneven Hardwood	2.0	0.2
	Uneven Mixedwood	16.3	1.5
	Uneven Softwood	48.7	4.4
	Forest Other	45.1	4.1
	Forest (total)	784.7	71.2
Wetland	Bog	13.4	1.2
	Treed Bog	6.4	0.6
	Fen	2.5	0.2
	Marsh	0.5	0.05
	Shallow Water	0.3	0.03
	Shrub Swamp	24.8	2.3
	Hardwood Treed Swamp	4.9	0.4
	Mixedwood Treed Swamp	33.5	3.0
	Softwood Treed Swamp	112.9	10.2
	Wetland (total)	199.2	18.1
Other	Barren	2.7	0.2
	Beach	0.1	0.01
	Corridor	25.6	2.3
	Open Water	77.5	7.0
	Other Non-Forest	0.5	0.05
	Urban/Industrial	11.9	1.1
Total		**1,102.2**	**100.0**

Note:
Data for upland areas from NSDNR. Data for wetlands derived from field surveys and interpretation, as described in Sections 5.5.4.1.2 and 5.5.4.1.3.

Upland vegetation types are discussed below by overarching forest type (i.e., hardwood, mixedwood, and softwood). Within each subsection, forest types are described in relation to the FEC Vegetation Types observed during field surveys.

<u>Hardwood Forest</u>

Intolerant Hardwood Forest Group

The Intolerant Hardwood Forest Group is mainly associated with the early stages of forest succession following stand level disturbances such as forest harvesting, wind throw or fire. Most of these stands are dominated by relatively short-lived species, and in the absence of disturbance they are quickly replaced by longer-lived shade tolerant species. Many tree species such as red maple, paper birch and heart-leaved birch (*Betula papyrifera var. cordifolia*) stump sprout prolifically following severe disturbances allowing them to persist for long periods when disturbance events are frequent. Two Intolerant Hardwood Forest Group vegetation types are present in the LAA: White birch-Red maple/Sarsaparilla-Bracken (IH6) and Red maple/Hay-scented fern-Wood sorrel (IH7). FEC types are further described in Appendix E.

Tolerant Hardwood Forest Group

The Tolerant Hardwood Forest Group is composed of forest stands dominated by shade tolerant deciduous tree species. Coniferous species may occur as scattered trees in the canopy, although in some stands dense patches of balsam fir and red spruce regeneration may be present in the shrub understory. The ground vegetation layer is characterized by an abundant growth of fern species. These stands are generally found on rich, well-drained soils, although they may be encountered over a variety of soil fertility and drainage conditions. Tolerant Hardwood Forest vegetation types are often found on the tops and upper slopes of hills. Three Tolerant Hardwood vegetation types were encountered in the LAA: Sugar maple/Hay-scented fern (TH1), Sugar maple/New York fern-Northern beech fern (TH2) and Red maple-Yellow birch/Striped maple (TH8). The Beech variant (TH1a) variant of the Sugar maple/Hay-scented fern (TH1) is also present in the LAA (Appendix E). In Nova Scotia, these Tolerant Hardwood vegetation types are associated with sites with relatively low fertility.

Mixedwood Forest

The Mixedwood Forest Group is represented by two vegetation types: Red spruce-Red maple-White birch/Goldthread (MW2) and Balsam fir-Red maple/Wood sorrel-Goldthread (MW4) (Appendix E). These vegetation types occur on a variety of moisture conditions ranging from well-drained to poorly-drained. Both of these vegetation types are generally found on infertile sites.

Softwood Forest

Spruce-Hemlock Forest Group

Vegetation types within the Spruce-Hemlock Forest Group are characterized by stands dominated by tolerant softwood species. In the LAA, red spruce and balsam fir are the species that typically dominate the tree layer of these vegetation types. The shrub layer is typically poorly developed and composed mainly of advanced regeneration of the overstory tree species, primarily balsam fir. The ground vegetation layer is characterized by a well-developed carpet of mosses and liverworts with small amounts of herbs characteristic of conifer stands. In the LAA, stands of this forest group are typically found on relatively infertile sites and in various moisture regimes ranging from mesic to imperfectly-drained. Two vegetation types belonging to the Spruce Hemlock Forest Group were encountered: Red spruce-Balsam fir/Stair-step moss-Sphagnum moss (SH6) and Balsam fir/Wood fern/Schreber's moss (SH8) vegetation types (Appendix E).

Spruce-Pine Forest Group

The Spruce-Pine Forest Group is typically associated with stony sites with shallow infertile soils. The vegetation types of this forest group that were encountered in the LAA include the Black spruce/Lambkill/Bracken (SP5), Black spruce-Red maple/Bracken-Sarsaparilla (SP6), and Black spruce/False Holly/Ladies'-tresses sphagnum (SP7) (Appendix E). These vegetation types are found in a wide range of moisture levels from dry to moist. Stands within this forest group typically have relatively open tree canopies and moderately dense to dense shrub understories composed of a mixture of regenerating tree species and shrubs tolerant of infertile conditions.

Coastal Forest Group

The Coastal Forest Group is generally restricted to a band along the coast that is exposed to cool moist conditions, high winds and salt spray. These conditions lead to the establishment of forest stands that are similar in species composition to boreal forest stands. In the LAA, the Coastal Forest Group was restricted to the southern end of Bear Paw near the existing gas plant site. The Black spruce-Balsam fir/Foxberry/Plume moss (CO1) is the only Coastal Forest Group vegetation type observed (Appendix E). Other Coastal Forest Group vegetation types may be present along the shores of the Strait of Canso; however, these areas are on private lands and could not be sampled during the 2015 field season.

Old Field Forest Group

The Old Field Forest Group occurs on sites that have been cleared for agriculture in the past. Following abandonment of these agricultural lands, forest stands dominated by coniferous tree species including white spruce, tamarack, balsam fir, and white pine develop on these sites. The tree canopies are typically dense and the understory of these stands is typically sparse and composed of a needle carpet or a patchy moss carpet. These stands can be found in a variety of nutrient and moisture regimes. One Old Field Forest Group vegetation type, the White spruce/Aster-Goldenrod/Shaggy moss (OF1), was encountered within the LAA (Appendix E).

Other Upland Habitat

Open Woodland Group

The Open Woodland Group occurs on sites with thin soils or exposed bedrock, very low fertility, and dry conditions. The severe growing conditions limit tree growth and favor the growth of dwarf heath plants that are tolerant of low soil fertility and dry conditions. These conditions also favor the growth of lichens. The physiognomy of these vegetation types is quite distinctive and is characterized by a very open tree canopy, a dense low shrub canopy and patches of reindeer lichens (*Cladonia* spp.) growing in areas where soils are thinnest. Black spruce/Lambkill/Reindeer moss (OW2) is the only Open Woodland vegetation type recorded in the LAA (Appendix E).

Wetland Vegetation Types

Wetlands in the LAA have been subdivided into five groups based on the Canadian Wetland Classification System (NWWG 1997). These groups include swamp, bog, marsh, fen, and shallow water wetland. There is some cross-over between the FEC System and the Canadian Wetland Classification System. Forested wetlands have been included in the FEC System, and correspond to treed swamps in the Canadian Wetland Classification System. For the purposes of the EA report, forested wetlands have been classified using the FEC System.

Swamps

Swamps are mineral wetlands or peatlands with standing water or water flowing slowly through pools or channels (NWWG1997). The water table is generally at or near the surface of the swamp. There is internal water movement from the margin of the swamp or from other sources of mineral enriched waters. If peat is present, it consists mainly of well decomposed wood, underlain at times by sedge peat. The vegetation typically consists of a dense cover of trees or shrubs, herbs and some mosses. Both treed and shrub-dominated swamps are present in the LAA. Softwood Treed Swamps correspond to the Wet Coniferous Forest FEC Group, and both Mixedwood Treed Swamps and Hardwood Treed Swamps fall into the Wet Deciduous Forest FEC Group.

Softwood Treed Swamp (Wet Coniferous Forest Group)

The wet Coniferous Forest Group is found on infertile poorly-drained sites, often in depressions or at the toe of slopes. It occurs throughout the LAA and is particularly prevalent in areas with low rolling topography. In the LAA, the vegetation types associated with the Wet Coniferous Forest Group are characterized by a relatively open tree canopy underlain by a nearly continuous carpet of sphagnum moss. Most stands are underlain by a thin layer of peat. All of the stands classified into the Wet Coniferous Forest Group were also classified as treed swamp - softwood. Four Wet Coniferous Forest vegetation types were encountered within the LAA: Black spruce/Cinnamon fern/Sphagnum (WC1), Black spruce/Lambkill-Labrador tea/Sphagnum (WC2), Balsam fir/Cinnamon fern-Three seeded sedge/Sphagnum (WC6), and Tamarack-Black spruce/Lambkill/Sphagnum (WC7) (Appendix E).

Mixedwood Treed Swamp and Hardwood Treed Swamp (Wet Deciduous Forest Group)

The Wet Deciduous Forest Group vegetation types are situated in depressions or near the bases of slopes where water is at or near the soil surface. In the LAA, these sites have low fertility but are not as infertile as the Wet Coniferous Forest Group vegetation types. Two vegetation types belonging to the Wet Deciduous Forest Group were identified: Red maple/Cinnamon fern/Sphagnum (WD2), which is also classed as hardwood treed swamp wetland type, and Red maple-Balsam fir/Wood aster/Sphagnum moss (WD6), which is classed as mixedwood treed swamp wetland type (Appendix E).

Shrub Swamps

The Shrub Swamp Group is characterized by a very sparse tree overstory combined with a dense shrub layer and a well-developed sphagnum moss carpet. Three Shrub Swamp vegetation types are present in the LAA, including Low Shrub Swamp (LSS), Oligotrophic Tall Shrub Swamp (OTS) and Mesotrophic Tall Shrub Swamp (MTS).

Low Shrub Swamp (LSS)

The LSS vegetation type is characterized by a dense shrub canopy composed of dwarf shrubs, the most abundant of which are leatherleaf (*Chamaedaphne calyculata*), sheep laurel, rhodora, and common Labrador tea (*Ledum groenlandicum*). Tree cover is very sparse and consists of scattered black spruce and tamarack. Stunted black spruce are relatively common in the shrub layer. Sphagnum moss is the dominant species of the ground vegetation layer, forming a nearly continuous carpet. Other common species in the ground vegetation layer include bunchberry, small cranberry (*Vaccinium oxycoccos*) and cottongrass (*Eriophorum virginicum* and *E. vaginatum*). The LSS vegetation type is uncommon in the LAA and is generally restricted to areas adjacent to stillwaters and the swampy margins of lakes and ponds.

Oligotrophic Tall Shrub Swamp (OTS)

The OTS vegetation type is associated with infertile sites that are too wet to support forested wetland. These sites have often had their hydrology adversely affected by beaver impoundment or human activities such as road or pipeline construction. This has resulted in heavy mortality of the tree overstory, which is slow to recover. The tree layer typically consists of scattered black spruce and tamarack. The shrub layer is moderately dense and consists of a mixture of tall and dwarf shrub species as well as stunted black spruce. The most abundant shrub species include northern wild raisin, rhodora and common Labrador tea. The ground vegetation layer consists of a sphagnum moss mat that is punctuated by three-seeded sedge, reindeer lichen and bunchberry.

Mesotrophic Tall Shrub Swamp (MTS)

The MTS vegetation type is found on sites that are more fertile than those where the OTS vegetation type is found. Tree cover consists of scattered black spruce and balsam fir and the shrub layer is composed of a dense cover of speckled alder. The ground vegetation layer is lush, consisting of multiple layers including a sphagnum moss mat, a grass sward composed of bluejoint reed grass (*Calamagrostis canadensis*) and manna grass (*Glyceria* spp.), and large ferns including cinnamon fern and sensitive fern (*Onoclea sensibilis*).

Bogs

Bogs are peatlands that have the water table at or near the peat surface. The bog surface is virtually unaffected by nutrient enriched groundwater from the surrounding mineral soils. As such, bogs are typically acidic and nutrient deficient. The dominant substrates of bogs are weakly to moderately decomposed sphagnum and woody peat that may occasionally be underlain by peat derived from sedges. Bogs may be treed or treeless and are usually occupied by various species of sphagnum moss and ericaceous shrubs (NWWG 1997). Treed Bog (TB) and Low Shrub Bog (LSB) vegetation types are present in the LAA. The LAA passes through a landscape where bogs are common; however, few bogs are present in the LAA. This is likely because Bear Paw parallels an existing pipeline, whose route was optimized to avoid large peatlands such as bogs.

Low Shrub Bog (LSB)

Tree cover is absent in the LSB vegetation type and shrub cover is patchy. The most abundant shrub species include sheep laurel, northern wild raisin, common juniper (*Juniperus communis*), pale bog laurel (*Kalmia polifolia*) and stunted tamarack. The bog surface is hummocky and relatively dry. The most abundant species include sphagnum moss, reindeer lichens, northern bog goldenrod (*Solidago uliginosa*), tufted clubrush (*Trichophorum caespitosum*) and tussock sedge (*Carex stricta*).

Treed Bog (TB)

The TB vegetation type is often found around the periphery of the LSB vegetation type. The tree canopy is open and consists of stunted tamarack and black spruce. Stunted black spruce and tamarack also form a substantial part of the well-developed shrub layer. Other common species of the shrub layer include common Labrador tea, mountain holly and sheep laurel. The ground vegetation consists largely of a hummocky moss mat composed of sphagnum moss and redstemmed feather moss. Bunchberry, three-seeded sedge and cinnamon fern are common species of the ground vegetation layer.

Fens

Fens are peatlands in which the water table is located at or just below the surface. The waters are generally nutrient and mineral enriched and derived from groundwater (NWWG1997). The vegetation of fens is characterized by the presence of sedges, grasses, reeds and brown mosses. A sparse cover of shrubs and occasionally trees may also be present. Fens in the LAA are infertile and are similar to the LSB vegetation type in regards to vegetation structure and species composition. One fen vegetation type is present in the LAA.

Fen Vegetation Type (FN)

Tree cover is absent in the FN vegetation type. The shrub layer is moderately dense and composed of a mixture of sweet gale (*Myrica gale*), leatherleaf, speckled alder and stunted tamarack. Bog rosemary (*Andromeda polifolia*) is abundant in fens located on lake shores, but is absent elsewhere. The infertility of fens in the LAA is reflected in the presence of sphagnum moss mats in all of the sampled fens, rather than brown moss. Sedges are the most abundant vascular plants in the sampled fens. The sedge species composition varies substantially between sites. The most abundant sedge species are coastal sedge (*Carex exilis*), slender sedge (*C.lasiocarpa*)and tussock sedge. Other common ground vegetation species include northern pitcher plant (*Sarracenia purpurea*), white beak rush (*Rhynchospora alba*) and Pickering's reed grass (*Calamagrostis pickeringii*).

Marshes

Marshes are typically mineral wetlands that are periodically inundated by standing or slow flowing water whose levels generally fluctuate seasonally. During drier periods, declining water levels may expose areas of matted vegetation and mud flats. The surface waters of marshes are typically rich in nutrients. Although their substrate is usually mineral material, well decomposed peat may occasionally be present. Marshes typically display zones or surface patterns consisting of pools or channels interspersed with patches of emergent vegetation, bordering wet meadows and peripheral bands of shrubs and trees. Marshes are uncommon in the LAA and most occur as a result of disturbance and hydrological modifications, caused by beavers or human activities, to forested swamps. These disturbed wetlands have a mixture of features characteristic of both swamps and marshes. Many of these disturbed wetlands may revert to swamps once hydrological conditions stabilize and tree and shrub cover re-establishes. Two Marsh vegetation types are present in the LAA: Basin Marsh (BM) and Riparian Marsh (RM).

Basin Marsh (BM)

The BM vegetation type includes the disturbed forested swamps. Alteration of wetland hydrology has resulted in heavy tree mortality, eliminating the tree overstory. The shrub layer is also adversely affected by the altered hydrology and is very sparse. The most abundant shrub species include balsam fir and black spruce regeneration as well as speckled alder. The ground vegetation layer can be quite variable between sites. Sphagnum moss, Canada manna grass (*Glyceria canadensis*) and sedges are present in most marshes and other species such as broad-leaved cattail (*Typha latifolia*) and common woolly bulrush (*Scirpus cyperinus*) are less frequent, but are often dominant when present.

Riparian Marsh (RM)

The RM vegetation type is found along the shores of larger rivers in the LAA. They are inundated during periods of high water and are exposed during much of the growing season. The seasonal flooding and scouring by water and ice result in an absence of tree cover and very low shrub cover. Shrub cover consists mainly of speckled alder, white meadowsweet and red raspberry. Ground vegetation cover varies depending on the degree of scouring. The most abundant species include bluejoint reed grass, lenticular sedge (*Carex lenticularis*), hairy flat-top white aster (*Doellingeria umbellata*), rough-stemmed goldenrod (*Solidago rugosa*) and royal fern (*Osmunda regalis*).

Shallow Water

Shallow Water Wetlands are transitional between wetlands that are saturated and/or seasonally wet and permanent deep water bodies. To be classed as a Shallow Water Wetland, an area must contain more than 75% open water that is less than 2 m deep. Shallow Water Wetlands may occur in lakes and ponds as well as along slow flowing portions of rivers. Shallow Water Wetland is uncommon in the LAA and is associated mainly with shallow near shore areas of lakes including Carters Lake and West Lake, and slow flowing areas of rivers such as the Salmon River and New Harbor River. One Shallow Water Wetland vegetation type is present in the LAA.

Shallow Water Wetland (SWW)

The vegetation of Shallow Water Wetlands in the LAA consists of a mixture of submerged and emergent aquatic plants. Species composition varies substantially by site. Species that are common and occur frequently include white buttons (*Eriocaulon aquaticum*), pickerelweed (*Pontederia cordata*) and bayonet rush (*Juncus militaris*).

Wetland Functions and Values

Wetland functions and values, including hydrological, water quality, ecological and socioeconomic, are described for each wetland class (and for combination of class and dominant vegetation type for swamps) in Table 5.5.2, along with other notes on their hydrological character.

The province (NSE 2013) does not identify any Wetlands of Special Significance (WSS) within the LAA. Wetlands of Special Significance may be identified however, as a result of the presence of SAR and lands that have been designated for future protection by the province, as described in Section 5.6. Many of the wetlands within the LAA are known to historically support SAR (JWEL 1998) or have potential to provide habitat for wildlife SAR, including moose (*Alces americanus*), olive-sided flycatcher (*Contopus cooperi*), Canada warbler (*Wilsonia canadensis*) and rusty blackbird (*Euphagus carolinus*).

Table 5.5.2 Functions, Values, and Hydrological Character of Wetland Classes (and Type, for Swamps) Surveyed in the LAA

Wetland Class (Type)	Percent of All Wetlands in the LAA -Surveyed and Interpreted1 (%)	Percent of LAA (%)	Wetland Function Categories			
			Hydrological	Water Quality	Ecological	Socioeconomic, Recreational, or Scientific Values in the LAA
Hardwood Treed Swamp	2.5	0.4	These tend to have peat accumulation suggesting stable hydrology, have evidence of groundwater input, and tend to be in defined basins that drain at the lower end. They likely play an important role in moderating flow and contributing baseflow to down-gradient watercourses.	While these wetlands show obvious signs of groundwater input, they are nutrient poor and do not process a large volume of water; only representing a small proportion of wetlands in the LAA.	These wetlands typically have a low to moderate amount of plant diversity, but tend to have well developed shrub layers and may provide browse for white-tailed deer (*Odocoileus virginianus*) and breeding habitat for Canada Warbler.	The wetlands are an important component of deer habitat but there was not any obvious evidence of human use.
Mixedwood Treed Swamp	16.8	3.0	These wetlands typically show some evidence of groundwater input along changes in topography but are also fed by surface water and precipitation. They may play a minor role in baseflow provision and flow regulation in down-gradient watercourses.	Water pH tends to be low (i.e., acidic), but not as acidic as softwood dominated swamps. Low pH has a negative effect on the productivity of downflow streams.	These wetlands typically offer a moderate amount of plant diversity but tend to have well developed shrub layers and may provide browse for deer and habitat for Canada warbler.	The wetlands are an important component of deer habitat but there was not any obvious evidence of human use.

Table 5.5.2 Functions, Values, and Hydrological Character of Wetland Classes (and Type, for Swamps) Surveyed in the LAA

Wetland Class (Type)	Percent of All Wetlands in the LAA -Surveyed and Interpreted1 (%)	Percent of LAA (%)	Wetland Function Categories			
			Hydrological	Water Quality	Ecological	Socioeconomic, Recreational, or Scientific Values in the LAA
Softwood Treed Swamp	56.7	10.2	Effective at sublimating snowfall directly on coniferous foliage in winter and mitigating spring thaws so that peak run-off periods are spread out over wider timeframes. They are areas of throughflow discharge but their lack of deeper groundwater inputs limits their ability to provide baseflow to down-flow watercourses under the driest conditions.	Typically large and flat, they allow rainwater to percolate slowly toward watercourses; they filter water, but the acidic soils lower pH of water in down-gradient watercourses.	Important habitat for wintering deer and a variety of other wildlife species because of snowfall sublimation ability. Plant diversity is generally low. Historically, these wetlands near the LAA have been documented to support a variety of SOCI, including yellow bellied flycatcher (*Empidonax flaviventris*), boreal chickadee (*Poecile hudsonica*), ruby crowned kinglet (*Regulus calendula*), Canada warbler, olive-sided flycatcher (*Contopus cooperi*), pine grosbeak (*Pinicola enucleato*), rusty blackbird, and four-toed salamander (*Hemidactylium scutatum*), and moose.[1]	Some are managed for timber, but productivity is low. There is little evidence of human use.

Table 5.5.2 Functions, Values, and Hydrological Character of Wetland Classes (and Type, for Swamps) Surveyed in the LAA

Wetland Class (Type)	Percent of All Wetlands in the LAA -Surveyed and Interpreted1 (%)	Percent of LAA (%)	Wetland Function Categories			
			Hydrological	Water Quality	Ecological	Socioeconomic, Recreational, or Scientific Values in the LAA
Shrub Swamp	12.4	2.3	These wetlands have a wide range of hydrological conditions, but typically have low groundwater inputs and most often occur in oligotrophic conditions. They tend to have capacity to hold excess surface water and can regulate peak flows.	These wetlands are typically acidic and do little to improve water quality in watercourses except that they can establish quickly after disturbance and provide filtration and shade in riparian situations.	Tall shrub wetlands typically have low diversity, although swamps dominated by alders are more diverse. This wetland type is historically known to support wildlife SOCI such as Canada warbler and ruby-crowned kinglet in the vicinity of the LAA.[2]	There were no obvious signs of social use of these wetlands.
Bog (incl. Treed Bog)	9.9	1.8	Bogs do not typically receive groundwater or surface water inputs but are primarily maintained through precipitation. Through the slow release of their water, they provide baseflow to streams.	Runoff from bogs is typically very acidic and does not improve water quality in watercourses.	Bogs contain plant species that are not found in other habitats. The combination of open water, herbaceous and shrub communities provides habitat to a variety of wildlife. Historically, these wetlands near the LAA are known to support a variety of SOCI, including yellow bellied flycatcher, boreal chickadee, ruby crowned kinglet,	Bogs have potential to support berry harvests and some evidence of ATV use was documented.

Table 5.5.2 Functions, Values, and Hydrological Character of Wetland Classes (and Type, for Swamps) Surveyed in the LAA

Wetland Class (Type)	Percent of All Wetlands in the LAA -Surveyed and Interpreted1 (%)	Percent of LAA (%)	Wetland Function Categories			
			Hydrological	Water Quality	Ecological	Socioeconomic, Recreational, or Scientific Values in the LAA
					Canada warbler, olive-sided flycatcher, pine grosbeak, and moose.[1]	
Fen	1.3	0.2	Fens in the LAA have obvious groundwater inputs, but the water is not nutrient rich. These wetlands contribute to base-flow maintenance of watercourses but may play only a minor role in retention and regulating watercourse flow due to their permanent state of positive water balance.	Heavily fed by groundwater, fens supply a steady and substantial flow of clean water to receiving watercourses. The water is not nutrient rich and may be acidic, as noted by the bog-like vegetation communities.	Contain plant species that are not found in other habitats, including Newfoundland dwarf birch. The combination of open water, herbaceous and shrub communities provide diverse habitat for a variety of species. These fens have low plant diversity compared to those found in other regions, but represent relatively diverse communities compared to other vegetation types in the LAA.	Possible hunting opportunities for waterfowl in some areas. No obvious evidence of such use noted.
Marsh	0.3	0.05	Uncommon in the LAA, these are typically associated with waterbodies and have little influence of the hydrology on the greater system. They are	In riparian situations they can retain quantities of suspended sediment. They can negatively affect surface water temperature by	While marshes are often associated with high species diversity, those in the LAA tend to be simple, post-disturbance communities such as	Possible hunting opportunities for waterfowl in some areas. No obvious evidence of such use noted.

Table 5.5.2 Functions, Values, and Hydrological Character of Wetland Classes (and Type, for Swamps) Surveyed in the LAA

Wetland Class (Type)	Percent of All Wetlands in the LAA -Surveyed and Interpreted1 (%)	Percent of LAA (%)	Wetland Function Categories			
			Hydrological	Water Quality	Ecological	Socioeconomic, Recreational, or Scientific Values in the LAA
			often formed as a byproduct of beaver activity in the LAA.	contributing to slight increases during times of peak flow.	found in old beaver ponds that are dominated by blue-joint reed grass. They may provide important habitat for fish, aquatic invertebrates and a variety of birds.	
Shallow Water	0.2	0.03	These wetlands have little effect on the hydrology of the lacustrine systems that they fringe, but they can reduce damaging wave energy near the shores.	These wetlands have a minor warming effect on adjacent waterbodies. Aquatic vegetation can increase dissolved oxygen levels in the water and reduce the presence of metals and other potential toxins.	Emergent plants such as white buttons, pickerelweed and bayonet rush provide shelter and important habitat for small fish, amphibians and invertebrates which support higher trophic levels of the lacustrine ecosystem. Shallow water wetlands also have potential to provide important summer foraging and thermoregulation habitat for moose.	Possible canoeing, angling and hunting opportunities for waterfowl in some areas. There was evidence of use of Carters Lake and West Lake for recreation.

Notes:

1 Within the LAA, only wetlands on crown lands were field surveyed.

2 From Jacques Whitford Environment Limited 1998

Species of Conservation Interest

The potential for plant SOCI to occur within the LAA was evaluated through available desktop information; actual occurrences were noted from the results of the field surveys on crown lands.

AC CDC Records within 5 km of the Project

An AC CDC data search indicates that within a 5 km buffer of the LAA, 16 SOCI have been recorded (AC CDC 2015a); these are briefly described below. Thirteen of these species are vascular plant SOCI, and three are lichen SOCI, including two SAR: boreal felt lichen – Atlantic population (ranked as *endangered* by COSEWIC, *SARA*, and NS *ESA*), and blue felt lichen (*Degelia plumbea*, ranked as *special concern* by COSEWIC and *vulnerable* by NS *ESA*, but with no *SARA* status or schedule) (Table 5.5.3).

Table 5.5.3 AC CDC Vascular Plant and Lichen Records within 5 km of the Project[1]

Scientific Name	Common Name	AC CDC S-Rank[2]	NSDNR General Status Rank
Vascular Plants			
Asplenium trichomanes	maidenhair spleenwort	S3	Secure
Dryopteris fragrans var. remotiuscula	fragrant wood fern	S2	Sensitive
Eriophorum gracile	slender cottongrass	S2	Sensitive
Geocaulon lividum	northern comandra	S3	Secure
Hypericum dissimulatum	disguised St John's-wort	S2S3	Sensitive
Listera australis	southern twayblade	S3	Secure
Montia fontana	water blinks	S1	May be at Risk
Platanthera hookeri	hooker's orchid	S3	Secure
Salix pellita	satiny willow	S2S3	Sensitive
Scrophularia lanceolata	lance-leaved figwort	S1	Undetermined
Senecio pseudoarnica	seabeach ragwort	S2	Sensitive
Sparganium hyperboreum	northern burred	S1S2	Sensitive
Suaeda maritima ssp. richii	white sea-blite	S1	Undetermined
Lichens			
Erioderma pedicellatum (Atlantic pop.)	boreal felt lichen - Atlantic pop.	S1S2	At Risk
Degelia plumbea	blue felt lichen	S2	Secure
Peltigera collina	tree pelt lichen	S2S3	Sensitive

Notes:

1 Data from AC CDC 2015a

2 S1 = critically imperiled, S2 = imperiled, S3 = vulnerable(AC CDC 2015b)

Maidenhair spleenwort (*Asplenium trichomanes*) is a small, tufted fern found on damp, shaded cliffs, and along talus slopes, typically on acidic rock such as granite and basalt, or sandstone (Munro et al. 2014). This species is listed as *secure* by NSDNR (2014) and considered vulnerable (*S3*) by the AC CDC (2014). Considering its habitat requirements, maidenhair spleenwort is unlikely to occur within the LAA.

Fragrant wood fern (*Dryopteris fragrans var. remotiuscula*) is a small, glandular fern that grows on dry, overhanging cliffs and in crevices along water (Munro et al. 2014). This species is listed as *sensitive* by NSDNR (2014) and considered imperiled (*S2*) by the AC CDC (2014). Considering its habitat requirements, fragrant wood fern is unlikely to occur within the LAA.

Slender cottongrass (*Eriophorum gracile*) is a narrow-stemmed graminoid found in wet, boggy peat and along wet shorelines (Munro et al. 2014). This species is listed as *sensitive* by NSDNR (2014) and considered imperiled (*S2*) by the AC CDC (2014). Potentially appropriate habitat for slender cottongrass is present in the LAA.

Northern comandra (*Geocaulon lividum*) is a small, inconspicuous plant. This species is listed as *secure* by NSDNR (2014) and considered vulnerable (*S3*) by the AC CDC (2014). Northern comandra was found within the LAA during the vegetation surveys and is discussed further below.

Disguised St. John's-wort (*Hypericum dissimulatum*), a species which closely resembles the more common Canada St John's-wort (*H. canadense*), is found in lacustrine habitats, in wet, mucky soils (Munro et al. 2014). This species is listed as *sensitive* by NSDNR (2014) and considered imperiled to vulnerable (*S2S3*) by the AC CDC (2014). Considering its habitat requirements, disguised St. John's-wort is unlikely to occur within the LAA.

Southern twayblade (*Listera australis*) is a small, inconspicuous, two-leaved plant of bogs or coniferous treed swamps. Its flowers, which are necessary for proper identification, are typically only present for a short time in June (Munro et al. 2014). This species is listed as *secure* by NSDNR (2014) and considered vulnerable (*S3*) by the AC CDC (2014). Southern twayblade is likely to be present within the LAA and is known to occur near Carters Lake (JWEL 1998).

Water blinks (*Montia fontana*) is a small, creeping plant that occurs on coastal springy or seepy slopes, or along coastal wet shores and brackish spots (Munro et al. 2014). This species is listed as *may be at risk* by NSDNR (2014) and considered critically imperiled (*S1*) by the AC CDC (2014). Water blinks has some potential to be found within the LAA, particularly near the Strait of Canso.

Hooker's orchid (*Platanthera hookeri*) is one of only two round-leaved species in this genus, which is found in open dry forests, typically in mixedwood, under conifers (Munro et al. 2014). This species is listed as *secure* by NSDNR (2014) and is considered vulnerable (*S3*) by the AC CDC (2014). Hooker's orchid has potential to be found within dry forests within the LAA, such as near West Lake.

Satiny willow (*Salix pellita*) is a lanceolate-leaved shrub or small tree that grows in riparian areas (Munro et al. 2014). This species is listed as *sensitive* by NSDNR (2014) and considered imperiled to vulnerable (*S2S3*) by the AC CDC (2014). There is potential for this species to be found within the LAA, in areas such as Salmon River, Clam Harbour River and St. Francis Harbour River.

Lance-leaved figwort (*Scrophularia lanceolata*) is a large, conspicuous plant with broad leaves, growing up to 2 m in height. It occurs in dry soils in open woods or dry thickets (Munro et al. 2014). This species is listed as *undetermined* by NSDNR (2014) and considered critically imperiled (*S1*) by the AC CDC (2014). There is potential for lance-leaved figwort to occur in various locations within the LAA.

Seabeach ragwort (*Senecio pseudoarnica*) is a stout, tomentose plant found on gravelly, bouldery, or cobbley seashores (Munro et al. 2014). This species is listed as *sensitive* by NSDNR (2014) and considered imperiled (*S2*) by the AC CDC (2014). There is potential for seabeach ragwort to be found in several locations within the LAA, including the banks of the Strait of Canso and along Milford Haven River.

Northern burreed (*Sparganium hyperboreum*) is the smallest burreed found in Nova Scotia, and occurs in peaty pools, within bogs (Munro et al. 2014). This species is listed as *sensitive* by NSDNR (2014) and considered critically imperiled to imperiled (*S1S2*) by the AC CDC (2014). There is some potential for northern burreed to occur in the LAA, such as within the dome bog near Carters Lake.

White sea-blite (*Suaeda maritima ssp. richii*) is a succulent halophite that inhabits salt marshes and seashores (Munro et al. 2014). This species is listed as *undetermined* by NSDNR (2014) and considered critically imperiled (*S1*) by the AC CDC (2014). There is some potential for white sea-blite to be found with the LAA along the shores of Milford Haven River, or at the Strait of Canso, although no salt marsh was noted in the area.

Boreal felt lichen – Atlantic population is a foliose lichen that is typically 2 cm to 5 cm in diameter, but can grow to widths of 10 cm or even 12 cm. The thallus colour can range from bluish grey to dark grey or greyish brown and the undersides, often upturned on the margins, are white. This species typically occurs on the trunks or branches of balsam fir in moist and cool forests where sphagnum mosses and cinnamon fern occurs (COSEWIC 2002). Boreal felt lichen – Atlantic population is a SAR, ranked *endangered* by COSEWIC, *SARA*, and NS *ESA*. It is also listed as *at risk* by NSDNR (2014) and considered critically imperiled to imperiled (*S1S2*) by the AC CDC (2014). As described in Section 5.5.4.1.2, this species was the focus of targeted surveys.

Blue felt lichen is a foliose lichen that is typically 5 cm in diameter, but can grow to widths of more than 10 cm. This species has a blue-grey thallus, often dotted with red-brown sexual reproductive structures. Blue felt lichen is typically found on mature to over-mature coarse-barked trees in wet areas relatively free of air pollution (COSEWIC 2010b). Blue felt lichen is a

SAR, ranked *special concern* by COSEWIC and *vulnerable* by NS *ESA*. It is also listed as *at risk* by NSDNR (2014) and considered critically imperiled to imperiled (*S1S2*) by the AC CDC (2014).

Tree pelt lichen (*Peltigera collina*) is a lichen that was found within the LAA during the 2015 surveys and is further discussed below.

Field Survey SOCI Observations

During field surveys completed in the fall of 2015, 379 species of vascular plants were observed (Appendix E), of which, eight were SOCI (Table 5.5.4). Seven vascular plant SOCI were encountered in the LAA, including: Newfoundland dwarf birch (*Betula michauxii*), halberd-leaved tearthumb (*Polygonum arifolium*), Nova Scotia agalinis (*Agalinis neoscotica*), woodland agrimony (*Agrimonia gryposepala*), running serviceberry (*Amelanchier stolonifera*), northern comandra, and Sitka clubmoss (*Lycopodium sitchense*) (Table 5.5.4). One lichen SOCI, tree pelt lichen, was observed in the LAA. Boreal felt lichen – Atlantic population, was not observed during targeted surveys.

Table 5.5.4 Vascular Plant and Lichen SOCI Observed within the LAA

Scientific Name	Common Name	AC CDC S-Rank[1]	NSDNR General Status Rank
Vascular Plants			
Betula michauxii	Newfoundland dwarf birch	S2	Sensitive
Polygonum arifolium	Halberd-leaved tearthumb	S2	Sensitive
Agalinis neoscotica	Nova Scotia agalinis	S3	Secure
Agrimonia gryposepala	woodland agrimony	S3	Secure
Amelanchier stolonifera	running serviceberry	S3?	Secure
Geocaulon lividum	northern comandra	S3	Secure
Lycopodium sitchense	Sitka clubmoss	S3?	Secure
Lichens			
Peltigera collina	tree pelt lichen	S2S3	Sensitive

Note:
[1] S1 = critically imperiled, S2 = imperiled, S3 = vulnerable(AC CDC 2015b)

Newfoundland dwarf birch is a low shrub that is found in peatlands. This species is common in northern Quebec, Newfoundland and Labrador and reaches its southern limits of distribution in Nova Scotia. Newfoundland dwarf birch is listed as *sensitive* by the NSDNR (2014) and considered imperiled (*S2*) by the AC CDC (2014).

In the LAA, Newfoundland dwarf birch was found in the large Gold Brook wetland complex near the SOEP Gas Plant between KP 0.0 and 0.5 (Map 1, Appendix E). At this location, Newfoundland dwarf birch was found in the Fen Wetland Vegetation Type. The fen where it was found was characterized by a sphagnum moss mat that was punctuated by a variety of graminoids and forbs including slender sedge, three-seeded sedge, Pickering's reed grass and northern pitcher plant. The shrub layer of the fen was composed of a mixture of leatherleaf, speckled alder, sweet gale and stunted tamarack. Approximately 30 patches of Newfoundland dwarf birch were found within the portion of the wetland located within the LAA. Each patch was on average approximately 1 m in diameter. This species has been recorded at several locations in the general vicinity of the proposed pipeline. Several thousand plants were found in a bog located approximately 200 m west of the existing pipeline near Northeast Branch Lake (KP 17.0) (JWEL 1998). Another population has been reported approximately 300 m east of KP 0.0 in a bog that forms part of the Gold Brook wetland complex (M. Crowell pers. com. 2015). It is likely that other populations of Newfoundland dwarf birch are present within the Gold Brook wetland complex.

Halberd-leaved tearthumb is listed as a *sensitive* species by NSDNR (2014) and is considered imperiled (*S2*) by the AC CDC (2014). This species is an annual, typically found in rich swamps, mostly under alders (Gleason and Cronquist 1991; Zinck 1998). It was encountered at one location along the pipeline LAA – at the edge of a marsh at KP 26.8 (Map 9, Appendix E). This marsh was formerly a forested swamp. The hydrology of the swamp had been altered by a combination of past pipeline construction and beaver activity. These alterations appear to have led to increased nutrient levels and productivity, as the altered wetlands supported plant species indicative of more mesotrophic conditions, compared to other surveyed wetlands within the LAA. The presence of this species was unexpected because it is typically found in wetlands more fertile than the majority of those encountered in the LAA. The altered wetland in which the halberd-leaved tearthumb was found currently has no tree cover and a sparse shrub layer composed of speckled alder, red raspberry and seedlings of balsam fir and black spruce. The ground vegetation is composed mainly of sphagnum moss, Canada manna grass, American bur-reed (*Sparganium americanum*), Canada rush (*Juncus canadensis*) and creeping bentgrass (*Agrostis stolonifera*). Halberd-leaved tearthumb has not been previously recorded near the LAA and is unlikely to be elsewhere in the immediate vicinity of Bear Paw given its habitat requirements.

Nova Scotia agalinis is a vascular plant species endemic to Nova Scotia. The Nova Scotia population is ranked as *secure* by NSDNR (2014) and vulnerable (*S3*) by the AC CDC (2014). Nova Scotia agalinis is typically found in moist acidic disturbed areas such as ditches and wood roads where competition with other species is low. It is found mostly in coastal areas in the southern part of the province (Zinck 1998). Nova Scotia agalinis was recorded at one location in the LAA, at the edge of the Eight Mile Lake Road at KP 6.3, where one plant was reported (Map 3, Appendix E). It was associated with a variety of plants including poverty oatgrass (*Danthonia spicata*), downy goldenrod (*Solidago puberula*), wild strawberry (*Fragaria virginiana*) and black knapweed (*Centaurea nigra*). Nova Scotia agalinis was noted at a number of disturbed sites outside of the LAA, suggesting that it is well established in the general area.

The Nova Scotia population of woodland agrimony is considered to be *secure* by NSDNR (2014) and vulnerable (*S3*) by the AC CDC (AC CDC 2014). Woodland agrimony is generally found in thickets, the margins of rich woods, intervals, and on slopes. It is typically associated with fertile sites (Zinck 1998). Two woodland agrimony plants were found on the left bank of the Clam Harbor River near KP 44.5 (Map 16, Appendix E). They were found in a narrow flood plain along the edge of the river at the base of a steep slope and were associated with several other plant species indicative of fertile conditions including zigzag goldenrod (*Solidago flexicaulis*) and Maryland sanicle (*Sanicula marilandica*). Woodland agrimony is unlikely to be widely distributed within the LAA but may be expected to occur at other locations along the Clam Harbor River as well as other larger rivers such as the St. Francis Harbor River and Salmon River.

Northern comandra is a hemiparasitic plant that is typically associated with sterile soils and damp sands in acid or peaty locations (Zinck 1998). The Nova Scotia population of northern comandra is considered by to be *secure* by NSDNR (2014) and vulnerable (*S3*) by the AC CDC (2014). All northern comandra plants recorded in the LAA were found in association with the Black spruce/Lambkill/Reindeer Moss (OW2) vegetation type, which is part of the Open Woodland Forest Group. The OW2 vegetation type was typically associated with areas of bedrock outcropping. The tree canopy was very sparse and was composed of scattered patches of black spruce and tamarack. Patches of stunted black spruce were also an important component of the shrub layer. The black spruce tended to occur in lower lying areas with better soil development and available moisture. Areas with thinner soil were occupied by a dense mixture of shrubs including northern wild raisin, rhodora, sheep laurel, and mountain holly. Areas with virtually no soil development were occupied by a carpet of reindeer lichen (*Cladina spp.*). Other common ground vegetation species included bunchberry, creeping snowberry, sphagnum moss and stiff clubmoss.

Northern comandra was recorded in the LAA at three locations (Maps 18, 19 and 21, Appendix E). The largest number of northern comandra shoots was found approximately 200 m southwest of Carters Lake at KP 52.7. A total of 337 shoots were recorded at this location. The second largest population was found approximately 700 m northeast of Carters Lake between KP 54.4 and 55.0, where 203 shoots were recorded. The third population consisted of only three shoots and was found at KP 51.0, approximately 200 m northwest of West Lake. Northern comandra has historically been recorded at a number of locations in the general vicinity of the LAA, including four populations recorded in the vicinity of Carters Lake (JWEL 1998). One small population is present in a bog near the SOEP Gas Plant and a second small population has been found near Port Hawkesbury (M. Crowell pers. com. 2015).

Running serviceberry is a shrub species that is generally found in sandy areas, rocky barren ground and boggy depressions (Zinck 1998). It is listed as *secure* in Nova Scotia by NSDNR (2014) and as *S3?* by the AC CDC (2014), indicating that the species is vulnerable in Nova Scotia, but its population status is poorly understood (AC CDC 2015b). This is attributable to the fact that species of the genus *Amelanchier* are difficult to identify and frequently hybridize. Running serviceberry was encountered at two locations in the LAA (Maps 18 and 19, Appendix E). One plant was found approximately 200 m southwest of Carters Lake at KP 52.7. A second plant was found approximately 700 m northeast of Carters Lake at KP 54.5. Running serviceberry was found in the same Black spruce/Lambkill/Reindeer moss (OW2, i.e., barren) vegetation type that northern comandra was found in. There are no other known running serviceberry sites in the general vicinity of the LAA. However, a review of recent aerial imagery revealed the presence of potentially suitable habitat to the west and east of Carters Lake.

Sitka clubmoss is typically found in alpine and sub-alpine barrens and wooded slopes in northern Nova Scotia (Zinck 1998). It is listed as *secure* in Nova Scotia by NSDNR (2014) and as *S3?* by the AC CDC (2014) indicating that the species is vulnerable in Nova Scotia but its population status is poorly understood (AC CDC 2015b). Sitka clubmoss was encountered at two locations in the LAA (Maps 18 and 19, Appendix E). A cluster of 12 plants was found approximately 200 m southwest of Carters Lake at KP 52.7. A second group of three plants was found approximately 700 m northeast of Carters Lake at KP 54.5. Sitka clubmoss was also found in the Black spruce/Lambkill/Reindeer moss (OW2, i.e., barren) vegetation type that northern comandra was found in. Although no other populations are known from the general vicinity of the LAA, the presence of more OW2 vegetation type outside of the LAA in the Carters Lake area would suggest that other populations of Sitka clubmoss are present nearby.

Tree pelt lichen is a foliose lichen with broad lobes and a grey to brownish grey or dark brown thallus that is smooth or slightly crusty (Brodo et al. 2001). This species is listed as *sensitive* in Nova Scotia by NSDNR (2014) and as *S2S3* by the AC CDC (2014) indicating that it is imperiled to vulnerable in Nova Scotia (AC CDC 2015b). Tree pelt lichen occurs most commonly on tree trunks and branches among mosses, and less frequently on mossy rocks (Brodo et al. 2001). This species was observed within the LAA on a white ash tree, within a mixedwood treed swamp (Maps 1 and 18, Appendix E).

5.5.5 Potential Environmental Effects and Project-Related Interactions

Activities and components could potentially interact with vegetation and wetlands and result in changes to SOCI populations, vegetation communities, wetland area and wetland function. The assessment of Project-related environmental effects on vegetation and wetlands is therefore focused on the following potential effects:

- change in SOCI; and
- change in wetland area or function.

The effect pathways and measurable parameters for the assessment of these effects are provided in Table 5.5.5.

Table 5.5.5 Potential Environmental Effects, Effects Pathways and Measurable Parameters for Vegetation and Wetlands

Potential Environmental Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in SOCI	• Vegetation clearing and ground disturbance within the PDA may result in direct (e.g., physical disturbance) and indirect (e.g., hydrological changes to habitats) effects on plant SOCI.	• Changes to vascular plant or lichen SAR or SOCI (number of individuals or populations).
Change in Wetland Area or Function	• Vegetation clearing and ground disturbance within the PDA during construction, and vegetation maintenance during operation and maintenance may change wetland area or function, either directly due to disturbance, or indirectly due to changes in hydrology.	• Loss of wetland area (ha).

5.5.5.1 Change in Species of Conservation Interest

Field surveys have identified SOCI in the LAA. Construction may result in the direct loss of some plant SOCI individuals or populations through physical disturbance. There is also potential for indirect effects to SOCI if the hydrology of wetlands within or adjacent to the PDA are altered, or sedimentation and erosion occurs in areas with SOCI.

Vegetation management will occur during the operation and maintenance phase of and could affect SOCI populations if they become established in the RoW after construction. However, many of the SOCI that would tend to populate the RoW during operation would typically be associated with disturbed or early-successional vegetation communities and their presence therefore benefit from periodic vegetation management initiatives. Operation of the compressor station will not result in an interaction with SOCI because associated activities will be restricted to the boundaries of the industrial site and permanent access roads.

5.5.5.2 Change in Wetland Area or Function

While avoidance of wetlands will be a priority during detailed routing, construction will result in the temporary direct disturbance of wetlands. Alteration of WSS could occur as a result of interactions with lands where SAR occur. Progressive rehabilitation practices will focus on restoring topography, hydrology and vegetation in disturbed wetland areas where practicable, to reduce permanent loss.

There is some additional potential for effects on wetlands outside the PDA, which would not typically result in a loss of wetland area, but rather a change in the wetland vegetation community. Operation of the compressor station will not result in an interaction with wetlands because associated activities will be restricted to the boundaries of the industrial site and permanent access roads.

5.5.6 Mitigation

Mitigation to reduce the environmental effects of the Project on vegetation and wetlands are identified in Table 5.5.6. Standard mitigation (Section 2.5.3) and measures identified in Sections 5.2 and 5.6 to reduce effects on aquatic resources and wildlife and wildlife habitat will also act to reduce effects on vegetation and wetlands. The use of some mitigation will be determined on a site-by-site basis in consideration of local concerns and conditions to provide the most effective mitigation. Locations for site-specific mitigation will be outlined in the EPP following detailed routing and in consultation with the appropriate regulatory authorities in consideration of the following criteria:

- rarity, status, or function of SOCI or wetland under consideration;
- ecology of SOCI under consideration;
- hydrological conditions of wetland under consideration;
- location of SOCI or wetland relative to the PDA;
- alternatives to current design;
- temporary or permanent mitigation; and
- public or landowner support (e.g., existing use/ownership).

Table 5.5.6 Mitigation for Vegetation and Wetlands

Effect	Mitigation
Change in SOCI	• Reduce physical disturbance to SOCI through detailed routing during detailed engineering. • Develop mitigation plans for unavoidable effects on SOCI in consultation with regulators. Mitigation may include collecting, propagating or transplanting seeds or live plants. • Use snow fencing and signage in areas of SOCI to protect plant occurrences near disturbance activities. If protecting the occurrence is not practical, temporarily cover the site with snow (given the season), geofabric and padding, flex net, swamp mats, or equivalent. • Inform users of access restrictions in the vicinity of fenced sites. • Restrict the general application of herbicide near SOCI. Spot spraying, wicking, mowing, or hand-picking are acceptable measures for integrated vegetation management in these areas. • If agreements can be reached, use the existing pipeline RoW for temporarily storing topsoil and subsoil. • Reduce grading in native vegetation communities. • Install cross ditches and berms on moderately steep and steep slopes in non-agricultural areas to prevent runoff along the RoW and subsequent erosion.

Table 5.5.6 Mitigation for Vegetation and Wetlands

Effect	Mitigation
	• In areas with native vegetation, allow for natural regeneration, or seed as directed by the appropriate Land Administrator on Crown lands. Natural recovery is the preferred method of reclamation on level terrain where erosion is not expected. Where appropriate, natural regeneration may be supplemented with seed harvested from the area, or through the salvage and transplantation of sod and plants. • Use bio-stabilization measures such as willow staking and erosion control blankets to reclaim riparian areas, as appropriate. • Where practical, leave stumps in place, particularly on stream banks, to provide surface stability. • All equipment must arrive at the site clean and free of soil or vegetative debris. Equipment will be inspected by the Environmental Inspector(s), or designate.
Change in Wetland Area or Function	• Reduce physical disturbance to wetlands through detailed routing during detailed engineering. • Progressive rehabilitation practices will focus on restoring topography, hydrology and vegetation in disturbed wetland areas where practicable, to reduce permanent loss. • Reduce the removal of vegetation in wetlands to the extent possible. • Conduct ground level cutting, mowing and mulching of wetland vegetation instead of grubbing, wherever practical. • Salvage and store wetland organic layer separately from upland topsoil. • Direct grading away from wetlands. • Reduce grading within wetlands. • Do not use wetlands as temporary workspaces, unless required for site-specific purposes. • When working on saturated soils during non-frozen ground conditions to reduce compaction and admixing, use equipment and techniques that distribute ground pressure (e.g., swamp mats, geofabric and padding, corduroy). • Use ditch plugs or similar water control structures in the trench at either end of wetland crossings where there is the potential of water migration along the trench. • Replace trench material as soon as practicable, and re-establish preconstruction contours within wetland boundary to re-establish drainage patterns. • Install berms, cross ditches, or silt fences between wetlands and disturbed areas when deemed necessary by the Environmental Inspector(s). • Use natural re-vegetation for wetlands. • Per NSE requirements, compensate for residual losses of wetland area in the PDAthrough the enhancement, restoration, or creation of wetland habitat, as may be arranged through agreement with a third party wetland compensation provider.

5.5.7 Residual Environmental Effects and Significance Determination

The Project has the potential to result in a loss of wetlands and SOCI; however, with implementation of mitigation listed in Section 5.5.6., effects on vegetation and wetlands are expected to be temporary and potentially reversible except where SOCI and wetlands fall within the footprint of the compressor station and permanent access roads. In such areas, there will permanent loss of SOCI and wetlands.

Avoidance and mitigation will be completed to the extent feasible; however, effects on vegetation and wetlands may still occur because of the uncertainty of success of reclamation techniques, and unforeseen natural events or processes. Predicted effects on SOCI and wetlands during operation may result from vegetation management.

5.5.7.1 Change in SOCI

Construction

Vegetation clearing, grading and trenching activities during construction have the potential to result in direct loss of SOCI. Vegetation disturbance during construction will primarily occur within an approximately 35 m wide RoW along the length of the new build pipeline and at the location of the compressor station. Areas within the PDA of the compressor station will experience long-term vegetation and wetland loss. The duration of disturbance to vegetation and wetlands within the PDA will vary depending on existing habitat (e.g., forested or non-forested). SOCI populations that have potential to be adversely affected by construction include Newfoundland dwarf birch, halberd-leaved tearthumb, woodland agrimony, running serviceberry, northern comandra and Sitka clubmoss. Although SOCI within the PDA would be disturbed during construction, the final PDA is likely to avoid many of the occurrences.

Dwarf birch was only found in one location, in an acidic fen near the southern end. If the position of the final PDA does not avoid these records, it is unlikely that the individuals lost will recover within the RoW following construction. The remaining locations for this species in the wetland would also be sensitive to hydrological changes that could potentially result from construction-related alterations, although the potential for such indirect effects will be reduced with mitigation.

Halberd-leaved tearthumb was found at only one location and may not persist at that location if it is within the PDA and is subject to direct disturbance. However, the species is an annual and has some ability to colonize disturbed areas if the seedbank is maintained and hydrological conditions are appropriate (Haines 2011).

Northern comandra and Sitka clubmoss were both found at multiple locations and typically occurred together in the same lichen-dominated barren habitat (OW2 habitat). While it is unlikely that these species will repopulate the RoW following construction given their apparent sensitivity to disturbance (populations intersected by the existing pipeline do not appear to have recolonized the pipeline), aerial imagery suggests that there is abundant available habitat for these species in the RAA and they appeared to be locally common. AC CDC (2015a) notes one record of northern comandra within 5 km of the Project, and Munro et al. (2014) indicate northern comandra records in the RAA, near the Strait of Canso and in the Cape Breton Ecodistrict. Munro et al. (2014) also indicate records of Sitka clubmoss in the RAA: in the Cape Breton Coastal Ecodistrict and within Guysborough County, on the border of the Eastern Interior Ecodistrict. While any of these plants falling within the PDA might be permanently displaced, it is unlikely that the ability of this species to persist within the RAA will be compromised.

No boreal felt lichen were found within the surveyed portions of the LAA. If this species occurs within the final PDA, which is unlikely, it would not recover, as it is typically found on balsam fir or other trees, which would be removed during construction. However, the AC CDC has noted 10 records of this species within 5 km of the Project, which indicates it would be unlikely that the Project would threaten the long-term sustainability of this species within the RAA.

Operation and Maintenance

Following construction, the resulting early successional habitat that will develop within the RoW during operation and maintenance will be favorable habitat for some SOCI known to occur in the RAA, and less favorable to others. There will be a variety of habitats available within the RoW similar to what can be observed in the adjacent existing pipeline RoW, including restored wetlands and grassy, dry upland areas, ericaceous shrub areas, and weedy forb-dominated areas. Many areas of the adjacent pipeline appear to have developed into a lichen-dominated barren area similar to the habitat where northern comandra and Sitka clubmoss were found, although it is not known if these occur in the existing pipeline RoW. These areas will be subject to periodic vegetation control and will tend to be dominated by more early successional species as a result.

One species that was observed within the LAA, Nova Scotia agalinis, is likely to increase in abundance in the PDA during operation and maintenance. This species was found in the LAA along roadsides but could also be seen in large numbers on the adjacent existing RoW where it is well suited to the open, managed habitat. Conditions that will be present within the PDA during operation and maintenance could have a positive effect on other SOCI that could occur in the RAA, such as field milkwort (*Polygala sanguinea, S2S3/sensitive*) and yellow ladies'-tresses (*Spiranthes ochroleuca*, *S3/secure*). Species such as these are adapted to the same type of open habitat that would be created by pipeline construction and maintained through operation and maintenance.

Populations of other SOCI for which there are records within 5 km of the LAA (Section 5.5.4.2.5) would not likely be affected by the Project, as none are particularly well-adapted to the anticipated operation and maintenance phase conditions within the PDA.

Two records of running serviceberry were found in one area near the edges of two barrens (OW2 habitat). Observations of the conditions in the existing adjacent RoW suggest that conditions within the RoW during operation and maintenance may be suitable for this species, which is adapted to well-drained acidic soils in full to partial sunlight. Should the PDA be positioned in such a way that these two plant occurrences are affected; this species could potentially recolonize the PDA after restoration.

Summary for Change in SOCI

In summary, the Project has the potential to result in a change in SOCI plant species, if present within the project footprint, during construction, and throughout the operation phase for those species that may not adapt to the operational RoW. These effects will be reduced through implementation of mitigation and route selection during the detailed engineering phase. Potential loss of some SOCI occurrences will be offset by anticipated benefits to other SOCI in the area. The Project will not threaten the ability of SOCI or other plant species to persist in the region over the long-term. With the application of recommended mitigation, residual effects of the Project on plant SOCI are predicted to be not significant.

5.5.7.2 Change in Wetland Area and Function

Construction

A portion of the 201.9 ha of wetlands within the LAA will be affected by construction, although the exact area and types of wetlands that will be disturbed during construction will depend on the final arrangement of the PDA. Construction activities could result in alteration to WSS if SAR are present. Progressive rehabilitation practices will focus on restoring topography, hydrology and vegetation in disturbed wetland areas where practicable, to reduce permanent loss. The compressor station is expected to remove approximately 1.8 ha of wetland from the PDA during construction and for the duration of operation. Similarly, access road construction will result in permanent loss of wetlands, though the exact extent and types of wetlands affected will not be known until access road locations are finalized. Indirect effects to adjacent wetland habitat will be reduced through some mitigation techniques described in Section 5.5.6.

For any wetlands within the PDA, the mitigation sequence of avoidance, minimization, and compensation will be followed. Under the provincial Wetland Policy (NSE 2011a), losses of wetland habitat, either through direct or indirect Project-related effects, may require compensation to replace the wetland functions lost as a result of the wetland alterations. To offset unavoidable wetland alteration, a wetland compensation plan will be developed in consultation with NSDNR and NSE prior to wetland disturbance. The objective of the compensation plan will be for activities to result in no net loss of wetland area or wetland function. However, temporary or minor losses of wetland function as a result of activities within the PDA will not likely require compensation.

Overall, effects to wetlands are likely to be minimal given the nature of the development and the mitigation measures that have been outlined. Pre-disturbance wetland boundaries will be delineated through the detailed routing process; therefore, change in wetland habitat will be measurable, and residual losses (i.e., after mitigation and onsite restoration) if they occur, will be compensated through NSE's Wetland Alteration Approval Process.

Operation and Maintenance

No additional wetland disturbance beyond the width cleared for construction is planned during operation and maintenance, except for vegetation management along the cleared portion of the RoW. Operation of the compressor station will not result in additional interaction with wetlands, because this facility will be an industrial site with graveled yard and permanent access roads. The creation of a new pipeline is not expected to increase vehicle traffic or access to previously inaccessible areas (a potential source of wetland disturbance) due to the presence of an existing RoW, which does not show evidence of heavy traffic. The vegetation cover in wetlands within the PDA will transition for many years following restoration, and the success of restoration efforts will be gauged through follow-up and monitoring. Residual loss of wetland resulting from failures in restoration efforts will be compensated for as required in consultation with NSDNR and NSE.

Summary of Change in Wetland Area and Function

In summary, the Project has the potential to result in a change in wetland area and function. These effects will be reduced through implementation of mitigation such as reducing direct effects to wetlands through final route and PDA selection. Wetlands within the PDA that are disturbed during construction will be restored where possible, and wetland area that will be permanently lost (e.g., within the footprint of the compressor station or resulting from access road construction) will be compensated for, as required. With the application of recommended mitigation, residual effects of the Project on wetland area or function are predicted to be not significant.

5.5.8 Monitoring and Follow-up

Prior to construction, further characterization of existing conditions will be undertaken during the detailed routing and permitting phase in order to provide the following information:

- wetland delineation and functional assessment surveys for wetlands within the defined PDA;
- surveys for SOCI plant occurrences on lands not surveyed in 2015;
- surveys for boreal felt lichen (and other cyanolichen SOCI) within areas of the LAA not previously surveyed that are identified as having relatively high potential to support this species; and
- breeding bird surveys within wetlands identified as having relatively high potential to support SAR and other SOCI.

Based on a consideration of existing conditions and likely residual effects of the Project, a wetland and SOCI monitoring plan will be developed and submitted to NSE. The goal of this plan will be to confirm the extend of wetland alteration and potential compensation requirements, and to monitor the effectiveness of proposed mitigation.

5.6 WILDLIFE AND WILDLIFE HABITAT

Wildlife and wildlife habitat is considered a VC because of potential Project interactions with wildlife (birds, mammals, herpetiles) and associated habitats, particularly with respect to species of conservation interest. Provincial and federal legislation addresses protection of many wildlife species, including species at risk and migratory birds.

Additional detail on wildlife habitat, including descriptions of plant community composition and structure, is available in Vegetation and Wetlands (Section 5.5). Conservation of wildlife and wildlife habitat is also linked to sustainable hunting activity (Land and Resource Section 5.8) and Traditional Land and Resource Use by the Mi'kmaq (Section 5.7).

Activities and components associated with construction and operation of Bear Paw have potential to interact with the environment in such a way that directly or indirectly adversely affects habitat availability, habitat connectivity and/or mortality risk for wildlife. The specialized mitigation measures prescribed in Section 5.6.6 will be implemented to reduce potential effects on wildlife and wildlife habitat, in addition to the more generalized standard mitigation measures outlined in Section 2.7.2. As explained in the assessment below, with the application of these mitigation measures, some of the residual Project-related environmental effects on wildlife and wildlife habitat are predicted to be temporary. Disturbance to sensitive habitat features will be avoided with final routing, where practical. No core habitat (as defined and legally protected under the NS *ESA*) has been identified to date within the boundaries of the LAA for any wildlife SAR, and the Project is not expected to result in any non-permitted contravention of the prohibitions stated in *SARA* or NS *ESA*. The Project is unlikely to threaten the long-term sustainability of any wildlife species (including SOCI) within the RAA. The assessment concludes that, with the application of the mitigation proposed herein, the residual environmental effects of Bear Paw on wildlife and wildlife habitat are anticipated to be not significant.

5.6.1 Regulatory and Policy Review

Migratory birds are protected federally under the *Migratory Birds Convention Act* (*MBCA*), which states that "no person shall disturb, destroy or take a nest, egg, nest shelter, eider duck shelter or duck box of a migratory bird" without a permit. Section 5.1 of the MBCA describes prohibitions related to depositing substances harmful to migratory birds. Bird species not protected under the MBCA, such as raptors and cormorants, are protected under the provincial *Wildlife Act* along with other wildlife.

Wildlife species that are protected federally under the *Species at Risk Act* (*SARA*) are listed in Schedule 1 of the Act. The purpose of this Act is to protect wildlife that are Species at Risk (SAR) and their critical habitat. *SARA* is administered by Environment Canada, Parks Canada Agency, and DFO.

Certain wildlife species are also protected under the Nova Scotia *Endangered Species Act* (NS *ESA*). Species recognized as being at risk of extinction in Nova Scotia are identified by a provincial status assessment process through the Nova Scotia Endangered Species Working Group. The conservation and recovery of species assessed and legally listed under the NS *ESA* is coordinated by the Wildlife Division of the Nova Scotia Department of Natural Resources (NSDNR). There is also a provincial general status assessment process that serves as a first alert tool for identifying species in the province that are potentially at risk. Under this process, species are assigned to categories that designate their population status in Nova Scotia, including *secure*, *sensitive*, *may be at risk*, and at risk. Although species assessed under this process are not granted legislative protection, the presence of species ranked as *sensitive*, *may be at risk* and at risk is an indication of concern by provincial regulators, as are those ranked as *S1*, *S2*, or *S3* by the AC CDC.

The wildlife and wildlife habitat VC focuses on SOCI, defined as those:

- listed under the Nova Scotia *Endangered Species Act* (NS *ESA*) or Schedule 1 of the *federal SARA* as being either *endangered*, *threatened*, *vulnerable*, or of *special concern* (i.e., Species at Risk);
- listed in Schedule 2 or 3 of *SARA*;
- not yet listed under provincial or federal legislations but identified by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as being either *endangered*, *threatened*, or of *special concern*;
- listed by the NSDNR (2014) to be at risk, *may be at risk*, or *sensitive* to human activities or natural events; and
- ranked as S1, S2, or S3 by the AC CDC (2014).

5.6.2 Boundaries

5.6.2.1 Spatial Boundaries

Spatial boundaries for the assessment of potential environmental effects on wildlife and wildlife habitat are presented below.

Project Development Area (PDA)

The PDA is defined as the maximum extent of the physical area of disturbance. The PDA includes temporary and permanent areas of ground disturbance for Bear Paw including: the pipeline RoW (both during construction and operation); the compressor station; temporary and permanent access roads; and storage, staging or other working areas required to support construction.

Local Assessment Area (LAA)

The LAA includes the assessment corridor, footprint of the compressor station, and areas within 1 km of these features. The LAA was established to consider the area in which the proposed activities and facilities could have direct or indirect effects on wildlife and wildlife habitat and take into consideration potential zones of influence (i.e., area of reduced use or avoidance). The LAA is the spatial boundary within which the environmental effects of a change in wildlife and wildlife habitat are primarily assessed, but field observations are discussed in the context of the assessment corridor.

Regional Assessment Area (RAA)

The RAA includes the Eastern Shore, Eastern Interior, Mulgrave Plateau, and Cape Breton Coastal Ecodistricts; as described in the Ecological land Classification for Nova Scotia (Neily et al. 2003). The RAA is used to provide context to the assessment of population effects on wildlife, including SAR.

5.6.2.2 Temporal Boundaries

The temporal boundaries for the assessment of potential Project effects on wildlife and wildlife habitat include construction, operation and maintenance, and decommissioning. Construction is currently scheduled to begin as early as 2017 and continues over a period of two years. Operation will follow construction and continue for the life of Bear Paw. Temporal considerations for wildlife and wildlife habitat include periods of sensitive life stages for species, including overwintering, breeding and other seasonal activities.

5.6.3 Significance Definition

This assessment considers residual effects on wildlife and wildlife habitat after mitigation is implemented. A determination of significance is made for each residual effect. A significant adverse residual environmental effect on wildlife and wildlife habitat is defined as:

- one that results in a non-permitted contravention of any of the prohibitions stated in Sections 32-36 of *SARA*, or in contravention of any of the prohibitions stated in Section 3 of the NS *ESA*;
- one that threatens the long-term sustainability of a wildlife species within the RAA; and
- one that is inconsistent with the goals, objectives or activities of recovery strategies and action plans for any SOCI, including SAR.

5.6.4 Description of Existing Conditions

This section describes the existing conditions for wildlife and wildlife habitat within the LAA, including information gathering methods. Mapbooks provided in Appendix F provide information on:

- Appendix F2: Land Class Data, Moose Observations, and Moose Habitat; and
- Appendix F3: Wetlands, Species of Conservation Concern, and Potentially Important Wildlife Habitat.

5.6.4.1 Approach and Methods

5.6.4.1.1 Desktop Assessment

Wildlife Occurrence Data

Desktop data sources were reviewed to identify wildlife species, particularly SOCI, that have been recorded within the vicinity of Bear Paw and could potentially occur within the LAA. Wildlife occurrence data from the AC CDC (2015) and the Maritimes Breeding Bird Atlas (MBBA) were obtained as part of the desktop review. Records of SOCI within a radius of 5 km from Bear Paw obtained from the AC CDC, along with other information on breeding birds were obtained. Data from the MBBA database (MBBA 2014) was also used to obtain information on the use of the surrounding landscape by breeding birds. In particular, data for the MBBA squares that are crossed by Bear Paw (i.e., 20PR00, 20PR01, 20PR02, 20PR12, 20PR13, 20PR23, 20PR24, 20PR25, and 20PR34) were obtained to provide a list of birds that have been found near Bear Paw and information on their breeding status. Additional desktop information used to inform the discussion of existing conditions include data on moose observations from the provincial government (NSDNR 2015a) and information from baseline environmental reports for other developments near Bear Paw (e.g., JWEL 1998; 2004).

The population status of each species identified by the AC CDC and MBBA data was identified using information from the General Status of Wildlife in Nova Scotia (NSDNR 2014), SAR in Nova Scotia (NSDNR 2015b), and the AC CDC (AC CDC 2014). The status of nationally rare species was obtained from *SARA* and COSEWIC (2015).

Land Cover and Interior Forest Conditions

Provincial forestry (NSDNR 2015c) and wetland inventory data (NSDNR 2015d) were obtained for the purpose of describing existing conditions within the LAA. This data was used to identify land cover classes that represent relatively broad habitat types within the LAA and to identify interior forest conditions.

The distribution and abundance of wetland classes within the majority of the LAA were primarily identified with reference to the provincial wetland inventory, but forestry data was used to identify additional areas likely to support wetland habitat. In particular, areas classified by NSDNR forestry data as supporting non-forested wetland habitat (i.e., FORNON codes 70, 71, 72, 73, and 75) and other areas identified as having poor drainage (i.e., WETCLASS = 1) were also classified as wetland, and further classified based on their dominant vegetation. As outlined in Section 5.5, wetlands within the assessment corridor and the location of the compressor station were identified and classified through field surveys and air photo interpretation.

Interior forest was defined as continuous stands of forest greater than 10 ha, with a maturity class of either "mature" or "overmature", and free of edge effect (i.e., more than 100 m from anthropogenic edges). The amount and distribution of mature forest habitat in the LAA was determined using NSDNR forest inventory data by establishing 100 m buffers around anthropogenic edges, including existing pipeline RoW, roadways, and other heavily disturbed non-forested habitat. The model was not able to capture the edge effects of recent clearcuts because of the lack of recent data on their extent within the LAA. Areas remaining after buffering these features were classed as forest interior habitat if they were 10 ha or greater in size.

Moose habitat

Potentially important mainland moose (*Alces alces americana*) habitat was identified using NSDNR forestry data and reference to regional guidance documents. In particular, moose shelter patches and buffers were identified following protocols identified in *Endangered Mainland Moose Special Management Practices* (NSDNR 2012), along with potentially important summer foraging and thermoregulation habitat.

Shelter patches are areas of potential importance for supplying important moose cover and security requirements, and are generally identified as closed canopy coniferous stands > 3 ha in area (NSDNR 2012). However, small stands greater than 0.1 ha may also have value as retention patches within fragmented landscapes. Coniferous treed wetlands are considered particularly valuable shelter habitat because they provide optimal shelter habitat during summer (i.e., thermoregulation functions) and may also serve as suitable calving sites or facilitate access to moose aquatic feeding areas (NSDNR 2012). Mixedwood stands on well-drained sites greater than 150 m in elevation on south facing slopes are considered important for maintaining winter shelter habitat in the Nova Scotia Uplands Ecoregion (NSDNR 2012). Based on these considerations, the abundance and distribution of the following types of moose shelter patches was determined within the LAA (including separate identification of those patches > 3 ha and those 0.1 to 3 ha in size):

- **Upland Conifer:** dry closed canopy coniferous stands (Forest GIS Inventory specifications: FORNON=0; >80% softwood; > 12 meter height; crown closure >60%; and WETCLASS ≠ 1).
- **Wet Conifer:** wet closed canopy coniferous stands (Forest GIS Inventory specifications: FORNON=0; >80% softwood; > 12 meter height; crown closure >60%; and WETCLASS = 1).
- **Upland Mixedwood:** dry closed canopy coniferous stands (Forest GIS Inventory specifications: FORNON=0; 50-80 % softwood; > 12 meter height; crown closure >60%; and WETCLASS ≠ 1), >150 m in elevation and on south facing slopes within the Nova Scotia Uplands Ecoregion.

Shallow water features that contain submerged and emergent plants provide important summer foraging and thermoregulation habitat for moose (Parker 2003; NSDNR 2007). Such habitat was identified within the LAA with reference to provincial forestry data. Areas identified by NSDNR as being "lake wetland" (i.e., wetlands that lie within fresh water) were considered potentially important foraging and thermoregulation habitat. Other areas considered to have potential to provide this function were those identified as "open water", "beaver flowage", "open bogs", and "other wetlands" (i.e., Forest GIS Inventory specifications: FORNON codes 70, 71, 72, 75, and 77).

Forested buffers are considered important for providing visual cover to moose that may be utilizing open wetland and aquatic habitats for summer foraging and thermoregulation purposes. Following provincial (NSDNR 2012) guidelines, potentially important buffers were identified using NSDNR forestry data as forested areas within 20 m of the mapped boundaries of open wetlands, watercourses, and waterbodies (Forest GIS Inventory specifications: FORNON=70, 71, 72, 75, and 77).

Other Important Wildlife Habitat

The Nova Scotia Significant Habitat Mapping Database (NSDNR 2015e) was consulted for information on important wildlife habitat near Bear Paw.

5.6.4.1.2 Field Surveys

Incidental observations recorded during vegetation, wetland, and aquatic field programs were used to obtain information on the presence of wildlife species within the LAA. Particular attention was given to recording signs of moose during these field programs, as well as other SOCI. Data collected during incidental wildlife observations included date, observer, location, species, and number; additional notes on habitat association, condition, and behavior were also recorded for SOCI where applicable.

- Although no dedicated breeding bird surveys have been conducted in support of Bear Paw, a reconnaissance survey of the portions of the Milford Haven River and Strait of Canso that are within the assessment corridor was undertaken on August 25, 2015 for the purpose of obtaining information on the importance of these areas as habitat for migratory water birds, including waterfowl and shorebird species. During the reconnaissance surveys, the shoreline extending 200 m outside of the assessment corridor was walked and shorebirds and water birds on the shore or in the waters adjacent to the shore were recorded. Birds observed flying over the defined study area were also recorded.

Dedicated moose field surveys were performed November 30 to December 3, 2015 and involved walking transects on crown land within the assessment corridor to identify signs of moose. The specific methods by which transect surveys were conducted are outlined below.

- Field surveys were performed along 16 transects within the assessment corridor, which represent approximately half of the linear distance of Crown land along the proposed route.
- Transects were 1,000 m in length but were split between multiple sections of crown land where there was not enough area to complete a full transect due to land access issues.

- While walking each transect, team members maintained a distance of 50 m from each other in order to maximize the area covered while maintaining safe working conditions. Teams consisted of two surveyors.
- Each person surveyed a 2 m wide swath of land (i.e., one meter on each side of observer), within which signs of moose, including pellets, tracks and browse were recorded.
- Moose sign recorded farther than 1 m from the observer was also recorded, as were deer pellets within the 2 m wide swath.
- Moose tracks and unusual sightings were photographed.
- Incidental observations of other wildlife sign were recorded during the surveys with an emphasis on SOCI.
- Transects were planned with reference to the following considerations:
  - Locations of moose sign observed during aquatic, vegetation, and wetland field surveys. Areas where moose sign was encountered had transects placed in them.
  - Potentially important moose habitat. Wetlands and mature conifer stands that provide potential thermal cover and areas with young hardwood cover to provide winter browse were preferentially targeted, as were those adjacent to lakes and ponds.
  - Vegetation Diversity. Transects were located to cross as many vegetation types as possible.
  - Safety and logistical concerns. Transects were not located in regions where extensive areas of pre-commercial timber thinning had been identified because these areas are unsafe to walk through and ground visibility is very limited by the presence of dense slash piles, which would strongly limit the ability to observe tracks or pellets. These areas also have limited browsing opportunities, and moose prefer mature conifer stands in winter for thermal cover.

Discussions with NSDNR indicated that winter aerial moose surveys had also been attempted over the last decade in the general vicinity of Bear Paw. However, these surveys were largely unsuccessful due to the timing of weather conditions required (e.g., fresh relatively deep snowfall) combined with the requirement for safe flying conditions (e.g., visibility). Given the likelihood of encountering similar conditions in the winter of 2015/2016, the early winter transect surveys were selected as the best option to obtain usable data for this environmental effects analysis.

5.6.4.2 Summary of Existing Conditions

5.6.4.2.1 Environmental Setting

Bear Paw primarily falls within the Eastern Interior Ecodistrict of the Eastern Ecoregion and the Mulgrave Plateau Ecodistrict of the Nova Scotia Uplands Ecoregion. Both of these ecodistricts are characterized by warm summers and long cold winters. The southern and northern limits of Bear Paw extend into the Atlantic Coastal Ecoregion, where vegetation and climate is strongly influenced by proximity to the ocean (Neily et al. 2003). Wildfires and hurricanes represent the dominant natural disturbances throughout much of the region, but the effects of natural disturbances are not as great as the influence of forest management activities. Although stand-replacing disturbance events are common, gap disturbances caused by insects, disease, blowdown, old age, or physical damage due to wind, snow, ice or lightning contribute to the development of uneven-aged stands within some portions of the regions crossed by Bear Paw (Neily et al. 2003). Data on the abundance of land cover classes (Table 5.6.1), indicate that the majority of the wildlife LAA is forested; but freshwater bodies and open wetlands are also common throughout the landscape.

Forest cover accounts for the large majority of the LAA, and is comprised of stands of varying composition and seral stages (Table 5.6.1). Stands of early-mid successional softwood are particularly abundant, but mid-successional stands of mixedwood and hardwood are also common. The current composition and structure of forests within the LAA strongly reflect the influence of logging activities. Much of the forest cover is fragmented by existing roads and other linear developments (e.g., pipeline RoW). There are 23 patches of interior forest within the LAA that are >10 ha in size, accounting for a total area of approximately 632 ha, or approximately 4.4% of the LAA. The patches vary in size from 10.1 ha (i.e., when truncated at the boundary of the LAA) to approximately 98.0 ha, with the average patch being 27.5 ha in size. Interior forest conditions are present throughout much of the route with relatively high concentrations occurring in the central portion of the LAA between Godfry Brook and near Nickerson Lake; and in the north from the Milford Haven River to near the Strait of Canso (Maps 1-8,d Appendix F2).

Available data indicates that approximately 15% of the LAA supports wetland habitat (Table 5.6.1). However, wetlands are likely more abundant throughout the landscape than data indicate because forested wetlands can be difficult to identify and field surveys were restricted to those areas of the assessment corridor that were on crown land. The majority of wetland throughout the surrounding landscape is comprised of swamp. Coniferous treed swamps are particularly abundant but those having a mixedwood overstory are also common, as are those dominated by tall shrubs. Peatlands (i.e., bogs and fens) are prominent features within portions of the LAA, such as near Carters Lake and although of much lesser abundance, occurrences of marsh and shallow-water wetland classes are also present.

Areas occupied by anthropogenic habitats comprise less than 5% of the LAA (Table 5.6.1). Urban and industrial land use types are particularly prominent at Bear Paw's southern and northern extents, where industrial parks, residential areas, and other human infrastructure are concentrated. Linear corridor from roads and existing pipeline RoW are prevalent throughout much of the LAA.

Additional information on vegetation and wetland conditions within the assessment corridor (including a discussion of dominant vegetation types) is provided in Section 5.5 (Vegetation and Wetlands).

Table 5.6.1 Land Cover within the LAA

Land Cover Class		LAA	
		Area (ha)	**Percent**
Forest	Regeneration-Young Hardwood	46.5	0.3
	Regeneration-Young Mixedwood	642.6	4.5
	Regeneration-Young Softwood	1,538.2	10.8
	Regeneration-Young Unknown	1,029.9	7.2
	Immature-Pole Hardwood	1,016.6	7.1
	Immature-Pole Mixedwood	1,031.9	7.2
	Immature-Pole Softwood	2,235.8	15.6
	Mature-Overmature Hardwood	392.8	2.7
	Mature-Overmature Mixedwood	461.9	3.2
	Mature-Overmature Softwood	491.8	3.4
	Uneven Hardwood	34.0	0.2
	Uneven Mixedwood	229.2	1.6
	Uneven Softwood	707.7	5.0
	Forest Other	620.0	4.3
	Forest (total)	1,0478.9	73.3
Wetland	Bog	68.2	0.5
	Bog or Fen	684.0	4.8
	Fen	149.6	1.0
	Marsh	20.1	0.1
	Shallow Water	11.7	0.1
	Swamp	1,080.3	7.6
	Unknown Wetland	89.8	0.6
	Wetland (total)	2,103.7	14.7
Other	Agriculture	55.7	0.4
	Barren	47.0	0.3
	Beach	1.0	0.0
	Corridor	206.4	1.4
	Open water	1,052.7	7.4
	Other Non-Forest	16.8	0.1
	Urban/Industrial	324.5	2.3
Total		**14,286.7**	**100.0**

5.6.4.2.3 Birds

The LAA has potential to support a wide variety of bird species because of the varying habitat conditions represented therein. AC CDC and MBBA data obtained for Bear Paw indicate that at least 142 bird species have been recorded near the LAA, including 10 SAR and 35 other SOCI. Incidental observations of 44 species were recorded during field surveys, including 11 SOCI. A complete list of birds identified by the AC CDC and MBBA data searches, and recorded during field surveys is provided in Table F.1 (Appendix F) and summarized below. The locations of SOCI recorded during field surveys are provided in Maps 1-8 (Appendix F3), along with AC CDC records in close proximity to Bear Paw and those reported as part of a baseline report (i.e., JWEL 1998) for an adjacent pipeline development.

Raptors

A variety of raptors are known to occur in the vicinity of Bear Paw. Their abundance and species richness would be highest during the breeding season, but several species would occur year-round. Raptors would use a variety of habitats found within the LAA, including open water (e.g., osprey (*Pandion haliaetus*)), mature forests of varying composition (e.g., broad-winged hawk (*Buteo platypterus*), northern goshawk (*Accipiter gentilis*)) and open terrestrial environments (e.g., northern harrier (*Circus cyaneus*), American kestrel (*Falco sparverius*)). Several raptor species were recorded during field surveys conducted, with one bald eagle (*Haliaeetus leucocephalus*) nest observed in the LAA along the north shore of the Milford Haven River, and an osprey nest observed near the SOEP Gas Plant (Map 1, Appendix F3). Desktop data indicate that two raptor SAR have been recorded within the vicinity of Bear Paw: peregrine falcon (*Falco peregrinus*) and short-eared owl (*Asio flammeus*). One additional raptor SOCI, long-eared owl (*Asio otus*), was also identified. Potentially appropriate nesting habitat for peregrine falcon is scarce in the LAA and it is unlikely to nest near Bear Paw. AC CDC data indicate that short-eared owl has been recorded at the southern end of the LAA, and potential habitat for this species would occur in association with large open bogs. AC CDC data indicate that long-eared owls have been recorded at both the southern and northern end of Bear Paw. This species, can be found in Nova Scotia year-round, prefers open areas for foraging and shrub lands or forests for nesting and roosting (Marks et al. 1994).

Forest Associated Birds

The composition and structure of forests within the LAA is varied and would support a diversity of forest-associated passerines, woodpeckers, and game birds. Desktop data indicate that 22 forest-associated SOCI have been recorded near Bear Paw, including the following SAR: olive-sided flycatcher (*Contopus cooperi*); eastern wood-pewee (*Contopus virens*); Canada warbler (*Wilsonia canadensis*); and rusty blackbird (*Euphagus carolinus*). The majority of the forest within the LAA is either coniferous or mixedwood, and a variety of SOCI that are associated with boreal forest conditions are present throughout the area, including: black-backed woodpecker (*Picoides arcticus*); gray jay (*Perisoreus canadensis*); boreal chickadee

(*Poecile hudsonica*); golden-crowned kinglet (*Regulus satrapa*); ruby-crowned kinglet (*Regulus calendula*); bay-breasted warbler (*Dendroica castanea*) and blackpoll warbler (*Dendroica striata*) – all of which were recorded as incidentals during field surveys. Deciduous forest is relatively uncommon within the LAA, but mature stands dominated by both intolerant and tolerant hardwoods are present, and have potential to support other passerine SOCI such as eastern wood-pewee.

Forested wetlands are common throughout the LAA and provide potentially important habitat for several SAR and other SOCI. For example, surveys conducted in support of an existing pipeline that runs parallel to Bear Paw, recorded a number of SOCI in association with treed wetland habitat, including: black-backed woodpecker; olive-sided flycatcher; yellow-bellied flycatcher (*Empidonax flaviventris*); gray jay; boreal chickadee; golden-crowned kinglet; ruby-crowned kinglet; Canada warbler; rusty blackbird; and pine grosbeak (*Pinicola enucleator*) (JWEL 1998).

Open Habitats/Grassland Associated Birds

A number of SOCI associated with non-forested and anthropogenic terrestrial environments have potential to occur within the LAA. In particular, desktop data indicate that eight species of SOCI that are associated with open habitat types, including grasslands have been recorded in the vicinity of Bear Paw, including four SAR: common nighthawk (*Chordeiles minor*); chimney swift (*Chaetura pelagica*); barn swallow (*Hirundo rustica*); and bobolink (*Dolichonyx oryzivorus*). SOCI such as brown-headed cowbird (*Molothrus ater*), bobolink, eastern kingbird (*Tyrannus tyrannus*), and killdeer (*Charadrius vociferous*) are often found in association with farmlands and pastures and because such habitats are scarce within the LAA, their distribution and abundance is likely to be quite limited. Common nighthawks may use a variety of habitats for nesting purposes including recent clear cuts, barrens, burnt areas, gravel pits or buildings; therefore, they have potential to occur throughout much of the LAA.

Marsh/Open Water Associated Birds

A variety of waterfowl and other waterbirds may occur in association with open freshwater features in the LAA, including several SOCI. Common loons (*Gavia immer*) are a SOCI that breed on quiet, freshwater lakes and winter in coastal waters, and are considered sensitive to pollution and human disturbance. Two loons were seen during field surveys in late August 2015, both on the Milford Haven River. A variety of waterfowl are likely to use the freshwater lakes and ponds of the LAA during the breeding season, including American black duck (*Anas rubripes*), common mergansers (*Mergus merganser*), mallard (*Anas platyrhynchos*), and ring necked duck (*Aythya collaris*). These species are generally only present inland during the spring, summer and fall, and they migrate to warmer areas for the winter. Spotted sandpipers (*Actitis macularius*) could also use the shorelines of open water habitats during the breeding season, where they nest in semi-open areas. Although not recorded in breeding season or habitat, a spotted sandpiper was observed during surveys along the shore of the Strait of Canso in late August, and is likely to be a migrating individual.

A portion of the Milford Haven River encompassed by the Wildlife LAA has been mapped by the province as an important area for migratory birds (Map 5, Appendix F3). A reconnaissance survey did not identify the portion of the river and associated coastline within the assessment corridor as having potentially important stop-over migration habitat such as could occur in association with extensive areas of marsh, beach, or mudflats. However, the Milford Haven River is likely to be used as a local fly-way for a variety of birds travelling from coastal areas to more inland habitats. Although the number of species recorded in the area during the reconnaissance survey was limited, they included waterbirds associated with both coastal and freshwater habitats, including northern gannet (*Morus bassanus*), greater yellowlegs (*Tringa melanoleuca*), and common loon.

Desktop data indicate that several SOCI which are associated with open wet areas, have been recorded within the vicinity of Bear Paw. Some of these species, such as American bittern (*Botaurus lentiginosus*) and Virginia rail (*Rallus limicola*), are associated with dense emergent vegetation of marshes, which are uncommon within the LAA. Although the habitat availability for such species is limited in the LAA, anthropogenic disturbances may have increased the amount of potential habitat available to some birds, depending on their particular habitat requirements. For example, Wilson's snipe (*Gallinago delicata*) typically use open wet areas, including muddy pond edges and damp fields; potential habitat for this species occurs in low-lying areas of the existing pipeline RoW that parallel much of Bear Paw. An incidental observation of Wilson's snipe was recorded during surveys at the northern end of the route (Map 8, Appendix F3).

Marine Associated Birds

Seabirds found in the region of the Strait of Canso include both pelagic and neritic seabirds. Pelagic seabirds are typically found out of sight of land and return to coastal waters only to breed and include storm petrels (*Oceanodroma spp.)*, auks, and some gulls. However, only the Leach's storm-petrel (*Oceanodroma leucorhoa*) is known to breed in the region of the Strait (JWEL 2004), where a colony is located in the vicinity of Canso (Erskine 1992). Neritic seabirds are species that predominantly occupy coastal waters and occasionally forage in inland areas, and include cormorants (*Phalacrocorax spp.*), gulls, terns, and black guillemots (*Cepphus grylle*). The abundance of seabird species near the Strait of Canso would vary throughout the year in response to seasonal conditions and life history requirements of species. The marine component of the LAA is located in nearshore waters and most of the birds present in this area are likely to be neritic seabirds, although incursions of pelagic seabirds may occur in nearshore waters during storm events (JWEL 2004).

A variety of sea duck, loon, and grebe species are also known to occur in association with the Strait of Canso (JWEL 2004). The majority of such species breed in freshwater habitats and spend the fall, winter and early spring in coastal waters. They are in greatest abundance in Nova Scotia during spring and fall migration (JWEL 2004). The highest concentrations of such waterfowl are found in the vicinity of Canso at the mouth of Chedabucto Bay during spring migration whereas low numbers of coastal waterfowl are found in the Strait of Canso during the same period (JWEL 2004). The most prevalent species amongst these include common eider (*Somateria mollissima*), black scoter (*Melanitta nigra*), white-winged scoter (M. fusca), surf scoter (*M. perspicillata*), red-breasted merganser (*Mergus serrator*), long-tailed duck (*Clangula hyemalis*), common golden-eye (*Bucephala clangula*), common loon, horned grebe (*Podiceps auritus*), and red-necked grebe (*P. grisegena*) (JWEL 2004). Dabbling ducks, such American black duck (*Anas rubripes*) are also present in relatively large numbers but are generally restricted to shallow, sheltered waters such as those found in salt marshes, barrachois ponds and sheltered coves (JWEL 2004).

Species at Risk

AC CDC and MBBA data indicate that at least ten bird SAR have been recorded within the vicinity of Bear Paw: peregrine falcon, short-eared owl, common nighthawk, chimney swift, olive-sided flycatcher, eastern wood-pewee, barn swallow, Canada warbler, bobolink, and rusty blackbird. Information on each of these species, including habitat associations, limiting factors, and known occurrences within the LAA are discussed in the following sections.

<u>Peregrine Falcon</u>

Peregrine falcons are designated as a species of *special concern* under *SARA* and by COSEWIC, and as *vulnerable* under the NS *ESA*. Peregrine falcon numbers decreased greatly during the 1950s and 1960s because of exposure to organochlorine pesticides that caused egg shell thinning and subsequent reproductive failure. The banning of DDT in the 1970s combined with recovery programs has resulted in a large-scale recovery of this species. Current populations are considered similar to historical levels. As of 2005, the Canadian population of the peregrine falcon ssp. *anatum*/*tundrius* was at least 1,168 mature individuals (COSEWIC 2007a). In the Maritime Provinces, the number of known sites occupied by this species has increased from none in 1980 to 20 in 2005, largely as a result of a successful reintroduction program. Current stressors to peregrine falcons include potential decreases in the abundance of food sources such as seabirds and shorebirds and possible adverse effects associated with the bioaccumulation of polybrominated diphenyl ethers. Other possible limiting factors include human disturbance, potential for legal harvesting for falconry, and illegal harvest of eggs and nestlings for falconry (COSEWIC 2007a).

Peregrine falcons occur in a wide range of habitats including tundra, forested areas, coastal islands, deserts, and cities. The main factors limiting its distribution are suitable nesting substrate and a sufficient supply of food (primarily birds). They prefer to nest on cliffs between 50 and

200 m in height, but will nest on other substrates including, quarry faces, road cuts, tall buildings, bridges, electrical transmission line towers and the abandoned nests of ravens and other raptors (COSEWIC 2007a). Although MBBA data identify peregrine falcon as a possible breeder in the area, AC CDC data do not contain records for this species within 5 km of Bear Paw and it is unlikely to occupy the area for nesting purposes.

Short-eared Owl

Short-eared owls are listed as *special concern* under both *SARA* and COSEWIC. Their designation is a result of a continuing population decline of approximately 3% per year over the past 40 years (COSEWIC 2008a). The primary threat to this species is the loss or alteration of habitat. Short-eared owls are present in Nova Scotia during the summer breeding season, and rarely also occur in the winter (Tufts 1986). They are found in areas with open habitat, including coastal marshes, grasslands, heathlands and occasionally, agricultural areas (Wiggins et al. 2006). Nesting occurs on the ground in open areas, which may include hayfields (Tufts 1986), with sites likely chosen based on proximity to a source of small mammal prey (COSEWIC 2008a).

AC CDC data indicate short-eared owls have been observed within both the southern and northern limits of Bear Paw. There is a report of a short-eared owl from a large bog approximately 1.5 km northeast of Carters Lake from the late 1990s (M. Crowell pers. com. 2015) (Maps 1 and 8, Appendix F3). Potential habitat for short–eared owls is relatively limited within the LAA and would primarily occur in association with large open peatlands, such as occur in the northern extent of Bear Paw near Carters Lake.

Common Nighthawk

Common nighthawks are listed as *threatened* under COSEWIC, *SARA* and the NS *ESA*. This species has experienced average declines of 4.2% per year since 1968, resulting in a population decrease of 49.5% during that period (COSEWIC 2007b). The threats to this species are not well understood, but may include a decline in insect prey due to widespread pesticide use, habitat loss and alteration (COSEWIC 2007b).

Common nighthawks breed in Nova Scotia and may be present in the LAA during the spring, summer and fall. They prefer open areas, including rocky barrens, old pastures, gravel pits, burnt over areas and forest clearings. Nesting occurs directly on the ground, and no actual nest structure is built. Common nighthawks will nest on newly cleared areas (as a result of clearcutting or urbanization) as well as on gravel rooftops (COSEWIC 2007b). AC CDC records indicate that common nighthawks have been recorded near the northern and southern limits of Bear Paw (Maps 1 and 8, Appendix F3). However, potential habitat for this species occurs throughout the LAA, particularly in association with disturbed habitats, such as recent clear-cuts and existing pipeline RoW.

Chimney Swift

Chimney swifts are listed as *threatened* under COSEWIC and *SARA*, and as *endangered* under the NS *ESA*. According to Breeding Bird Survey data, this species has declined by 95% in Canada between 1968 and 2005 (COSEWIC 2007c). The largest factor in this decline is likely the loss of suitable breeding and roosting sites. Prior to the arrival of Europeans in North America, they would have used large, hollow trees for nesting and roosting but after European settlement, they moved to masonry chimneys (COSEWIC 2007c). Currently, both of these structures are limited; large hollow trees are rare because of forest practices, and traditional masonry chimneys are no longer widespread. Chimney swifts are aerial foragers, and often feed on insects over water (COSEWIC 2007c).

Chimney swifts breed in Nova Scotia and may potentially be found in the LAA in the spring, summer or fall. The AC CDC data search resulted in only one chimney swift record, in the Guysborough area. Ample suitable habitat exists for foraging in the LAA, but no active nesting or roosting sites are known to occur within the vicinity of Bear Paw.

Olive-sided Flycatcher

Olive-sided flycatchers are Neotropical migrants that breed throughout Nova Scotia and are listed as *threatened* by COSEWIC, *SARA* and the NS *ESA*. Like many aerial insectivores, this species has experienced long-term declines in Canada; the population declined by 79% from 1968 to 2006, and by 29% from 1996 to 2006 (COSEWIC 2007d). Limiting factors for this species are not completely understood, but likely include habitat loss in breeding and wintering grounds, loss of breeding habitat, and the reduction of insect prey (COSEWIC 2007c).

Olive-sided flycatchers prefer open areas and their associated edge habitats. These include natural forest edges such as are associated with rivers, lakes, wetlands or burned areas, and human-made edges, such as may occur in logged areas. Tall snags or trees are an important habitat component used for perching. Although olive-sided flycatchers will use natural and human-made edges, nesting success is lower in harvested stands compared to burnt edges (COSEWIC 2007d).

Natural and human-made edge habitats that provide potentially suitable habitat for olive-sided flycatchers are widespread throughout the LAA, and they have potential to occur near Bear Paw wherever suitable habitat exists. AC CDC data indicate that they have been recorded near Bear Paw throughout its extent (Maps 1-8, Appendix F3). Surveys conducted in support of an existing pipeline that runs parallel to Bear Paw, document several occurrences of olive-sided flycatchers in association with swamps and bogs of the Carters Lake Area (JWEL 1998).

Eastern Wood Pewee

Eastern wood pewees are listed as *special concern* under COSEWIC and as *vulnerable* under the NS *ESA*. This species declined by 70% between 1970 and 2012 (COSEWIC 2012). Similar to the olive-sided flycatcher, limiting factors are not fully understood, but may include loss and/or degradation of habitat on wintering or breeding grounds, and declines in availability of flying insect prey (COSEWIC 2012).

Eastern wood pewees use a variety of forested habitats during the breeding season in Nova Scotia, including deciduous, mixed wood, and less commonly, coniferous forest. They are usually associated with edge habitats in mature and intermediate-age forests (COSEWIC 2012). In the Maritime provinces, they tend to be associated with marshes, lakes, ponds and rivers, and are negatively associated with harvested areas, urban areas and roads (M. Campbell unpubl. data in COSEWIC 2012). AC CDC data indicate that the eastern wood pewee has been recorded at two locations within the vicinity of the northern half of the route, but pockets of potential habitat for this species occurs throughout much of Bear Paw's extent.

Barn Swallow

Barn swallows are listed as *threatened* under COSEWIC and as *endangered* under the NS *ESA*. Between 1970 and 2009, the population in Canada declined by 76%. Prior to European settlement, barns swallows nested on natural features such as caves, or crevices and ledges associated with rocky cliff faces (COSEWIC 2011). After European settlement, barn swallows moved to human structures, including open barns, garages, sheds, bridges and road culverts. Roosting sites include alder groves and cattail and bulrush marshes. During migration, barn swallows often gather over marshes or lakes, where concentrations of flying insects are high (COSEWIC 2011). One of the major reasons for the decline of barns swallows is believed to be the loss of nesting habitat. Old, wooden farm structures are commonly being replaced by modern buildings, which are often inaccessible for swallows. The movement towards metal roofed barns, may also be contributing, as these structures are less thermally stable than wooden roofed barns, and may result in heat-induced mortality (COSEWIC 2011). Other limiting factors may include the loss of suitable foraging habitats and large-scale declines in prey insect abundances.

AC CDC data include records for barn swallows near the southern end of Bear Paw and in central portions. Very little agricultural land exists within the LAA and the availability of potential barn swallow habitat is limited; however, this species could potentially nest in the LAA in association with old buildings and other structures.

Canada Warbler

Canada warblers are listed as *threatened* under both COSEWIC and *SARA*, and as *endangered* under the NS *ESA*. This species breeds in Nova Scotia and throughout Canada, and winters in

South America. The Canadian population has declined by approximately 85% between 1968 and 2007 (COSEWIC 2008b). The reasons behind this decline are not fully understood, but may include habitat loss and degradation in wintering and breeding grounds.

During the breeding season, Canada warblers require habitat with a well-developed shrub layer and structurally complex forest floor, which is generally most abundant in moist, mixed forest or riparian shrub forest (COSEWIC 2008b). Forest structure appears to be more important than its composition. A decline in forested wetlands through conversion to agricultural or urban lands has resulted in a decrease in suitable breeding habitat (COSEWIC 2008b).

Potential Canada warbler habitat is abundant throughout much of the LAA, particularly in association with mixed and deciduous treed swamps. AC CDC data obtained for Bear Paw indicate that this species has been recorded in the vicinity of the LAA throughout its extent (Maps 1-8, Appendix F3). Canada warblers were recorded in association with swamps at two locations during surveys conducted in support of the existing pipeline, in the Carters Lake Area and near Godfrey Brook (JWEL 1998).

Bobolink

Bobolinks are listed as *threatened* under COSEWIC and as *vulnerable* under the NS *ESA*. This species has experienced severe declines since the 1960s, with a loss of 88% of the population in the last 40 years (COSEWIC 2010). Bobolink is a grassland species that breeds throughout Nova Scotia and Eastern Canada. Breeding habitat includes grasslands, meadows, hay fields and pastures. Within agricultural lands, bobolinks nest primarily in forage crops, such as clover, timothy, tall grasses and broadleaved plants (COSEWIC 2010). One of the major threats to bobolinks is incidental mortality due to agricultural operations. Modern agricultural operations tend to favour earlier cutting, which can occur when nests contain eggs or young (COSEWIC 2010). Other threats include habitat loss and fragmentation. This species is susceptible to fragmentation, which results in increased nest predation.

AC CDC data contain two records of bobolinks, one of which is located near the town of Guysborough and the other to the north near MacPherson Lake. Very little agriculture land exists within the LAA, and it is unlikely that much suitable habitat for bobolinks exists near Bear Paw.

Rusty Blackbird

Rusty blackbirds are listed as *special concern* by COSEWIC and *SARA* and as *endangered* under the NS *ESA*. It is estimated that the Canadian population has decreased by 85% since the mid-1960s (COSEWIC 2006). Limiting factors for this species include the loss of wintering habitat and bird control programs in the southeastern United States (COSEWIC 2006). Breeding habitat loss may also be a contributing factor to the decline.

Rusty blackbirds breed in Nova Scotia and may occur near Bear Paw in the spring, summer and fall. During this time, they occupy conifer-forested wetlands, including peat bogs, marshes, swamps, beaver ponds and slow moving streams. Rusty blackbirds are associated with riparian areas, and often use scrub riparian habitats of islands, lakes, rivers and streams (COSEWIC 2006). Nests are generally built close to water, and away from human disturbance.

Ample suitable habitat exists for rusty blackbirds throughout much of the LAA. AC CDC data obtained contain three records of rusty blackbirds towards the northern half of Bear Paw. Rusty blackbirds were recorded in association with swamps at two locations during surveys conducted in support of the existing pipeline, in the Carters Lake Area and near Northeast Branch Lake (JWEL 1998).

5.6.4.2.4 Herpetiles

Eight herpetile species were recorded during field surveys, including seven amphibians and one reptile, none of which are identified as SOCI. Desktop data indicate that two herpetile SOCI have been recorded in proximity to the wildlife LAA: wood turtle (*Glyptemys insculpta*) and four-toed salamander (*Hemidactylium scutatum*). A complete list of herpetiles recorded during field surveys in support of Bear Paw and identified by the AC CDC data search is provided in Table F.2, Appendix F. The locations of AC CDC records for SOCI in close proximity to Bear Paw are presented in Maps 1-8, Appendix F3.

Wood turtles are designated as *threatened* under Schedule 1 of *SARA* and by COSEWIC, and as *vulnerable* under the NS *ESA*. They are associated with streams, creeks, rivers and adjacent forest, shrub communities, meadows, and farmland habitat (COSEWIC 2007a). Streams with sand and/or gravel bottoms are preferred, but rocky streams are used occasionally. Though semi-aquatic, the wood turtle spends more time in the terrestrial environment than most other freshwater turtles; they may wander some distance from watercourses during summer foraging, but characteristically remain within linear home ranges. These home ranges are 1 to 6 ha in size, and are centered on a suitable river or stream where non-vegetated or sparsely vegetated sandy beaches and banks are present that serve as nesting sites (COSEWIC 2007a). Natural nesting sites consist of sandy river beaches but may also include disturbed sites such as railway grades and roadsides. Some turtles may travel considerable distances up small tributaries that lack suitable nesting sites and hibernacula during the summer months but offer good foraging opportunities. These smaller streams may serve as dispersal corridors between populations on different river systems. Wood turtles have also been observed in a variety of other habitat types, including bogs, beaver ponds, coniferous and mixed forests, and agricultural fields (COSEWIC 2007a). AC CDC data indicate that the closest wood turtle record is approximately 20 km from Bear Paw and correspondence with NSDNR indicates that this may be associated with Country Harbour River (NSDNR pers. comm. 2015). The wildlife LAA does not provide good habitat for wood turtles because it is primarily comprised of stony infertile soils, and the watercourses in the area typically have stony banks with few sandy beaches. The Salmon River provides the best potential wood turtle habitat within the LAA, but is not known to support this species.

Although the four-toed salamander is not designated as protected under either *SARA* or the NS *ESA* and is considered to have a *secure* population by NSDNR, it is uncommon in the province and currently ranked as *S3* by the AC CDC. Four-toed salamanders are highly fossorial (live underground) and are difficult to detect. They nest in sphagnum moss hummocks at the edges of small pools in swamps and bogs. The adults forage in forested areas surrounding these wetlands. This species can only be reliably detected during the breeding season, which encompasses May and June. The LAA contains large numbers of swamps and bogs, many of which contain the small pools and sphagnum moss hummocks required for reproduction. Available data on the occurrence of this species within the vicinity of Bear Paw indicate that it has been recorded at several locations in the LAA in association with watercourse and wetland habitat between West Lake and Carters Lake (JWEL 1998; AC CDC 2015).

5.6.4.2.5 Mammals

AC CDC data and incidental field observations indicate that at least 17 mammal species have been recorded near Bear Paw, including one SAR: the mainland moose. Although not identified by AC CDC data obtained for Bear Paw, there is also potential for bats to occur within the LAA. A complete list of mammals recorded during field surveys in support of Bear Paw and identified by the AC CDC data search is provided in Table F.3, Appendix F. The locations of moose observations provided by the province (NSDNR 2015a) and moose sign recorded during field surveys is presented in Maps 1-8, Appendix F2.

A review of the NSDNR significant habitat mapping database (NSDNR 2007) indicates that two Deer Wintering Areas (DWAs) are intersected by the wildlife LAA (Maps 1-8, Appendix F3). One of these areas is located in the southern extent of Bear Paw and encompasses the first 2 km of the LAA. The other DWA occurs in association with the Salmon River and encompasses a portion of the LAA that is approximately 1.5 km wide.

Moose

The population of mainland moose is listed as *endangered* under the NS *ESA*. This designation reflects its small and declining size, which is the result of several complex, poorly understood, but interrelated factors (McNeil 2013). The potential threats and limiting factors that face the mainland moose include:

- disease;
- habitat loss;
- fragmentation alteration from development and forestry practices;
- poaching;
- vehicular collisions;
- climate change; and
- deficiencies in trace elements and/or elevated levels of toxic heavy metal uptake resulting from acidification (NSDNR 2007).

The importance of each of these factors, how they interact with one another, and how they vary across different geographic regions of the province is largely unknown, but threats to habitat may be increasingly important (McNeil 2013).

The habitat requirements of the mainland moose are complex as they require a mosaic of forested and wetland environments that provide food, shelter and appropriate thermal conditions (Parker 2003; NS DNR 2007; McNeil 2013). They primarily feed on twigs, stems and foliage of young deciduous trees and shrubs, as are typically abundant in forest landscapes subject to recent disturbance by fire, wind, disease or timber harvesting activities. Moose shift their habitat use seasonally: during warmer months they prefer areas interspersed with wetlands that allow access to aquatic vegetation and refuge from high temperatures and biting insects (Parker 2003). Landscapes which support recently disturbed mixedwood forests for food and adjacent mature conifer cover for escape and shelter are preferred in winter, and forests with dense canopy closure are favored during severe winters (Bowyer et al. 2003). The specific spatial and temporal habitat preferences and limiting factors for the mainland moose are poorly understood (McNeil 2013); but a recent study suggested that they are vulnerable to thermoregulatory stress during warm weather (Broders et al. 2012). During such conditions, they may rely on mature forest that provides adequate cover; however, such stands are increasingly uncommon in the province as a result of forest harvesting practices (NS DNR 2007).

The *Endangered Species Act* prohibits destroying or disturbing core habitat, which is habitat considered essential to the long term survival and recovery of endangered or threatened species. No core habitat has been identified within the LAA.

The stated goal of the provincial Recovery Plan for the mainland moose (NSDNR 2007) is to "maintain the population of mainland moose in Nova Scotia within their current range" and the identified recovery objectives are to: 1) maintain and enhance the current population and distribution; 2) mitigate threats that limit recovery; 3) initiate research to address priority knowledge gaps; and 4) maintain and enhance habitat. Because of the importance of habitat availability, NS DNR has issued a Special Management Practices (NSDNR 2012) document for forest harvesting activities on provincial crown lands within identified "significant population concentration areas". The Special Management Practices document outlines requirements to maintain shelter patches for thermal cover, retention patches to provide cover within harvested areas, and the decommissioning of roads and access points when no longer required (McNeil 2013).

Moose are known to occur throughout the landscape in which Bear Paw is located. Much of Bear Paw (particularly the southern half of the pipeline route) passes through an area identified by NSDNR as a significant population concentration area (NSDNR 2012). Moose observation data obtained from the province (NSDNR 2015) indicates that this species has been observed throughout the area surrounding Bear Paw; the data, however, does not clearly indicate any particular area of concentration (Maps 1-8, Appendix F2). Similarly, field surveys conducted in support of Bear Paw have identified moose sign in several areas of the LAA (Maps 1-8, Appendix

F2). These field observations are scattered along the length of Bear Paw and do not indicate that moose prefer one area to others.

Several incidental observations of moose sign were recorded during field surveys in support of the vegetation, wetlands, and aquatic programs. These observations, shown on Maps 1-2, Appendix F2, include:

- tracks in the south end of Bear Paw near Goldbrook Road;
- fresh tracks and summer scat in the northern half near Clam Harbour River;
- old winter feces near the south side of the Strait of Canso; and
- several potential moose rubs and evidence of browsing activity along the southern end of Bear Paw between Goldboro and Eight Mile Lake.

Transect surveys conducted in December, 2015 identified one additional set of moose tracks within the northern part of Bear Paw near West Lake (Map 7, Appendix F2). Three instances of moose sign were observed at this location, but are likely to have been created by the same animal, based on similarities in print/track measurements, directions of travel, and proximity of the tracks to one another.

Core habitat has not been identified in the LAA.

Desktop modeling data indicate that some types of potentially important moose habitat are abundant within the landscape, but others are relatively scarce (Table 5.6.2 and Maps 1-8, Appendix F2). Approximately 53 ha (15%) within the LAA were identified as moose shelter patch habitat. All except one of the nine moose shelter patches were comprised of upland conifer and three of these were less than three hectares in size. Shelter patch habitat was restricted to the central portion of the LAA, between Godfry Brook and Clam Harbour River, except for one more southerly occurrence near Beach Hill Lake. Shallow water features that provide potentially important summer foraging and thermoregulation habitat (i.e., wetlands and waterbodies) were relatively abundant throughout the LAA, accounting for over 1,000 ha. The majority of terrestrial habitat along the boundaries of these freshwater features is forested, and therefore has potential to provide visual cover to moose if they were to use open wetland and aquatic habitats for summer foraging and thermoregulation purposes.

Table 5.6.2 Potential Moose Habitat Features within the LAA

Potential Moose Habitat	Moose Habitat Feature	Number	Area (ha)
Shelter Patches	Upland Conifer >3 ha	5	37.7
	Upland Conifer <3 ha	3	6.9
	Wet Conifer >3 ha	0	0.0
	Wet Conifer <3 ha	0	0.0
	Upland Mixedwood >3 ha	1	8.7
	Upland Mixedwood <3 ha	0	0.0
	Total	**9**	**53.3**
Summer Foraging / Thermoregulation Habitat	Wetlands (general)	134	475.5
	Beaver Flowage	24	79.6
	Open Bogs	17	57.8
	Lake Wetland	67	66.5
	Inland Water	68	337.3
	Total	**310**	**1016.7**
Forested Buffers around Freshwater Features	Regeneration-Young Hardwood	2	0.4
	Regeneration-Young Mixedwood	44	15.5
	Regeneration-Young Softwood	139	37.0
	Regeneration-Young Unknown	79	13.9
	Immature-Pole Hardwood	42	8.6
	Immature-Pole Mixedwood	92	22.6
	Immature-Pole Softwood	240	116.0
	Mature-Overmature Hardwood	23	5.5
	Mature-Overmature Mixedwood	36	13.6
	Mature-Overmature Softwood	53	33.1
	Uneven Mixedwood	15	5.7
	Uneven Softwood	108	59.7
	Forest Other	69	21.3
	Total	**942**	**353.2**

Bats

There are three bat species that reside in the province year round and which have been listed as *endangered* under *SARA*: little brown bat (*Myotis lucifugus*), northern long-eared bat (*M. septentrionalis*), and tri-coloured bat (*Perimyotis subflavus*). These bats rely on forested and rural areas in the summer for roost sites and foraging opportunities. The little brown bat also readily occupies structures, such as barns or attics, and may establish maternity colonies in such structures. All three species of resident bats rely on underground openings in the winter for hibernation, which include natural caves and abandoned mines, but they require very specific conditions for hibernation in regards to humidity and temperature (Raesly and Gates 1987). Little brown bats, northern long-eared bats and tri-coloured bats will often hibernate together at the same sites. The populations of these three species have declined rapidly since 2011, due to white-nose syndrome, which is a disease caused by the fungus *Pseudogymnoascus destructans*.

Although AC CDC data do not contain records for bats or bat hibernacula within 5 km of Bear Paw (the closest recorded bat observation is almost 40 km from Bear Paw), there is some potential for this species to be found in the LAA. In particular, a review of the abandoned mine opening data base (NSDNR 2008) indicates that there are a high number of abandoned mine shafts in the southern extent of the LAA as a result of historical gold mining initiatives. However, there are no limestone or gypsum deposits in the area so it is unlikely that natural caves are present in the area that would provide hibenaculum sites for bats.

5.6.5 Potential Environmental Effects and Bear Paw-Related Interactions

Activities and components could potentially interact with wildlife and wildlife habitat through:

- direct loss or alteration of habitat as a result of vegetation clearing and construction of the pipeline and above-ground infrastructure;
- indirect loss or alteration of habitat as a result of sensory disturbance or changes in habitat connectivity during construction, operation and decommissioning;
- direct mortality of wildlife as a result of interactions with equipment and infrastructure; and
- indirect mortality through loss of fitness and increased exposure to threats.

In consideration of these potential interactions, the assessment of Project-related environmental effects on wildlife and wildlife habitat is focused on the following potential environmental effects:

- change in habitat availability;
- change in habitat connectivity; and
- change in mortality risk.

The effects pathways and measurable parameters for the assessment of these effects is provided in Table 5.6.3.

Table 5.6.3 Potential Environmental Effects, Effects Pathways and Measurable Parameters for Wildlife and Wildlife Habitat

Potential Environmental Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in Habitat Availability	Construction and operation could affect habitat availability through vegetation clearing and sensory disturbance.	Area (ha) of land cover classes and potential habitat directly disturbed by the Project, including any defined critical or core habitat for SAR. Habitat loss due to reduced habitat effectiveness (e.g., sensory disturbance) will be addressed qualitatively.
Change in Habitat Connectivity	The Project could alter or block wildlife movement during construction and operations due to physical barriers, sensory disturbance, or vegetation clearing (i.e., gaps in forested habitats).	Change in localized movement patterns will be assessed qualitatively.
Change in Mortality Risk	Mortality risk could change for some species during construction because of interactions with clearing, trenching, and vehicles; and during operations as a result of increased human access and activity associated with RoW maintenance and increased access by recreational users.	Change in direct mortality risk (e.g., through destruction of active nest, den or vehicle/wildlife collisions) or indirect mortality risk (e.g., increased human access, predation rates due to edge effects) to be assessed qualitatively.

Habitat availability refers to the presence of conditions that are suitable to support the life requirements of wildlife. Bear Paw has the potential to result in the direct loss of wildlife habitat during construction as a result of vegetation clearing, grading, and trenching within the PDA. Sensory disturbance (i.e., noise, visual and olfactory stimuli) during construction and operation may result in habitat avoidance or reduced habitat effectiveness for some species. Habitat loss and fragmentation may also result in secondary effects to wildlife. For example, habitat fragmentation may lead to greater mortality risk to songbirds through increased predation and nest parasitism, lower nesting success, and decreased ability to colonize new areas (Johnson 2001; Stephens et al. 2004; Bayne et al. 2005).

Under *SARA*, critical habitat is defined as the habitat necessary for the survival and recovery of a listed wildlife species, and that has been explicitly identified in a Recovery Strategy or in an Action Plan for the species (Government of Canada 2012). No critical habitat has been identified within the boundaries of the LAA for any SAR to-date.

The NS *ESA* prohibits destroying or disturbing of core habitat. Core habitat has not been identified within the boundaries of the LAA for any wildlife SAR to-date, including moose.

Habitat connectivity refers to the ability of the landscape to maintain local or regional wildlife movements. Developments that result in physical barriers, the removal of wildlife habitat, or the introduction of noise, visual and olfactory stimuli that have the potential to fragment natural habitats and impede or prevent the exchange of wildlife between habitat units. Species with limited dispersal capabilities are generally most susceptible to fragmentation. The open cut, spoil and topsoil piles as well as strung pipe could act as physical barriers to species movement with limited dispersal abilities, most notably amphibians, reptiles and small mammals.

Construction of the pipeline and facilities also creates habitat edges/gaps, which could result in temporary barriers to movement. The presence of a cleared RoW, roads, and above-ground facilities during operations can continue to influence the localized movement of some wildlife species. In addition, the presence of a cleared RoW during construction and operation may result in changes to habitat connectivity, even for some highly mobile animals such as birds (Giraudo et al. 2008). Furthermore, sensory disturbance from vehicles, equipment and personnel might deter some wildlife, including moose, from using traditional travel corridors during construction, as well as during operations.

Construction may increase wildlife mortality risk through a number of mechanisms including destruction of nests, dens, and burrows as well as through trench entrapment and collisions with vehicles and other infrastructure. For example, there is potential for increased risk of mortality to migratory birds if vegetation clearing activities occur during the summer months; ground-nesting birds would also be vulnerable to grubbing and other disturbance events during this time. Similarly, the young of mammal species would be vulnerable to clearing and grubbing activities and small mammals that spend most of their time underground or under cover of objects might experience increased risk of mortality during the clearing and grubbing phase of construction. Hibernating herpetiles or mammals would be at risk of mortality from clearing or grubbing during winter months. Small mammals and amphibians have potential to become trapped in trenches during the excavation process and to therefore be subject to increased risk of mortality (Woinarski et al.2000). There is also increased mortality risk due to potential vehicle collisions along the RoW and roads in the LAA during both the construction and operation phases, as well as for increased predation and hunting pressure because of changes to site access. For example, roads, trails, and other utility corridors are known to result in an increased mortality risk to moose and deer by providing access for competitors and predators, increasing hunting pressure, and facilitating vehicle access (Beazley et al. 2004 and references therein).

5.6.6 Mitigation

5.6.6.1 Operational and Safety Considerations

First and foremost, safety is Bear Paw Pipeline's core value and will not be compromised. Bear Paw Pipeline will prioritize safety in construction and operation activities. Bear Paw Pipeline will follow applicable legislation, regulations and technical specifications relevant to its facilities and assets. Within the context of prioritizing safety during construction and operation, Bear Paw

Pipeline commits to implementing reasonable and effective mitigation to reduce potential effects on wildlife and wildlife habitat, including moose and the habitat they require.

Although, the regulations governing pipelines do not prescribe vegetation management requirements such as maintained RoW widths or how such areas should be reclaimed or maintained, the Canadian Standards Association (CSA Z662) states that where the easement permits, vegetation and RoWs should be controlled, '*…to maintain clear visibility from the air and provide ready access for maintenance crews*".

It is imperative that the pipeline operator has access over the pipeline ditch to conduct regular maintenance and integrity inspections. This is critical for maintaining pipeline safety, which translates to the stakeholders, the public and employees.

In general, the operational RoW will be allowed to regenerate (note that natural and active (i.e., planting) regeneration methods will be determined through development of the Moose Management Plan), except for a 10m width on each side of the centreline, which will be cleared on a 3 year rotational schedule (i.e., the operational RoW will be cleared on a cycle so that at any given time, there will be areas that have 3 years of regeneration present). As described below, and where it is determined to be safe and within the operating requirements of Bear Paw, there will be areas where the maintained RoW will be reduced to 5 m on each side of the centreline, such as riparian zones and in areas identified as providing important moose habitat. However, as safety is a core value for Bear Paw Pipeline, the vegetation management protocols and schedule will be determined in order to allow for aerial and ground inspections; access to emergency situations; and/or pipeline patrols. Maintaining either a 10 m or 20 m RoW will make pipeline markers and warning signs visible.

5.6.6.2 General Mitigation

The most notable form of mitigation has been considered in the identification of the assessment corridor, and Bear Paw Pipeline's commitment to construct the Project as close as practicable to the existing RoW. As such, this design-mitigation will effectively and substantially reduce fragmentation and disturbance in the landscape versus a green-field development. Moreover, Bear Paw Pipeline is in communication with the operators of the existing pipelines, and will work with them to potentially reduce the distance between the existing and new RoWs. This may allow for the existing cleared RoW to be used to accommodate some of the ancillary activities (e.g., access, work-room), which could reduce the clearing-width requirement for Bear Paw during construction, in some areas.

Mitigation measures to reduce Project-related effects on wildlife and wildlife habitat are identified in Table 5.6.4. Standard mitigation (Section 2.7.2), and mitigation measures identified in Sections 5.5 and 5.2 to reduce effects on vegetation, wetlands, and aquatic habitats, will also act to reduce effects on wildlife and wildlife habitat. The use of some mitigation measures will be determined on a site-by-site basis and identified in consideration of local concerns and conditions to provide the most effective mitigation.

5.6.6.3 Riparian Zone Mitigation

The large number of watercourse crossings on this Project presents a unique opportunity for managing vegetation in a way that is beneficial to the riparian zone, and also to providing wildlife habitat mitigation. In total, there are 69 watercourse crossings, which are spaced relatively evenly across the 60 km of pipeline on the mainland side of the Project. Where practicable, and to mitigate potential effects at riparian areas, provide vegetation cover, and reduce fragmentation, Bear Paw Pipeline will maintain a RoW of 10 m at the majority of the 69 watercourse crossings, as shown in Figure 5.6.1.

In many instances, watercourse crossings are associated with habitat features considered to be important for moose (e.g., wetland). In these cases, the mitigation implemented for watercourses will be extended such that the RoW is narrowed for a greater distance to provide habitat protection and refuge. This is further discussed below in Section 5.6.6.3.

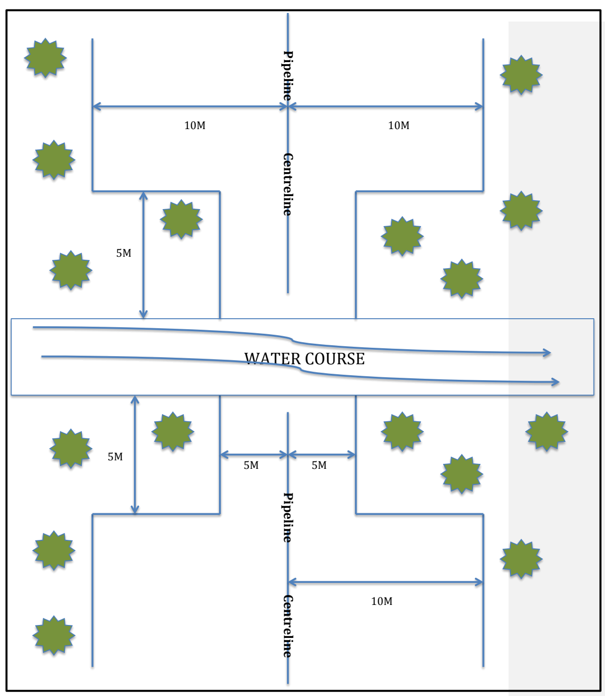


Figure 5.6.1 RoW Width Management at Watercourse Crossings (conceptual)

5.6.6.4 Moose Habitat Specific Mitigation

Habitat modeling, as presented in Appendix F had identified a number of habitat features that could provide important moose shelter/foraging/thermoregulation (i.e., from heat or cold) characteristics. Because of the value attributed to the mainland moose, Bear Paw Pipeline will be working with NSDNR and NSE on the development of a Moose Management Plan, to be included in the EPP. This management plan will be developed based on more detailed engineering than is now available, to identify protection measures for moose and moose habitat. There are a number of mitigation measures that will be considered in the development of the Moose Management Plan, including those listed in Table 5.6.4, below.

It is too early in the planning and routing process to identify where on the landscape these mitigation measures may be implemented. However, for the sake of illustration, the following example is provided, and illustrated in Appendix F. This example is provided for illustration purposes only. Detailed engineering and final routing has not been completed at this time. Final routing and site-specific mitigation will be developed in the Moose Management Plan.

Location: Between KP 16 and KP 20

Features of interest: In this area, the assessment area runs between two polygons identified as providing potential summer foraging/thermoregulation habitat. Closer to KP 19, a stand of this same habitat is intersected by the assessment area.

Potential Mitigation:

- During detailed design, every effort will be made to reduce direct effects to the wetlands present near KP 17 by choosing an alignment that crosses the most narrow portion of this wetland, in consideration of other constructability constraints.
- The construction RoW would be situated as close as possible to the existing RoW, to reduce the amount of clearing required.
- The operational RoW may be reduced from 20 m to 10 m in this location. The area available for regeneration (i.e., outside of the 10 m RoW) will be revegetated. Note that natural and active (i.e., planting) regeneration methods will be determined through development of the EPP.
- Consideration to reducing human access to the Bear Paw RoW will be given at the nearby Eight Mile Lake Rd. through the use of constructed berms or the roll-back of cleared vegetation to create an impediment to ATV access of the RoW.
- Where the assessment area intersects potential summer foraging/thermoregulation habitat near KP 19, effort will be made during detailed routing to avoid this habitat.

Limitations: It is important to note that while Bear Paw Pipeline is committed to working with NSE and NSDNR on the development and implementation of mitigation such as that described above, the future use (e.g., harvesting, clearing) of adjacent areas by members of the public, forestry companies, or other entities is outside of Bear Paw Pipeline's control. Further, in most cases, Bear Paw will be directly adjacent to the existing RoW, and habitat revegetation and access control cannot extend beyond Bear Paw Pipeline's RoW lease.

5.6.6.5 Moose Management Plan

As discussed above, Bear Paw Pipeline further proposes that a management plan be developed for moose and moose habitat, in association with NSDNR, the Mainland Moose Recovery Team and other pertinent experts. Bear Paw Pipeline is committed to adhering to its core safety values and all regulatory requirements and protocols in the development and operation of the pipeline while working collaboratively with recognized experts to develop site-specific mitigation and a Moose Management Plan. This management plan will include the identification of practical habitat mitigation, in consideration of operating requirements, safety, and feasibility. Specific recommendations will be defined in parallel with detailed engineering and the identification of the final route. The following information will be provided in the Moose Management Plan.

- goals and objectives will be defined for the protection of moose and habitat important to moose;
- construction mitigation will be identified and described, as well as identified in site-specific environmental protection plans (SSEPPs);
- site specific mitigation to be implemented through operation will be described, as well as identified in SSEPPs;
- if required, monitoring and follow up actions will be identified and described.

Table 5.6.4 Mitigation for Wildlife and Wildlife Habitat

Effect	Mitigation
Change in Habitat Availability	• Reduce the area of direct habitat disturbance by: o Reducing the operational RoW width to 10 m with natural regeneration, where feasible, only in areas where important wildlife habitat has been identified ((i.e., summer foraging, thermoregulation habitat; moose shelter) • Allow full vegetation regeneration (natural and active regeneration methods will be identified in the EPP) within the RoW, leaving a 10 m controlled vegetation regrowth width across the pipeline ditch, where important wildlife habitat has been identified: o Bank restoration and shrub staking at watercourse crossings to restore vegetation, reduce human use of access roads and trails, and reduce line-of-sight. o Provide line-of-sight breaks via vegetation regeneration and management and through use of berms to reduce human use of access roads and trails. o Berms may be considered at access control points along the RoW where coarse woody debris and excavator mounding treatments are not practical. o Permit regeneration across sections of the RoW and plan three year rotational clearing pending consideration of pipeline integrity, safe operation, and regulatory approval.

Table 5.6.4 Mitigation for Wildlife and Wildlife Habitat

Effect	Mitigation
	• Reduce indirect loss of habitat / sensory disturbance through access management: o use existing access for construction and operation (i.e., reduce temporary access), where possible; o increase public awareness through signage to reduce human use of access roads and trails; o use gates to reduce human use of access roads with landowner permissions; o deactivate temporary roads to reduce access created by Bear Paw; o use excavator mounding to restore vegetation and reduce human use of access roads with landowner permission; o rollback slash/woody debris.. • Reduce indirect loss of habitat / sensory disturbance through traffic management: o adhere to posted speed limits; o use of multi-passenger vehicles for the transport of crews to and from job sites; o install signage where specific wildlife concerns have been identified. • Facilitate habitat restoration by reducing surface disturbance and soil stripping in sensitive areas during construction: o work in frozen-ground conditions where feasible; and o use matting to protect soil and vegetation from compaction by heavy equipment. • Reduce sensory disturbance in areas of potentially important moose habitat: o maintain vegetation buffer in areas adjacent to potentially important moose habitat; and o reduce, if possible, construction and maintenance activities during periods when moose are observed proximate to construction. • Provide Human-Wildlife Conflict training to personnel, including information on effectively managing human-moose interactions
Change in Habitat Connectivity	• Reduce the area of direct habitat disturbance by: o Reducing the operational RoW width to 10 m with natural regeneration where feasible, only in areas where important wildlife habitat has been identified ((i.e., summer foraging, thermoregulation habitat; moose shelter) • Allow full vegetation regeneration (natural and active regeneration methods will be identified in the Moose Management Plan) within the RoW, leaving a 10 m controlled vegetation regrowth width across the pipeline ditch, where important wildlife habitat has been identified: o Bank restoration and shrub staking at watercourse crossings to restore vegetation, reduce human use of access roads and trails, and reduce line-of-sight. o Provide line-of-sight breaks via vegetation regeneration and management and through use of berms to reduce human use of access roads and trails. o Berms may be considered at access control points along the RoW where coarse woody debris and excavator mounding treatments are not practical. o Permit natural vegetation regeneration across sections of the RoW and plan a three year rotational clearing pending consideration of pipeline integrity, safe operation, and regulatory approval.

Table 5.6.4 Mitigation for Wildlife and Wildlife Habitat

Effect	Mitigation
	• Provide line-of-sight breaks via vegetation regeneration and management and through use of berms to reduce human use of access roads and trails. Berms may be considered at access control points along the RoW where coarse woody debris and excavator mounding treatments are not practical.
Change in Mortality Risk	• Monitor the open cut for trapped wildlife before the daily start of construction, or prior to resuming work after a shutdown, and remove wildlife before startup. • Reduce potential for interactions with wildlife through traffic management (refer to mitigation items identified under Change in Habitat Availability). • Reduce potential for interactions with wildlife by limiting site access (refer to mitigation items identified under Change in Habitat Availability). • Avoid planting species preferred by white-tailed deer to avoid interspecific food competition and increased parasite transmission between moose and deer. • Avoid attracting black bears to the RoW by avoiding planting preferred forage species. This could be most effective during the calving season when predation of calves can restrict populations of moose in areas of low population density. • Conduct vegetation disturbance activities outside of the breeding season for migratory birds (April 1 to August 31; Environment Canada 2014) during both construction (e.g., vegetation clearing) and operations (e.g., vegetation management). Where this is not possible, develop a Bird Nest Mitigation Plan (prior to construction) in consultation with Environment Canada and provincial regulators. Include this plan in the final EPP. • Provide human-wildlife conflict training to personnel.

5.6.7 Residual Environmental Effects and Significance Determination

5.6.7.1 Change in Habitat Availability

Construction

Vegetation clearing, grading and trenching activities in the PDA during construction will result in direct habitat loss and alteration by disturbing areas that provide breeding, foraging, overwintering, and other functions to wildlife within the LAA. Vegetation disturbance during construction will primarily occur within an approximately 35 m wide RoW along the 62.5 km pipeline (approximately 219 ha) and within the footprint of the compressor station (approximately 15 ha). Areas within the PDA of the compressor station will experience long-term habitat loss. The duration of effects on habitat availability within the pipeline construction RoW will vary depending on existing conditions (e.g., forested or non-forested) and the nature of the restoration undertaken.

Much of the area to be disturbed during construction is forested. The PDA of the compressor station is primarily comprised of immature pole softwood, but treed swamp is also present (Table 5.6.5). Although the detailed route is not identified at this time, over 70% of the assessment corridor is forested, including treed wetlands and upland stands of varying composition and maturity (Table 5.6.5). Many wildlife species require forested habitat for breeding, foraging, or other activities (e.g., roosting). However, all forested land cover classes within the assessment corridor are relatively abundant elsewhere in the LAA (Table 5.6.5) and the surrounding landscape may therefore accommodate displaced individuals. In particular, the amounts of forested land cover classes within the assessment corridor represent approximately 10% or less of that available within the LAA (Table 5.6.5).

Disturbance to open environments (e.g., marshes, shallow water wetlands, and existing RoW corridors) is likely to result in a short-term loss of habitat availability for associated species because these habitats will be largely rehabilitated following pipeline installation. Approximately 15% of the assessment corridor is comprised of open environments (Table 5.6.5). There is some potential for species that nest or breed in disturbed environments, such as common nighthawk, to experience increased habitat availability because of vegetation disturbance. Open land cover classes within the assessment corridor are all relatively abundant elsewhere in the LAA. In particular, open land cover classes within the assessment corridor represent approximately 10% or less of that available within the LAA (Table 5.6.5).

Table 5.6.5 Land Cover Classes within the Assessment Corridor and Compressor Station

Land Cover Class		Assessment Corridor		PDA of Compressor station	
		Area (ha)	Percent of LAA[1]	Area (ha)	Percent of LAA[1]
Forest	Regeneration-Young Hardwood	0.0	0.0		NA
	Regeneration-Young Mixedwood	49.4	7.9	<0.1	0.0
	Regeneration-Young Softwood	128.0	8.4		0.0
	Regeneration-Young Unknown	91.1	8.9		0.0
	Immature-Pole Hardwood	78.0	7.7		NA
	Immature-Pole Mixedwood	57.7	5.6		0.0
	Immature-Pole Softwood	151.4	6.9	13.1	9.1
	Mature-Overmature Hardwood	25.4	6.5		NA
	Mature-Overmature Mixedwood	48.8	10.6		NA
	Mature-Overmature Softwood	29.7	6.0		0.0
	Uneven Hardwood	2.0	5.9		NA
	Uneven Mixedwood	16.3	7.1		NA
	Uneven Softwood	48.7	6.9	<0.1	0.0
	Forest Other	45.1	7.3		0.0
	Forest (total)	771.6	7.4	13.1	3.9

Table 5.6.5 Land Cover Classes within the Assessment Corridor and Compressor Station

Land Cover Class		Assessment Corridor		PDA of Compressor station	
		Area (ha)	Percent of LAA[1]	Area (ha)	Percent of LAA[1]
Wetland[2]	Bog or Fen	22.3	2.5		0.0
	Marsh	0.5	2.5		NA
	Shallow Water	0.3	2.6		NA
	Swamp	174.3	16.3	1.8	4.5
	Unknown Wetland	0.0	0.0		0.0
	Wetland (total)	197.4	9.4	1.8	1.5
Other	Agriculture	0.0	0.0		NA
	Barren	2.7	5.7		NA
	Beach	0.1	10.0		NA
	Corridor	25.6	12.4	<0.1	0.4
	Open water	77.5	7.4		0.0
	Other Non-Forest	0.5	3.0		NA
	Urban/Industrial	11.9	3.7		0.0
Total		**1,087.3**	**7.7**	**14.9**	**3.2**

Notes:

1 The LAA for the assessment corridor and compressor station represent the area within a 1 km buffer around those features.

2 The amount of forested wetland (particularly swamp) within the LAA may be underestimated because wetlands outside the boundaries of the compressor station and assessment corridor were identified through interpretation of NSDNR data only, which typically under represents forested wetland.

In addition to direct habitat loss or conversion to early successional conditions, construction will result in increased edge influences. Edge influences have the potential to negatively affect some populations of birds and mammals due to reduced habitat suitability (i.e., loss of contiguous habitat patches) and increased predation or nest parasitism (Stephens et al. 2003; Batary and Andras 2004), while positively affecting species that benefit from edge effect (e.g., white-tailed deer, Alverson et al. 1988; foraging bats, Morris et al. 2008).

Loss of interior forest will occur in the LAA as a result of direct conversion to early successional stages and edge influences. Changes in the availability of interior forest conditions, however, are reduced by the location of Bear Paw adjacent to the existing RoW. For example, only six patches of interior forest intersect the assessment corridor, and therefore have potential to be directly altered because of construction (Table 5.6.6). These patches comprise an area of 16.0 ha, or approximately 2.5% of the amount of interior forest within the LAA. No patches of interior forest conditions are located within the PDA of the compressor station, or within 100 m of this feature.

Environmental effects of Bear Paw on moose habitat will vary over time and spatially in response to vegetation conditions within and adjacent to the PDA. Although some studies (e.g., Bartzke et al. 2015) have not associated linear corridors (such as power lines) with a functional loss of moose habitat, others (e.g., Joyal et al. 1984) have demonstrated that they use adjacent forested habitats more than cleared RoWs. Conversely, linear features are sometimes attractive to moose because they can provide browsing opportunities and can be easier to travel in than adjacent habitats (Jalkotzy et al. 1997). Linear developments through closed forest open up the canopy and create edges where shrubs that provide preferred moose browse is encouraged (Joyal et al. 1984; Jalkotzy et al. 1997; Bartzke et al. 2015). The cleared RoW will provide limited habitat for moose immediately following construction, but its value will increase with successional development of vegetation. Studies have demonstrated that moose will not begin to preferentially use cutovers until 10 to 15 years post-cut, when some degree of forest cover has returned (Monthey 1984; Potvin et al. 1999).

Table 5.6.6 Interior Forest and Moose Habitat within the Assessment Corridor and PDA of the Compressor Station

Habitat Feature		Assessment Corridor[1]			Compressor Station PDA		
		Number	Area		Number	Area	
			Ha	% of LAA[2]		Ha	% of LAA[2]
Interior Forest		6	16.0	2.5	0	0	0
Shelter Patches	Upland Conifer	2	2.8	6.3	0	0	0
	Upland Mixedwood	1	0.3	4.0	0	0	0
	Total	3	3.2	5.9	0	0	0
Summer Foraging / Thermoregulation Habitat	Wetlands (general)	17	22.2	4.7	0	0	0
	Beaver Flowage	3	4.2	5.3	0	0	0
	Open Bogs	1	0.5	0.8	0	0	0
	Lake Wetland	3	0.3	0.4	0	0	0
	Inland Water	5	1.5	0.4	0	0	0
	Total	29	28.7	2.8	0	0	0
Forested Buffers around Freshwater Features	Regeneration-Young Hardwood	0	0.0	0.0	0	0	0
	Regeneration-Young Mixedwood	7	0.9	5.9	0	0	0
	Regeneration-Young Softwood	14	1.6	4.4	0	0	0
	Regeneration-Young Unknown	4	0.0	0.1	0	0	0
	Immature-Pole Hardwood	5	0.3	3.6	0	0	0
	Immature-Pole Mixedwood	7	1.8	8.0	0	0	0

Table 5.6.6 Interior Forest and Moose Habitat within the Assessment Corridor and PDA of the Compressor Station

Habitat Feature		Assessment Corridor[1]			Compressor Station PDA		
		Number	Area		Number	Area	
			Ha	% of LAA[2]		Ha	% of LAA[2]
	Immature-Pole Softwood	25	4.3	3.7	0	0	0
	Mature-Overmature Hardwood	3	0.5	8.2	0	0	0
	Mature-Overmature Mixedwood	3	0.9	6.4	0	0	0
	Mature-Overmature Softwood	1	0.1	0.4	0	0	0
	Uneven Mixedwood	0	0.0	0.0	0	0	0
	Uneven Softwood	10	0.7	1.1	0	0	0
	Forest Other	4	0.2	0.9	0	0	0
	Total	83	11.3	3.2	0	0	0

Notes:

1 The assessment corridor encompasses the pipeline PDA but does not represent the area of physical disturbance that will result from construction (i.e., approximately 35 m wide construction RoW).

2 Data on the LAA for individual Bear Paw features (i.e., assessment corridor and compressor station) represent the area within a 1 km buffer around those features.

Construction activities have the potential to change the availability of moose habitat that may be important at particular times of the year and for certain activities. For example, a recent study suggested that mainland moose in Nova Scotia are subject to thermoregulatory stress during warm periods (Broders et al. 2012); therefore, disturbance to moose shelter patches could have an important influence on moose during these conditions. During detailed routing, the three areas (two identified as upper conifer moose shelter habitat and one area as upper mixed wood shelter habitat) that may be directly disturbed during construction (Table 5.6.6) will be identified as constraints and consideration will be given to whether they can practicably be avoided (in view of other identified constraints and constructability considerations). These areas represent an area of 3.2 ha, or approximately 5% of the shelter patch habitat identified within the LAA. A total of 29 freshwater features that provide potential summer foraging / thermoregulation habitat for moose occur in the assessment corridor, representing 28.7 ha, or 2.8% of that habitat type within the LAA. Forested buffers within 20 m of the edges of these freshwater features are common within the assessment corridor and comprise an area of 11.3 ha, or approximately 3.2% of those areas represented in the LAA (Table 5.6.6). Disturbance to such areas will be reduced through detailed routing and will be temporary in nature because of mitigation measures to encourage vegetation growth within wetlands and riparian areas. No potentially important moose habitat (including shelter patches, potentially important summer foraging / thermoregulation habitat or associated forested buffers) are present within the boundaries of the compressor station.

Construction activities will result in indirect habitat loss (i.e., avoidance) due to sensory disturbance associated with noise, artificial lights, or vibrations. Responses will vary depending on species and individuals, and the degree to which wildlife are exposed and habituated to existing human activities (e.g., such as near existing roadways or industrial activities). Many sources of sensory disturbance associated with construction would be temporary, as high-disturbance activities (e.g., vegetation clearing, blasting) would only last a few weeks at a given location. Exceptions would be the site of the compressor station, where activities might last weeks to months, and at HDD sites. Some level of sensory disturbance may be expected throughout the construction phase as much of the RoW would support human activities during this time.

Operation and Maintenance

First and foremost, the operation and maintenance of the Bear Paw will be in accordance with the core values expressed in Section 2.7.2, with respect to the safety of the pipeline and in compliance with all applicable legislation and guidelines pertaining to pipeline inspection and monitoring. Bear Paw would work collaboratively with the operators of the adjoining RoW to implement rotational and complementary vegetation management.

Although efforts will be made to maintain wildlife habitat availability for moose and other species, there are operational requirements that necessitate certain vegetation controls, examples are provided below.

- It is a regulatory requirement for pipeline proponents to conduct regular inspections of specific pipeline facilities, such as valve stations, compressor station, and meter stations. Aerial inspections of the entire RoW are also required. These inspections will require ground access to specific facilities and aerial visibility of the RoW.
- Although it is possible to allow some vegetation regeneration within the RoW, Bear Paw will need to maintain a cleared width centred over the pipeline ditch, in order to enable access to the pipeline for maintenance and repairs.
- Much of Bear Paw will parallel the existing pipeline RoW and work collaboratively with the operators of the adjoining RoW to maintain and manage their respective RoWs in a like manner.

Substantial wildlife habitat, including important areas for moose will be maintained through the vegetation management protocols implemented some watercourse crossings and in areas of important habitat. By reducing the RoW width at these locations to 10 m, where practicable, these corridors will be maintained for habitat function, and line-of-sight reduction.

Sources of sensory disturbance as a result of operation and maintenance will be localized and ongoing (e.g., compressor station), or intermittent and short-term (e.g., maintenance activities along the RoW). Wildlife may habituate to ongoing sensory disturbance, or may relocate to other suitable habitats nearby. There is some potential for increased sensory disturbance during operation because of increased site access, but such effects would be minor in consideration of outlined mitigation. For example, gates can be effective at temporarily controlling public access (e.g., Switalski and Nelson 2011) and can also be used (in combination with other access control measures) to deter human access during reclamation to allow tree saplings to reach an effective height and density to control access (Sherrington 2003). Access restriction will require permission of landowners. Similarly, rollback of large woody debris provides an effective barrier to humans traveling on off-road vehicles during the snow-free months (CRRP 2005). Noise and lighting from the compressor station during operation could result in effects to habitat availability, including displacement of some wildlife.

Summary for Change in Habitat Availability

The Project will result in a loss of wildlife habitat availability as a result of direct physical disturbance and indirectly through sensory disturbance but effects will be reduced through mitigation. Direct effects of habit conversion will be permanent within the footprint of the compressor station, and will vary from temporary to permanent within the pipeline RoW. Some portion of the construction RoW will be allowed to return to pre-disturbance conditions following cessation of the construction phase; however an area of 10-20 m, will be maintained in a staggered, rotational basis (3 year cycle) in an open condition for operational, maintenance, and safety reasons. Disturbance to many sensitive habitat features could likely to be avoided with final routing. With the application of recommended mitigation, residual effects of Bear Paw on wildlife habitat availability are predicted to be not significant. In particular, residual effects do not result in non-permitted contravention of any of the prohibitions stated in the *SARA* or NS *ESA* and are unlikely to threaten the long-term sustainability of wildlife species within the RAA. Mitigation measures have been identified to be consistent with the goals, objectives or activities of recovery strategies and action plans for SOCI that are known to occur near Bear Paw.

5.6.7.2 Change in Habitat Connectivity

Construction

Construction activities have the potential to result in changes to daily and seasonal movement patterns for wildlife. The presence of a cleared RoW and associated activities are likely to provide a barrier to some species, particularly amphibians or small mammals, but are less likely to affect the movements of highly mobile species. There remains a greater potential for Bear Paw to affect habitat connectivity for some species where the RoW is immediately adjacent to other linear developments such as the existing RoW. Although sensory disturbance from vehicles, equipment and personnel might deter wildlife from using traditional travel corridors during construction, most sources of sensory disturbance during construction would only last a few weeks at a particular location, with the exception of the compressor station and HDD sites.

Operation and Maintenance

Residual effects to wildlife movement during operation include habitat avoidance as a result of sensory disturbance (e.g., noise at compressor station) and potential to act as a barrier to movement from the presence of the pipeline RoW. Sources of sensory disturbance during operation will either be localized and ongoing (e.g., compressor station) or intermittent and short-term (e.g., maintenance activities along the RoW). Residual effects resulting from the presence of the RoW will be reduced through revegetation following construction to within 10 m on either side of the centreline, or 5 m on either side of the centreline at some watercourses and in areas of important habitat.

The primary mitigation for fragmentation was in locating the pipeline adjacent to the existing RoW. Although linear corridors such as power lines have not been found to have an important influence on the movement of moose (Joyal et al. 1984; Bartzke et al. 2015), there is evidence that larger RoWs are not as frequently crossed by moose at certain times of the year (Joyal et al. 1984). Substantial wildlife habitat, including important areas for moose will be maintained through the vegetation management protocols. By reducing the RoW width at key locations to 10 m, these corridors will be maintained for habitat function, and line-of-sight reduction.

The pipeline RoW could also serve as a travel route for ATVs and snowmobiles which can have a negative influence on wildlife movement through sensory disturbance. Site access can be reduced through a number of mitigation measures (e.g., gates, rollbacks, mounding) as presented in Section 5.6.6.

Summary for Change in Habitat Connectivity

The potential for Bear Paw to result in a change in wildlife habitat connectivity will be reduced by a number of mitigation measures including reducing the RoW width at watercourse crossings. With the application of recommended mitigation, residual effects of Bear Paw on wildlife habitat connectivity during construction and operation are predicted to be not significant. In particular, Bear Paw is unlikely to limit the movement of moose or other SOCI within the landscape in such a way as to threaten their long-term sustainability within the RAA.

5.6.7.3 Change in Mortality Risk

Construction

Construction will result in an elevated mortality risk for wildlife, but residual effects are likely to be minor in consideration of outlined mitigation. For example, the potential for an increased risk of mortality to migratory birds will be reduced by scheduling vegetation clearing activities outside of the breeding season. Small mammals that spend most of their time underground or under cover of objects may experience an increased risk of mortality during the clearing and grubbing phase of construction. Hibernating herpetiles or mammals will also be at risk of mortality from clearing or grubbing during winter months. Monitoring of trenches for entrapment will reduce the potential for small mammals and herpetiles to be subject to increased risk of mortality during construction.

Operation and Maintenance

Effects of operation on wildlife mortality risk are expected to be minimal in consideration of recommended mitigation. By scheduling vegetation maintenance outside of the breeding season for migratory birds, effects to birds and other wildlife will be reduced. Mortality risk associated with collisions with vehicles during operation would be lower than during construction because fewer vehicles would be present and ongoing employee training would increase awareness of environmental issues around sensitive species, seasons and areas. Although maintenance of the operation RoW corridor could potentially result in increased access by recreational users, hunting is a regulated activity, and the presence of the RoW is unlikely to increase hunting pressures, particularly where access is already provided by nearby pipeline RoWs. Furthermore, mitigation will be used to discourage access to the RoW with landowner permission (i.e., through the use of gates, excavator mounding, road deactivation, signage, etc.) and will serve to reduce mortality risk for moose and other SOCI that could occur as a result of poaching activities or stress from exposure to sensory disturbances.

Summary for Change in Mortality Risk

Wildlife will experience an increase in mortality risk as a result of construction and operation, but the effects are expected to be minor as a result of the nature of Bear Paw activities and proposed mitigation measures. Residual effects of Bear Paw on mortality risk for wildlife during construction, operation and maintenance are predicted to be not significant. In particular, residual effects do not result in non-permitted contravention of any of the prohibitions stated in the *SARA* or NS *ESA* and are unlikely to threaten the long-term sustainability of wildlife species within the RAA. Mitigation measures have been identified to be with the goals, objectives or activities of recovery strategies and action plans for SOCI known to occur near Bear Paw (e.g., moose).

5.6.8 Monitoring and Follow-up

As indicated follow-up work will include the development of a Moose Management Plan that will be developed in conjunction with final routing and detailed engineering, to specify site-specific mitigation for construction and operation. This will be included in the EPP.

A spring pellet survey will be conducted on accessible Crown lands in 2016, as soon as snow cover and ground conditions are suitable. Results from these suveys will be submitted to NSE and NSDNR and will be used to inform final routing and the development of site-specific mitigation in the Moose Management Plan.

Migratory bird surveys will be carried out in 2016 on accessible crown lands. The results of these surveys will be submitted to NSE and NSDNR and will be used to inform final routing decisions.

5.7 TRADITIONAL LAND AND RESOURCE USE

Traditional land and resource use has been selected as a VC in recognition of the current use of land and resources for traditional purposes by the Mi'kmaq, and the potential for Project-related interactions with these current uses of lands and resources for traditional purposes. This VC includes lands and resources of specific social, cultural or spiritual value to the Mi'kmaq of Nova Scotia, with a focus on current use of land and resources (including terrestrial, freshwater and marine resources) for traditional purposes.

Activities and components associated with Bear Paw have potential to interact with the environment in such a way that directly or indirectly adversely affects traditional land and resource use by affecting access to Mi'kmaq fishing, hunting and harvesting opportunities. In addition to the more generalized standard mitigation measures outlined in Section 2.5.3, the specialized mitigation measures prescribed in Section 5.7.6 will be implemented to reduce potential effects on traditional land and resource use by the Mi'kmaq.

As explained in the assessment below, plant and animal species identified as valuable for Mi'kmaq use are considered common and abundant throughout Nova Scotia, and it is expected that these resources can be readily accessed by the Mi'kmaq for traditional use elsewhere nearby. Bear Paw is consistent with the land use currently in the area (i.e., within industrial zones at Goldboro and Point Tupper and paralleling an existing pipeline RoW through rural areas). The assessment concludes that, with the application of the mitigation recommended herein, the residual environmental effects of Bear Paw on traditional land and resource use are anticipated to be not significant.

The traditional land and resource use VC has linkages to the following other VCs: Archaeological and Heritage Resources (Section 5.9), Freshwater Environment (Section 5.2), Vegetation and Wetlands (Section 5.5), and Wildlife and Wildlife Habitat (Section 5.6).

A Project-specific Mi'kmaq Ecological Knowledge Study (MEKS) was carried out by Membertou Geomatic Solutions (MGS) to identify Mi'kmaq traditional use activities that have taken place or currently are taking place near the Project. This MEKS is a key reference for this section and is included as Appendix B.

5.7.1 Regulatory and Policy Overview

There are two key Mi'kmaq guidelines which influenced the EA process: the *Proponents' Guide: The Role of Proponents in Crown Consultation with the Mi'kmaq of Nova Scotia* (NSOAA 2012) which is used to inform engagement activities with Aboriginal groups (Section 3); and the *Mi'kmaq Ecological Knowledge Study Protocol* (Assembly of Nova Scotia Mi'kmaq Chiefs 2007) which is adhered to in the preparation of a Mi'kmaq Ecological Knowledge Study (MEKS) for the Project by MGS and UINR (Appendix B).

5.7.2 Boundaries

5.7.2.1 Spatial Boundaries

The assessment of potential environmental effects on traditional land and resource use by the Mi'kmaq encompasses three spatial boundaries: Project Development Area (PDA), Local Assessment Area (LAA), and Regional Assessment Area (RAA). The PDA is defined within Section 2.1. Spatial boundaries are presented below and Figure 5.7.1.

Local Assessment Area (LAA)

The LAA is the maximum area within which Project-related environmental effects can be predicted to occur or measured with a reasonable degree of accuracy and confidence, and encompassing the likely zone of influence. For traditional land and resource use, this area, as identified in the MEKS, is a 500 m wide corridor extending 62.5 km between Goldboro and Bear Head.

Regional Assessment Area (RAA)

The RAA is the area within which Project-related environmental effects may overlap or accumulate with the environmental effects of other projects or activities that have been, or will be carried out. The scope of the MEKS report (Appendix B) includes an MEKS Study Area that extends 5 km in all directions from the LAA. The RAA is limited to and includes the MEKS Study Area.

5.7.2.2 Temporal Boundaries

The temporal boundaries for the assessment of the potential environmental effects of the Project on traditional land and resource use include construction, and operation and maintenance. Construction is currently scheduled to begin as early as 2017 and continue over a period of two years. Operation will follow construction and continue for the life of Bear Paw.

Temporal boundaries also consider periods of enhanced biological sensitivity for resource species and times used for resource harvesting with respect to current use for traditional purposes (e.g., fishing, hunting and gathering).

5.7.3 Significance Definition

A significant adverse residual environmental effect on traditional land and resource use is defined as a Project-related environmental effect that results in a long-term, unaccommodated loss of the availability or access to land and resources that are currently used by the Mi'kmaq for traditional purposes, such that these lands and resources cannot continue to be used by the Mi'kmaq at current levels within the LAA for extended periods of time.

5.7.4 Description of Existing Conditions

5.7.4.1 Approach and Methods

The MEKS (Appendix B) identifies Mi'kmaq traditional use activities that have taken place or currently are taking place within the LAA (referred to as the Project Site in the MEKS) and surrounding RAA (referred to as the Study Area in the MEKS), as well as any Mi'kmaq traditional ecological knowledge that presently exists with respect to those areas.

The two main components of the Project-specific MEKS are:

- a study of past and present Mi'kmaq traditional land and resource use activities (using interviews as the key source of information); and
- a Mi'kmaq species significance analysis considering resources that are important to Mi'kmaq use.

As a first step to gathering traditional use information, the MGS MEKS team initiated dialogue and correspondence with the relevant Mi'kmaq communities. Mi'kmaq communities located near the Project that may be potentially affected by Project-related activities include Paq'tnkek, Waycobah, Wagmatcook, Potlotek and Millbrook. Discussions occurred regarding the identity of individuals within these communities who undertake traditional land use activities, or those who are knowledgeable of the land and resources, and an initial list of key people was developed by the MGS team. These individuals were then contacted by MGS and interviews were scheduled (MGS 2016).

For this MEKS, 39 individuals were contacted to provide any land use knowledge they had in the Study Area; 17 individuals agreed to participate in the interviews. All of the interviews were completed in accordance with the *Mi'kmaq Ecological Knowledge Protocol, 2nd Edition*.

In addition to interviews, a combination of desktop research and site visits were also used to identify past and present land and resource uses and features of the LAA and RAA that are of particular importance to the Mi'kmaq people. Further details about the methods employed for the MEKS are provided in Appendix B.

5.7.4.2 Summary of Existing Conditions

The Mi'kmaq of Nova Scotia are the holders of information about traditional and current hunting, trapping, fishing, gathering, and other land and resource uses that can meaningfully contribute to Project-related research and the environmental assessment process. There are 13 First Nation communities with Chiefs in Council in Nova Scotia. The Kwilmu'kw Maw-klusuaqn Negotiation Office (KMKNO) represents the negotiations between the Mi'kmaq of Nova Scotia, the Province of Nova Scotia and the Government of Canada. The Sipekne'katik (Shubenacadie) First Nation, however, is not represented by the KMKNO. Mi'kmaq people living off-reserve are represented by the Native Council of Nova Scotia (NCNS).

There are five Mi'kmaq communities located near the Project that have the potential to be affected by Project-related activities including: Paq'tnkek, Waycobah Wagmatcook, Potlotek and Millbrook (Figure 5.7.1). Population details of these communities are provided in Table 5.7.1.

Table 5.7.1 Mi'kmaq Community Population Summary

Mi'kmaq Community	Total Population	Female Population	Male Population
Paq'tnkek	375	200	175
Waycobah	810	400	410
Wagmatcook	520	240	275
Potlotek	485	235	240
Millbrook	995	470	530
Source: AANDC 2011			

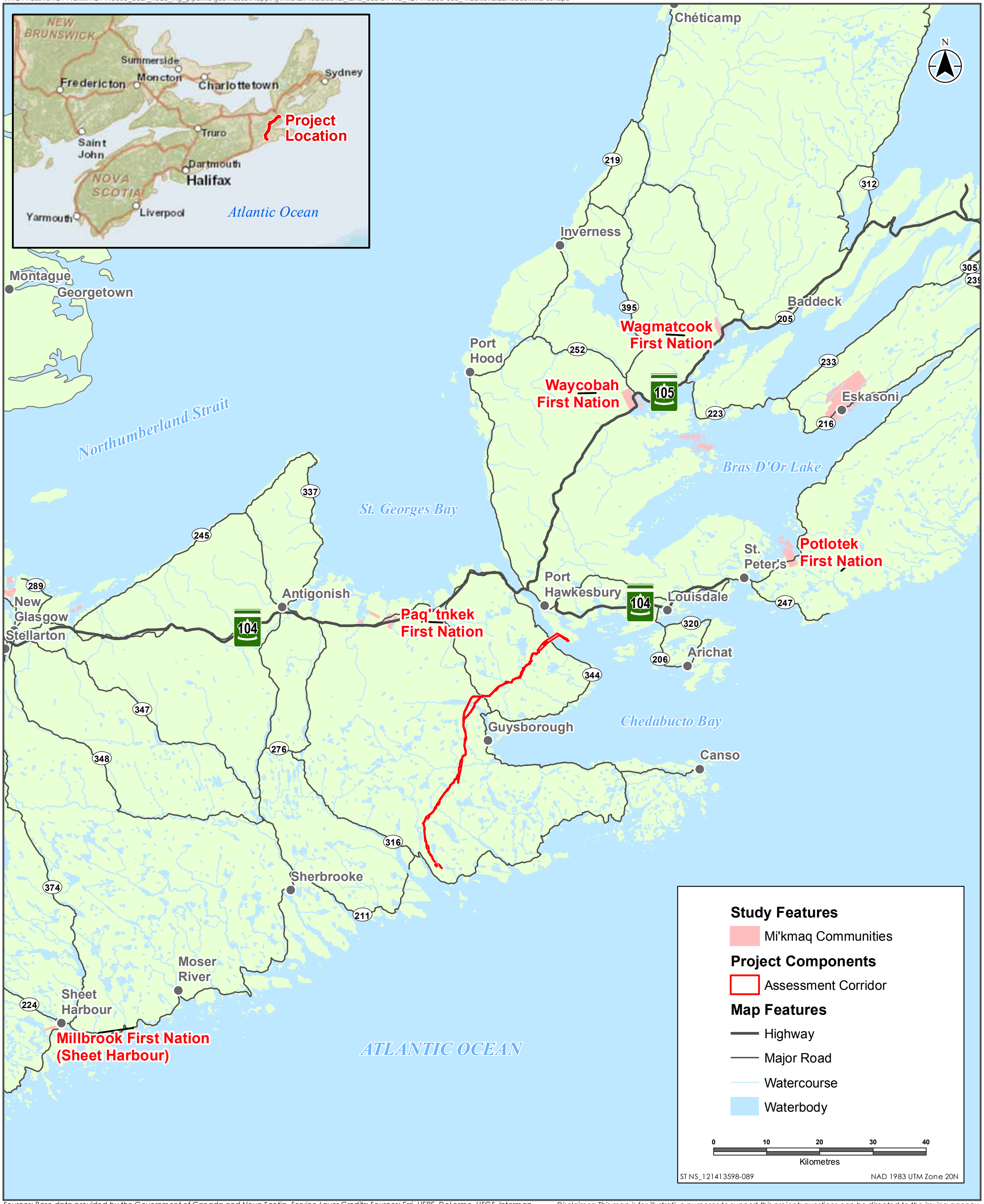
The Paq'tnkek community is located 20 km from the LAA. Established in 1820, the community is located in Antigonish County 24 km east of Antigonish (Paq'tnkek n.d.). The community is located near St. Georges Bay, which has historically and continues to be an important resource for the community. Today, the operation of the Paq'tnkek Fisheries Enterprise incorporates their cultural identify as well as treaty driven economic development opportunities (Paq'tnkek n.d.). Community infrastructure includes gas station and convenience store, restaurant, daycare, school (grades primary to six), health care, and band offices.

Waycobah, traditionally known as We'koqma'q, is located along the bras d'Or Lakes and 44 km from the LAA. A rapidly growing community, the community focuses on economic and social development to enhance Waycobah's natural attributes (Waycobah n.d.). Community infrastructure includes gas station and convenience store, gaming centre, traditional shops such as a basket shop, school (from primary to grade 12), daycare, band administrative buildings, and health centre.

Wagmatcook is located along the Bras d'Or Lakes on Highway 105 outside the village of Baddeck. The community is located 64 km from the LAA. The community is supportive of social and economic development within their community (Wagmatcook n.d.). Community infrastructure includes culture and heritage centre, pre-school, restaurant, and administrative buildings. The community operates the Wagmatcook Commercial Fishery that is communally owned by registered members of Wagmatcook band (Wagmatcook n.d.).

Potlotek, also known as Chapel Island, is located in Chapel Island on the Bras d'Or Lake, 44 km from the LAA. In 1995 the Apaqtukewaq Fisheries Co-op was formed operating two vessels fishing for lobster and crab (Potlotek n.d.). An oyster plant was opened outside of the community due to a demand for oysters. Community infrastructure includes gas station and convenience store, restaurant, daycare, school (grades primary to six), health care, and band offices.

V:\1214\active\121413xxx\121413598_bear_head_lng_pipeline\geomatics\mapping\mxd\EIA\traditional_land_use\ST NS_121413598-089_TraditionalLandUse.mxd cshupe



Sources: Base data provided by the Government of Canada and Nova Scotia. Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

Traditional Land Use

BEAR PAW PIPELINE PROJECT

Figure 5.7.1

Millbrook First Nation is located within the town of Truro, approximately 75 km from the LAA. Economic development in the community has grown over the past decade with the development of the Truro Power Centre, the Cole Habour land development of apartment buildings and General Dynamics Building, community wind farms, as well as advances in the gaming, fishery and tobacco industries (Millbrook website n.d.).

Historic Review

As identified in the MEKS, the LAA crosses six known and probably ancient travel routes from the coasts of Chedabucto Bay and the Atlantic, leading deep into the interior of the Province and connecting with head waters of other rivers flowing to all coasts. There is little archaeological evidence within this region to indicate the presence of early peoples, which may be factor of too little investigation and a light population resulting in fewer accidental archaeological finds. A review of historical maps and documents reveals the Mi'kmaq connection to the land.

The last known traditional hunting territories near the Project Corridor include: Traditional Territory No. 43 covering the area of Loon Lake; No. 42 covering the area of Isaacs Harbour; and No. 44 along the Strait of Canso. Hunting territories in Cape Breton include No. 47, covering much of Cape Breton Island, and No. 48 including Ile Madame.

The shores and islands of Chedabucto Bay, particularly the Canso area, were favorite landings for European fishermen as an area to dry their catches, and an area for the Mi’kmaq to trade with the Europeans since the mid 1500’s.

During the early 1680’s, the Mi’kmaq had an encampment in the area of the present-day Guysborough town site. Nineteenth century Mi’kmaq encampments are reported at School House Brook, Issacs Harbour and another where the Issacs Harbour River flows into the harbour. The School House Brook location is also thought to be a Mi’kmaq burial site. Other sources place Mi’kmaq encampments along the Strait of Canso at McNairs Cove and Melford Point.

A review of historic maps of Guysborough County in the late 1800's show very little recorded evidence of Mi’kmaq settlements within the LAA and some of the locations along Chedabucto Bay and Eastern Shore. However, a Census of the early 1900’s enumerated the Mi’kmaq of “Cooks Cove Micmac Reservation” of unknown location, which indicated a population of approximately 40 persons identifying themselves as Mi’kmaq near the community of Guysborough.

A review of current Land Claims show no current active claims within the PDA and LAA.

Traditional Use in the LAA and RAA

Based on the data documented and analyzed for the MEKS, Mi'kmaq use has been reported in the LAA and the RAA, and continues currently. These activities primarily involve harvesting of fish and animals, but also include harvesting plants, and tree species. These activities occur in varying locations and at varying times of the year.

A site visit in support of the MEKS was conducted in fall 2015 and identified plant and animal species and habitats, or other land/water features that are of importance to the Mi'kmaq. There were 66 plant and tree species, animal signs or other important features noted with the most common observations being maple trees, balsam fir trees, black spruce trees, partridge berries, and blueberries. All observations are provided in Table 1 of the MEKS in Appendix B.

Trout and salmon were found to the most fished species within the LAA and the RAA. Other fish species fished in the LAA includes striped bass, mackerel, and sea urchin. Eel, clam lobster, and scallops were also identified in the RAA. Fishing locations are identified in Section 4.4 of the MEKS, Appendix B. Nearly all the fishing areas described by participants were used for Food, Social, Ceremonial (FSC) harvesting purposes, with the exception of three fishing areas used for commercial purposes (sea urchin and elvers).

Deer and rabbit were found to be the most hunted species within the LAA and the RAA. Other hunted species in the LAA and RAA include partridge and duck. Hunting activities are for the most part used for FSC harvesting purposes with only one participant noting hunting activity for the purpose of commercial uses. Hunting locations are identified in Section 4.4 of the MEKS, Appendix B.

Gathering in the LAA and RAA mainly consisted of blueberry gathering. Other gathering activities in the LAA included mushroom, balsam fir, spruce, cranberries and sweetgrass. Cranberry and "wood splint" gathering areas were identified in the RAA. Gathering locations are identified in Section 4.4 of the MEKS, Appendix B.

The MEKS maintains that all traditional use activities are considered important means of preserving the Mi'kmaq way of life. However, three activities were highlighted in the MEKS as having special importance to the Mi'kmaq. This includes Atlantic salmon and trout fishing and sweetgrass gathering. The Atlantic salmon, considered an endangered species, is used by the Mi'kmaq for sustenance and cultural ceremonies. Trout fishing is important due to the frequency of the activity and is an activity that has been occurring historically, recently and currently. Sweetgrass is used during ceremonies to smudge, or cleanse oneself of negativity.

5.7.5 Potential Environmental Effects and Project-Related Interactions

Activities and components could potentially interact with traditional land and resource use by affecting access to Mi'kmaq fishing, hunting, and gathering opportunities as well as the availability of resources used for traditional purposes. The assessment of Project-related environmental effects on traditional land and resource use is therefore focused on the following potential environmental effect:

- change in traditional use.

The effect pathway and measurable parameters used for the assessment for this environmental effect is provided in Table 5.7.2.

Table 5.7.2 Potential Environmental Effects, Effects Pathways and Measurable Parameters for Traditional Land and Resource Use

Potential Environmental Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in Traditional Use	• Direct or indirect loss in accessibility to and availability of traditional use resources arising from Project activities.	• Documented current use of land and resources for traditional purposes by the Mi'kmaq. • Project effects on traditional land access. • Change in habitat that could affect resource use for traditional purposes. • Potential social and/or economic effects to the Mi'kmaq that may arise as a result of any change in the environment due to the Project.

A change in traditional use could potentially occur as a result of potential Project-related changes in marine and terrestrial habitats. Construction, and operation and maintenance activities have potential to affect Mi'kmaq land and resource use for current and future generations. Restricted access to the PDA during construction could constrain Mi'kmaq fishing, hunting, and gathering opportunities. During operation and maintenance, the presence of permanent infrastructure associated with the pipeline could similarly restrict Mi'kmaq fishing, hunting, and gathering opportunities.

5.7.6 Mitigation

Potential Project-related effects on traditional land and resources use will be mitigated through implementation of standard mitigation noted in Section 2.5.3 as well as the recommendation stated in the Project-specific MEKS report. Mitigation for traditional land and resources use are provided in Table 5.7.3.

Table 5.7.3 Mitigation for Traditional Land and Resource Use by the Mi'kmaq

Effect	Mitigation
Change in Traditional Use	• As noted from the MEKS, it is recommended that Bear Paw Pipeline communicate with the Assembly of Nova Scotia Mi'kmaq Chiefs to discuss future steps, if required, with regards to Mi'kmaq use in the area. • Access restrictions will be defined in advance and will be limited in size to reduce interactions with land and resource users. • The mitigation recommended for the heritage resources VC (Section 5.9) will minimize potential Project-related effects on sites or artifacts of archaeological or heritage importance to the Mi'kmaq. • Mitigation carried out in support of the biophysical environment (i.e., the freshwater environment (Section 5.2), marine environment (Section 5.4), wildlife and wildlife habitat (Section 5.6), vegetation and wetlands (Section 5.5) and land and resource use (Section 5.8) VCs) will protect habitats and species of traditional importance to the Mi'kmaq.

5.7.7 Residual Environmental Effects and Significance Determination

Change in Traditional Use

Construction

Even with the application of mitigation described in Table 5.7.3, changes in traditional land and resource use may result in direct and indirect disturbance to or loss of resources traditionally harvested on the lands in the LAA. A number of species were noted in the MEKS as being hunted or gathered by the Mi'kmaq in the LAA including the gathering sweetgrass, which was identified as an activity of importance due to ceremonial uses. Communication and engagement with the Mi'kmaq will be important prior to and during construction activities.

During construction activities, there will be a loss of access to lands within the PDA used for traditional activities including hunting and gathering. This loss of access will be temporary for the construction of the pipeline; however, it will be permanent for the life of the Project in areas of surface infrastructure (i.e., compressor station, valve stations, access roads) resulting in the loss of land resources that otherwise potentially could have been used for traditional purposes by the Mi'kmaq. In general, Bear Paw is consistent with current surrounding land uses (i.e., within industrial zones at Goldboro and Point Tupper, and paralleling an existing pipeline RoW) and the location of components has been selected, in part, for this reason to reduce potential effects, including potential effects to traditional use.

Construction in marine and freshwater environments has the potential to temporarily affect traditional fishing activities in the PDA. Trout and salmon fishing was identified in the MEKS as a common activity within the LAA and of importance to the Mi'kmaq for FSC harvesting purposes.

Bear Paw Pipeline will provide reasonable and safe access, as feasible, to Mi'kmaq fishers whose traditional fishing areas near Project infrastructure and activities.

Operation and Maintenance

During Project operation and maintenance, areas of surface infrastructure (i.e., compressor station, valve stations, access roads) will preclude Mi'kmaq use of that land and associated resources for traditional purposes. Since the pipeline will be buried, no long-term effects are anticipated for hunting and gathering activities. The plant and animal species identified within the MEKS are considered common and abundant throughout Nova Scotia and it is anticipated that areas for hunting and gathering are available for Mi'kmaq use outside of the PDA. It is therefore expected that these resources can be readily accessed by the Mi'kmaq for traditional use elsewhere nearby.

During operation and maintenance there is potential for effects on the freshwater environments used for traditional fishing activities could result from vegetation clearing; however, with the implementation of mitigation measures described in Section 5.2.6, it is anticipated that freshwater habitats will return to near baseline conditions, and vegetation control will not permanently alter the freshwater environment to a point where freshwater habitats in the LAA are marginalized.

Summary of Change in Traditional Use

In summary, the Project will result in a change in traditional use that will persist over the life of the Project. Construction activities will temporarily cause disturbance to traditional resources or access to lands used for traditional purposes. The presence of the aboveground structures (e.g., compressor station and valve stations) will represent a permanent change in land use and will restrict certain traditional land use activities within those footprints. These effects will be reduced through implementation of mitigation including ongoing communication with the Mi'kmaq. Activities are not anticipated to cause disruption, wide spread restrictions, or the degradation of land and traditional resource use to a point where it cannot generally continue at current levels. With the application of recommended mitigation, residual effects of the Project on traditional use are predicted to be not significant.

5.7.8 Monitoring and Follow-up

With the implementation of standard mitigation and follow-up and monitoring proposed in the freshwater, marine environment, and wildlife and wildlife habitat VCs, no follow-up and monitoring is proposed to be implemented for routine Project activities. Ongoing engagement with local Mi'kmaq community representatives will provide feedback on the effectiveness of this mitigation and confirm this effects prediction and any required adaptive management.

Environmental Assessment
March 2016

5.8 LAND AND RESOURCE USE

Land and resource use was selected as a VC to evaluate:

- the interactions between Bear Paw and the current use of land and resources within the defined assessment corridor; and
- Bear Paw's compatibility with existing and proposed land and resource uses, and with municipal land use plans and zoning designations.

Land and resource use includes existing residential, industrial, commercial, recreational and agricultural land uses, and resource use (e.g., forestry, mineral exploration), and other areas of special community or social value.

Activities and components associated with Bear Paw have potential to interact with the environment in such a way could or indirectly adversely affects land and resource use. The specialized mitigation measures prescribed in Section 5.8.6 will be implemented to reduce potential effects on land and resource use, in addition to the more generalized standard mitigation measures outlined in Section 2.5.3.

As explained in the assessment below, the development of Bear Paw is consistent with land use currently in the area (i.e., within industrial zones at Goldboro and Point Tupper and paralleling an existing pipeline RoW). Bear Paw is not expected to cause disruption, widespread restrictions, or the degradation of land and resource use to a point where it cannot generally continue at current levels. It is expected that the change in land and resource use attributable to Bear Paw will provide an important component of energy infrastructure in Nova Scotia including the resultant economic benefits. The assessment concludes that, with the application of the mitigation proposed herein, the residual environmental effects of Bear Paw on land and resource use are predicted to be not significant.

This land and resource use VC is linked to other VCs that are described elsewhere in this EA, including Section 5.2 (Freshwater Environment), Section 5.4 (Marine Environment), Section 5.5 (Vegetation and Wetlands), and Section 5.6 (Wildlife and Wildlife Habitat). Traditional land and resource use by the Mi'kmaq of Nova Scotia is addressed separately and described in Section 5.7 (Traditional Land and Resource Use).

5.8.1 Regulatory and Policy Overview

Bear Paw falls within the MODG and the Municipality of the County of Richmond. Nova Scotia municipalities are enabled to create legally binding municipal planning strategies pursuant to Nova Scotia's *Municipal Government Act*. Municipal planning strategies as well as land use bylaws are used by municipalities to guide the development of land use in the municipality; more specifically the planning strategy provides policy direction to regulate the use of land within the borders of a municipality to reduce conflicts between land uses, while the zoning bylaw provides the regulatory tools to execute the strategy.

Municipalities, however, do not regulate oil and gas pipelines. The pipeline is regulated under the Nova Scotia *Pipeline Act*; associated infrastructure, such as the development of the compressor station, is subject to development regulations and must align with provisions within the applicable planning strategy and land use bylaw.

The MODG has a noise bylaw that outlines the times of day that noise from construction activity is permitted. Construction activities, for which a Building Permit has been issued by the Municipality, are permitted between the hours of 7:00 am and 9:00 pm.

Crown land traversed by the pipeline is administered by NSDNR under the Nova Scotia *Crown Lands Act*, which regulates the development, protection and management of Crown lands resources. NSDNR issues dispositions for Crown lands including leases and licensing agreements for economic purposes. Licenses and leases range in purpose from the establishment of cranberry bogs to power lines (NSDNR 2015f). An easement will be required from NSDNR for the construction and operation of the pipeline RoW within provincial crown lands.A permit under the Nova Scotia *Beaches Act* and Provincial Crown Land lease under the *Crown Lands Act* (Section 16(1)(a)) may also be required from NSDNR for the construction of the water crossings depending on construction method.

The Nova Scotia *Wildlife Act* regulates hunting, fishing and trapping on private and public land, and establishes protected wildlife management areas.

The *Navigation Protection Act* is administered by Transport Canada. The latter describes navigable waters as "any body of water capable of being navigated by any type of floating vessel for the purpose of transportation, recreation or commerce". Waterways designated as "scheduled" support commercial or recreational-related navigation. Transport Canada has designated the Atlantic Ocean, which includes the Strait of Canso, as a scheduled waterway (Schedule 2).

5.8.2 Boundaries

5.8.2.1 Spatial Boundaries

The assessment of potential environmental effects on land and resource use encompasses three spatial boundaries: Project Development Area (PDA), Local Assessment Area (LAA), and Regional Assessment Area (RAA). The PDA is defined within Section 2.1.The LAA and RAA spatial boundaries are discussed below.

Local Assessment Area (LAA)

The LAA is the maximum area within which Project-related environmental effects can be predicted to occur or measured with a reasonable degree of accuracy and confidence, and encompasses the likely zone of influence. For land and resource use, this area includes the assessment corridor, within which the pipeline and compressor station will be located (Maps 1-8, Appendix G). The assessment corridor is approximately 100 m wide (100 m minimum, wider when necessary) for most of the length of the pipeline.

Regional Assessment Area (RAA)

The RAA is the area within which Project-related environmental effects may overlap or accumulate with the environmental effects of other projects or activities that have been, or will be carried out. For this VC, the RAA includes the municipal boundaries of the MODG and the Municipality of the County of Richmond.

5.8.2.2 Temporal Boundaries

The temporal boundaries for the assessment of the potential environmental effects of Bear Paw on land and resource use include construction, and operation and maintenance. Construction is currently scheduled to begin as early as 2017 and continue over a period of two years. Operation will follow construction and continue for the life of Bear Paw.

5.8.3 Significance Definition

A significant adverse residual environmental effect on land and resource use will occur if proposed activities are not compatible with adjacent land or resource use activities as designated through the municipal land use planning process, and/or the proposed use of the land will create a change or disruption that widely restricts or degrades the present land or resource use to a point where activities cannot continue at current levels and for which this change is not mitigated.

5.8.4 Description of Existing Conditions

5.8.4.1 Approach and Methods

A combination of spatial analysis and baseline research was used to characterize the types and extent of the land uses and resource use activity within the LAA. Baseline research included a review of online sources for land use information including:

- GIS databases;
- published maps and aerial photography;
- Department of Natural Resources website;
- Department of Mines and Energy website;

- municipal websites; and
- LiDAR surveys.

5.8.4.2 Summary of Existing Conditions

The pipeline will extend approximately 62.5 km between supply sources near Goldboro, Nova Scotia, and the site of the future Bear Head LNG Export Facility in Point Tupper, Nova Scotia. Bear Paw is located in a mostly rural area of Nova Scotia. The LAA covers approximately 1,102 ha area of land of which approximately 46% is Provincial Crown Land (Maps 1-8, Appendix G).

The municipal planning strategy and land use bylaw were amended for the MODG in 2013. As indicated by these plans, Bear Paw is located in the following zones: Industrial Resources (I-3), Natural Resources (NR-1) and Mixed Use Rural Residential (MRR-1). The compressor station is located within the Industrial Resources Zone and is consistent with relevant land uses in the area. In the Municipality of the County of Richmond, Bear Paw is located in an Industrial Zone, specifically the Point Tupper Industrial Park, governed by the Eastern District Planning Commission bylaws.

A municipal development permit or building permit will be obtained from the municipalities, as required for the development of Project-related buildings, in particular for the compressor station in the MODG.

Residential, Industrial and Commercial Land Use

Bear Paw is located within the MODG and Municipality of the County of Richmond. There are approximately 10 buildings located within the LAA, with small clusters of residential dwellings located within the MODG and concentrated primarily around the residential population centres at Sunnyville, the town of Mulgrave, and the community of Guysborough located south of the LAA. In the Municipality of the County of Richmond, nearby settlements include Point Tupper and Port Hawkesbury.

Within the LAA, there are no commercial or institutional land uses.

The compressor station is located within the Goldboro Industrial Zone near the existing SOEP Gas Plant. The LAA within the Municipality of the County of Richmond is also located within an industrial zone, the Point Tupper Industrial Park.

Agriculture and Natural Resource Use

There are no agricultural lands identified within the LAA. Based on aerial photo interpretation, and incidental observations noted during the terrestrial surveys conducted for Bear Paw, limited farming activity occurs within the LAA; the little that exists appears to comprise mostly hobby farming, concentrated near a few old homesteads, not all of which may be currently active.

The majority of the LAA is forested, accounting for approximately 771 ha, or approximately 70% of the LAA. The presence of actively managed woodlots in the LAA was identified during the terrestrial surveys undertaken in support of the current EA in; A presence of clear-cutting equipment and recently used logging roads were noted.

There are no registered gravel pits or quarries within the LAA. Exploration Orex Incorporated and Annapolis Properties Corporation have registered mineral exploration licenses within the LAA. These licenses account for 21.6 ha of the LAA (1.96%).

Hunting, Trapping, and Fishing

Hunting and fishing activities are permitted on Crown land, in season and with a license (NSDNR 2015g). Hunting and trapping of rabbit, mink, muskrat, red squirrel, skunk, weasel, otter, bobcat, beaver, fox and coyote are known to occur within the LAA. Bear Paw is located within NSDNR Deer Management Zone 110. Deer Management Zones were introduced in 1998 to more easily provide hunting opportunities in areas where deer numbers had increased, while limiting (bucks only) hunting where numbers were lower (NSDNR n.d.). Antlerless deer and moose hunting stamps are available through special application and a limited license draw process. In 2015, 400 deer stamps were available for Deer Management Zone 110 (NSDNR n.d.). Moose hunting is not permitted on the mainland Nova Scotia.

The PDA crosses approximately 69 freshwater inland watercourses, including the Salmon River, the largest of the crossings. Fish and fish habitat surveys were conducted in 2015 in watercourses located on Crown land within the LAA. Twenty-nine watercourses were identified as accessible to the public and potentially used for recreational fishing. Of the watercourses visited by the field crews, the Salmon River was described as the watercourse within the LAA likely to be most commonly used for recreational fishing activities, given its size and easy accessibility from both the South River Lake Road and the local trail system. Recreational fishing for mackerel occurs in the Canso Causeway, more specifically from local wharves and piers around Port Hawkesbury, as well as from the southeast tip of Bear Head. Two mackerel traps are registered in the wider area of the Strait where it opens to Chedabucto Bay (SNC 2015). Fish species assemblages in these watercourses are described in Section 5.2 (Freshwater Environment) and Section 5.4 (Marine Environment).

There is no evidence of any large-scale fishery in the Strait of Canso (SNC 2015), including prior to the installation of the causeway (McCracken 1979). No commercial fisheries occur in the Strait of Canso near the assessment corridor because this area is used for shipping and the adjacent lands have been extensively industrialized (SNC 2015). The water in the Strait deepens quickly given the steep topography in the area, and the narrow shoreline provides limited habitat for many commercial species, such as lobster.

Milford Haven River is only used for recreational fishing, but the same populations of marine fish found in the Milford Haven River may be commercially fished when move downstream. Bivalve fisheries species in the river include bar clams, soft shell clams, bay quahogs, razor shells, clams, mussels and oysters. It is noted that there is a DFO order currently prohibiting fishing these species because of contamination (DFO 2014). Recreational fishing for small mouth bass, brown trout, and speckled trout takes place in the freshwater environment of the upper reaches of the Milford Haven River (DFO 2015; Nova Scotia 2014).

Recreational and Protected Areas

The Snowmobilers Association of Nova Scotia is a non-profit organization that manages the snowmobile trails on behalf of NSDNR (NSDNR 2015h). Designated trails are identified in each of four regions in the province (NSDNR 2015h). The LAA is located in Zone 3 (Eastern Nova Scotia). There are, however, no designated snowmobile trails located near the LAA, but indications of unofficial trails and their use have been noted in the area.

The LAA is located in the Chedabucto Multi Use Trail Zone (Zone 5). Although no official trail mapping was available to support trail use in the LAA, evidence of widespread ATV use along the entire existing RoW was noted during the terrestrial surveys. Several multi-use trail systems were noted, including signs that indicated recent activity.

A section of the TransCanada Trail is intersected by the PDA. The Guysborough County Nature Trail is a 45 km trail that is part of the Trans Canada Trail system (Canada Trails n.d.). The trail runs between Country Harbour Cross Roads to the town of Guysborough. Activities along this trail include walking, hiking, cycling, horseback riding, cross-country skiing, snowmobiling and ATV use.

Bear Paw crosses a small portion of the pending Chedabucto Fault Nature Reserve. Bear Paw is also in close proximity to the pending Mulgrave Nature Reserve (Mapbook, Appendix G). The Ogden Round Lake Wilderness Area, located 1 km north of the LAA (Maps 4-5, Appendix G), is also a provincially protected area. Within this wilderness area, there are opportunities for hiking as well as several larger lakes ideal for fishing and exploration by canoe.

There are no federal or provincial parks within the LAA. The nearest provincial park is the Boylston Provincial Park located 1 km from the LAA (Map 5, Appendix G).

Linear Infrastructure

The LAA intersects Highway 16 that runs from the Trans-Canada Highway (TCH 104) into the MODG and is the heaviest travelled route in the LAA. From the intersection with TCH 104 in Monastery, Nova Scotia, Highway 16 follows the Tracadie River crossing Milford Haven River and travels along the west of the river to its mouth at Guysborough where it continues to the coastline of Chedabucto Bay.

There are two existing pipelines (M&NP NPS 8 NG pipeline and SOEP NPS 8 NGL pipeline) near Bear Paw; these extend from Goldboro, NS to Point Tupper, NS. These buried pipelines were constructed and designed at the same time, and are positioned approximately 30 cm from each other sharing a common trench and RoW (Maps 1-8, Appendix G). Bear Paw will parallel the existing pipeline RoW to the extent possible (Maps 1-8, Appendix G).

Navigation

Bear Paw crosses the Strait of Canso, which is a deep-water channel separating mainland Nova Scotia and Cape Breton Island. Due to its depth and width, the fact that it is ice-free and abuts industrially zoned lands, the Strait accommodates a substantial amount of marine traffic. The Canso Canal is operational for approximately 254 consecutive days per year on a 24-hour basis during ice-free conditions (Government of Canada 2015). Annual statistics of marine vessels that have moved in and out of the Canso Traffic Zone are compiled by the Sydney Marine Communications Traffic Services on a year-over-year basis. Generally, only marine traffic 20 m or more in length is accounted for, with most non-reporting traffic consisting of small fishing vessels and pleasure craft. The number of vessels recorded by the Marine Communications Traffic Services during 2014 was 962 (J. Gaudet pers. comm. 2014). The Canso Canal caters primarily to commercial ships, with approximately 85% owned and operated by shipping companies, fisher persons and government; the remaining 15% of users are identified as pleasure craft (Government of Canada 2015). The Canso Canal is owned by the Government of Canada and is operated by the Canadian Coast Guard (Government of Canada 2015).

Recreational boating is believed to occur at other watercourse crossings along the RoW, including, but not limited to, the Milford Haven River and Salmon River.

5.8.5 Potential Environmental Effects and Project-Related Interactions

Activities and components could potentially interact with land and resource use by disrupting existing uses. The assessment of Project-related environmental effects on land and resource use is therefore focused on the following potential environmental effect:

- change in land and resource use.

The effect pathways and measurable parameters used for the assessment of the environmental effect are provided in Table 5.8.1.

Table 5.8.1 Potential Environmental Effect, Effect Pathways and Measurable Parameters for Land and Resource Use

Potential Environmental Effect	Effect Pathway	Measurable Parameters and Units of Measurement
Change in Land and Resource Use	• Activities during construction will result in the disruption of existing land use as a result of temporary access restrictions, disruption to traffic patterns, and changes in sound/dust levels. • The RoW will be cleared of merchantable timber and will no longer be available for forestry activities during operation. • Pipeline installation and operation near watercourse crossings and in the marine environment has the potential to disrupt existing uses caused by change in access. • Operation activities (e.g., maintenance of the RoW) could or may result in long-term loss or alteration of habitat for wildlife that is hunted in the area. • Construction activities could result in long-term restrictions on future land use activities within the PDA (e.g., mining activities). This could continue through operation and maintenance activities. • Operation and maintenance activities may result increased access for recreational users.	• Change in sound/dust level. • Area (ha) of land use affected (e.g., forestry). • Habitat loss or alteration associated with Bear Paw (ha). • Catch and harvesting levels of freshwater and saltwater fish harvesting areas.

A change in land and resources use from Project-related activities may occur as a result of loss of and changes to access to land and resources. Although most changes are limited to the construction phase, some, such as restrictions on future land use within the PDA, extend throughout operation.

Potential interactions may include:

- noise emissions during construction;
- short-term traffic increases during construction;
- permanent loss of merchantable forest resource as a result of construction, specifically the clearance of the RoW;
- temporary loss of agricultural land and production as a result of construction;
- short-term reduction in access for hunting, fishing, ATV/snowmobile use during construction;
- restrictions on permissible uses of RoW lands during operation; and

- potential increase in non-permitted use of RoW during operation.

As discussed in Section 5.1, air emissions will include dust and exhaust emissions during construction. Control measures, such as the use of dust suppression techniques, will be used in construction zones to reduce dust. Air emissions will be maintained within the limits specified by the Nova Scotia *Air Quality Regulations* (*Environment Act*). Air quality effects on land use are therefore not considered further in this analysis. Noise emissions will not exceed provincial guidelines at the closest residences (Section 5.1), and are not expected to result in nuisance effects. Noise emissions are also therefore not discussed further in this analysis.

5.8.6 Mitigation

Bear Paw Pipeline is actively working with potentially affected landowners (i.e., private landowners and Crown lands) to identify properties where easements will be required for the installation of the pipeline. Property owners that may have changes made to the access to their property as a result of construction activities or pipeline routing will be also be consulted and their needs accommodated where possible. Property-specific mitigation will be developed in consultation with the affected landowners (e.g., the provision of signage, temporary detours, alternative access).

Potential adverse effects on land and resources use will be mitigated through the implementation of standard mitigation measures noted in Section 2.5.3. Mitigation measures specific for land and resource use are provided in Table 5.8.2.

Table 5.8.2 Mitigation for Land and Resource Use

Environmental Effect	Mitigation
Change in Land and Resource Use	• During the construction, and operation and maintenance, noise and air (dust) emissions will be mitigated to acceptable levels (Section 5.1.6). • Owners of private land will be consulted and accommodations made prior to construction. • Crown lands leases will be obtained as needed by NSDNR. • Crossing agreements and other accommodation will be negotiated with license holders prior to construction. • Measures will be employed along the pipeline route to limit unauthorized traffic (e.g., installation of fencing or posting of signs). • Timber and brush disposal options are subject to agreements with landowners, occupants and the appropriate regulatory agency where public lands are intersected. • If requested, leaseholder/ landowners will be allowed to use timber cut on their property. • Bear Paw Pipeline will announce schedules for activities, particularly those related to clearing activities and involving access restrictions. • Access restrictions will be defined in advance and will be limited in size to reduce interactions with land and resource users. • Sites requiring little or no modification, such as forestry landings or harvested fields will be used for temporary staging areas.

Table 5.8.2 Mitigation for Land and Resource Use

Environmental Effect	Mitigation
	• Communication with respect to activities with offshore marine resource users will serve to mitigate potential conflicts with navigation during pipeline installation. • Land use development agreements will be obtained for the development of the compressor facilitiy and other structures, as required. • Discussions with regulatory authorities including NSE and NSDNR to address potential concerns with development within or near Nature Reserve areas.

5.8.7 Residual Environmental Effects and Significance Determination

5.8.7.1 Change in Land and Resource Use

Construction

Residential, Industrial and Commercial Land Use

Construction activities related to site preparation within the PDA and pipe placement have the potential to change land use by altering terrain and temporarily restricting access throughout the LAA. Land agreements will be negotiated with landowners along the RoW, which will provide compensation for loss of use and address other matters such as the need for alternative access should circumstances warrant.

Disruption in traffic flow, particularly on Highway 16 that is the most heavily travelled route along the LAA, could potentially occur as a result of activities. Disruptions in traffic flow may include change in access, delays and increased wait times. Bear Paw Pipeline will apply standard traffic control procedures to reduce trafffic interruptions and maintain traffic continuity.

There is limited commercial and industrial development within the LAA. Most commercial and industrial activities are located in, or close to, existing towns and villages within the RAA. There is some industrial activity near the compressor station and that portion of the LAA located in the Municipality of the County of Richmond, i.e., within the Point Tupper Industrial Park. Activities are expected to be consistent with these current uses and therefore no environmental effects are anticipated on commercial or industrial development as a result of Bear Paw.

Agriculture and Natural Resource Use

The LAA does not cross agricultural lands. Therefore, no predicted interaction with agricultural land uses during construction is predicted. Hobby farming was identified during the terrestrial field surveys; this type of agricultural use (e.g., pasture) is compatible with pipeline development (e.g., pasture land can be restored and maintained across the RoW).

Construction activities will interact with forestry resource land use. Site preparation, including clearing, grubbing, grading, and topsoil stripping will remove forest resources. This activity may result in a direct loss of marketable trees. The construction of temporary ancillary structures and facilities may also result in the loss of trees. As the RoW will be relatively small compared to the overall forest resources in the region, it is not anticipated that Bear Paw will result in a substantial decrease in merchantable forest resources. Bear Paw Pipeline will work with forestry resource owners to salvage merchantable timber that may be affected by construction.

The LAA crosses approximately 121 ha of exploration licenses held by Orex Incorporated and Annapolis Properties Corporation. Crossing agreements and other accommodation will be negotiated with license holders prior to construction.

Recreational Use

Construction has the potential to interact with recreational land use. Recreational land use in the LAA includes fishing, hunting and trapping, trail use (e.g., Guysborough Nature Trail), snowmobiling and ATV use. The LAA does not pass through either federal or provincial parks. Recreational fishing and access along roads and areas used for hunting, ATV use, or hiking, may be temporarily interrupted during construction. Where trails parallel or intersect the PDA, construction activities may limit access to trails in the local area. Construction might overlap with the hunting seasons for some species (e.g., deer), but few residual effects are expected because wildlife tends to avoid active construction areas. Measures designed as part of the overall Bear Paw Environmental Protection Plan will restrict access to the RoW for recreational use during construction.

Effects to recreational use are anticipated to occur only during construction and should cease after RoW reclamation has been completed.

The LAA crosses a small portion of the pending Chedabucto Fault Nature Reserve. As the assessment corridor in this area is adjacent to the existing RoW, it is the preferred routing option. Bear Paw Pipeline is consulting with Nova Scotia Environment on this issue, and will continue to do so through the detailed routing process to develop appropriate mitigation.

Navigation

Dependent on the type of crossing method used, construction activities related to site preparation and watercourse crossings may temporarily affect navigation for navigable watercourses. Trenchless watercourse crossings will not affect navigation as the pipeline will be laid under the waterway. Watercourse crossings requiring bottom lay construction will cause a temporary loss of access during construction. The bottom laid pipeline will not; however, pose restrictions to boating on the watercourse once construction activities are complete. For those watercourse crossings deemed navigable by Transport Canada (i.e., Milford Haven River and the Strait of Canso) shoreline signage and registering the alignment for navigation charts, will be instigated. As necessary, signage will also be placed at other watercourse crossings (e.g., Salmon River) to indicate ongoing work, and disruption to access. Communication (including issuance of Notices to Mariners and Notices to Shipping) at the Strait of Canso with offshore users and vessel pilots within the compulsory pilotage area will help to mitigate potential conflicts with shipping during pipeline installation.

Operation and Maintenance

The operation and maintenance will not result in effects on natural resource use (i.e., forestry) beyond those resulting from construction activities. The heavy equipment and machinery required for forestry operations, however, may be restricted from using the RoW during pipeline operation.

Since the pipeline will be buried, no long-term effects would be expected for recreation or certain types of agriculture (shallow rooted crops) during operation. The existence of the pipeline RoW may increase ATV traffic along the RoW; public access, however, may be restricted along the RoW by the implementation of signage upon landowner request. It is expected that the nearby presence of the existing pipeline RoW will continue to provide access in the area until eventual decommissioning.

<u>Summary of Change in Land and Resource Use</u>

In summary, the Project will result in a change in land and resource use that will persist over the life of the Project. Construction activities will temporarily affect adjacent land uses through emissions of noise and dust as well as access restrictions. The presence of the pipeline and above ground structures (e.g., compressor station and valve stations) will represent a permanent change in land use and will restrict certain future activities within those footprints. These effects will be reduced through implementation of mitigation including compensating and otherwise accommodating landowners for the use of their lands. Activities are not anticipated to cause disruption, wide spread restrictions, or the degradation of land and resource use to a point where it cannot generally continue at current levels. The Project is consistent with the land use currently in the area (i.e., within industrialize zones at Goldboro and Point Tupper and paralleling an existing pipeline RoW) and the location of components has been selected, in part, for this reason. It is expected that the change in land and resource use attributable to the Project will provide an important component of energy infrastructure in Nova Scotia including the resultant economic benefits. With the application of recommended mitigation, residual effects of the Project on land and resource use are predicted to be not significant.

5.8.8 Monitoring and Follow-up

No follow-up and monitoring is proposed for land and resource use.

5.9 HERITAGE RESOURCES

Heritage resources are a VC in recognition of their importance to the Mi'kmaq, the public as a whole, and provincial and federal regulatory agencies responsible for the management of such resources. Heritage resources include consideration of historical, archaeological, architectural (built heritage) and palaeontological (fossil) resources.

For the purposes of this assessment, heritage resources are defined as physical remains from the past, including human use of and interaction with the physical environment, that inform us of the past. These resources may be above or below the ground. The pertinent timeframes are:

- the period of human use and occupation of the project area since the arrival of humans to the general area following deglaciation, approximately 13,000 years ago, to the relatively recent past; and
- the biological history of Nova Scotia as it is presented in the fossil record.

Activities and components associated with Bear Paw have potential to interact with the environment in such a way that directly affects heritage resources. The specialized mitigation measures prescribed in Section 5.9.6 will be implemented to reduce potential effects on heritage resources, in addition to the more generalized standard mitigation measures outlined in Section 2.5.3.

As explained in the assessment below, residual Project-related environmental effects on heritage resources are predicted to be localized; heritage resource sites of high potential were not identified during desktop research and field studies; and procedures for notification (e.g., Nova Scotia Heritage Division) and work stoppage will be developed for use in the event that previously unknown resources are discovered during construction activities. The assessment concludes that, with the application of the mitigation proposed herein, the residual environmental effects of Bear Paw on heritage resources are predicted to be not significant.

A Mi'kmaq Ecological Knowledge Study (MEKS) was conducted for Bear Paw (Appendix B). The MEKS, in addition to identifying current use of lands by the Mi'kmaq, provides a review of historic Mi'kmaq land use near the Project. Further details are included in Section 5.6 (Traditional Land and Resource). Where applicable, the information in the MEKS was considered in this assessment.

5.9.1 Regulatory and Policy Overview

Heritage resources in Nova Scotia are protected under the Nova Scotia *Special Places Protection Act* administered by the Nova Scotia Museum of Natural History. Built heritage is managed under the *Heritage Properties Act* administrated by the Nova Scotia Department of Communities, Culture and Heritage.

Palaeontological resource surveys are conducted under a Heritage Research permit (palaeontology) issued under the *Special Places Act*. Archaeological resource impact assessments (ARIA) are conducted in accordance with a Heritage Research Permit (archaeology) also issued under this Act, both of which are administered by the Heritage Division of Nova Scotia Department of Communities, Culture and Heritage. Archaeological and palaeontological sites considered to have value as heritage resources may not be disturbed except under strictly controlled conditions imposed by the terms of a permit issued by the Province. With respect to archaeology, various archaeological resource impact assessments (ARIA) have been conducted near Bear Paw under Heritage Research Permits A1996NS025, A1997NS025, A1997NS48, A1998NS013, A1999NS02, A1999NS16 and A2005NS93. Work for this assessment was conducted under Heritage Research Permit A2015NS099. These assessments are discussed in more detail in Section 5.9.4.2 and in Appendix H.

5.9.2 Boundaries

5.9.2.1 Spatial Boundaries

The assessment of potential environmental effects on heritage resources encompasses three spatial boundaries: Project Development Area (PDA), Local Assessment Area (LAA), and Regional Assessment Area (RAA). The PDA is defined within Section 2.1. Spatial boundaries are presented below.

Local Assessment Area (LAA)

The LAA is the maximum area within which Project-related environmental effects can be predicted to occur or measured with a reasonable degree of accuracy and confidence, i.e., the LAA is the likely zone of influence. The LAA includes the areas where Bear Paw will be constructed, and where maintenance activities that could involve ground disturbance will take place. Since heritage resources may be affected by surficial or subsurface disturbance of the area within which they are located, the LAA is the only area within which such resources could be affected. As the potential environmental effects on heritage resources are limited to the area of physical disturbance, the LAA is limited to the PDA.

Regional Assessment Area (RAA)

The RAA is the area within which Project-related environmental effects may overlap or accumulate with the environmental effects of other projects or activities that have been, or will be carried out. The RAA for this VC is considered an area approximately 100 km on either side of the assessment corridor.

5.9.2.2 Temporal Boundaries

The temporal boundaries for the assessment of the potential environmental effects on heritage resources include construction, and the operation and maintenance. Construction is currently scheduled to begin as early as 2017 and continue over a period of two years. Operation will follow construction and continue for the life of Bear Paw.

Heritage resources are relatively permanent features of the environment; their integrity, however, is highly susceptible to the environmental effects of ground disturbing activities. Project-related effects on heritage resources are more likely to occur during the construction phase. Fieldwork to identify and develop mitigation for potential adverse environmental effects on heritage resources is more easily carried out between spring and fall, when ground conditions allow for the examination of proposed construction areas and for the implementation of recommended mitigation measures.

5.9.3 Significance Definition

A significant residual adverse environmental effect on heritage resources is defined as a Project-related environmental effect that results in a disturbance to, or destruction of, an archaeological, palaeontological, architectural, or other historical resource that is considered by the provincial heritage regulators to be of major importance due to factors such as rarity, undisturbed condition, spiritual importance, or research importance that is not mitigated or compensated.

5.9.4 Description of Existing Conditions

5.9.4.1 Approach and Methods

The assessment of the heritage resource potential within the LAA was based upon a number of sources including:

- archaeological site records at the Nova Scotia Museum;
- palaeontological sites listed for protection in Nova Scotia;
- historic literature and archival resources;
- interviews with people knowledgeable on the history of the area; and
- a visual reconnaissance of the LAA by a permitted archaeologist.

5.9.4.2 Summary of Existing Conditions

There are buildings within or in proximity to the LAA that may be affected by construction; their heritage potential is not known at this time.

It is anticipated that some bedrock formations may be encountered during construction, in particular during trenching to install the pipeline. A review of the database of protected paleontological sites in Nova Scotia indicated that there are no protected sites within the LAA.

Since 1996, several ARIAs have been conducted near Bear Paw. The LAA follows, where possible, two existing pipeline RoWs, which have undergone previous archaeological assessments. The following reports, which relate to those assessments, have been reviewed for the archaeological assessment of Bear Paw:

- AGRA Earth & Environment Ltd. 1999. Sable Offshore Energy Project Natural Gas Liquids Pipeline Construction Heritage Resource Monitoring Project;
- Jacques Whitford Environment Ltd. 1999. An Archaeological Resource Impact Assessment for the Point Tupper Natural Gas Lateral Pipeline Route;
- Washburn & Gillis Associates Ltd. 1999. Sable Offshore Energy Project natural Gas Liquids Pipeline Archaeological Assessment for 1996, 1997, 1998 and 1999; and
- Jacques Whitford Ltd (JWEL). 2006. Archaeological Impact Assessment of a Proposed Natural Gas Pipeline from Bear Head, Richmond County to Goldboro, Guysborough County. Heritage Research permit A 2005NS93.

The 2015 archaeological assessment for Bear Paw focused on areas within the LAA that were outside the areas covered by these previous assessments. Three areas were identified within the LAA as having elevated potential for archaeological resources: Steep Creek, Salmon River, and a site near Eight Mile Lake Road. Fields surveys were conducted in each of these areas at sites located on Crown land; these are discussed below and further in Appendix H.

- **Steep Creek:** The 2015 field survey at the Steep Creek location occurred from approximately KP57.0 to KP54.0 (Figure 1.1.2), where it intersects with an existing pipeline RoW and is located on Crown lands. The eastern section of this area, which runs down to the Strait of Canso, was not evaluated in 2015. This eastern section of the area, within the LAA, contains a registered archaeological site, the Steep Creek Site (BjCi-02); it is the location of a nineteenth century historic foundation (Appendix H).

  The area that was surveyed during the 2015 field survey is located on the west side of the Strait of Canso and is approximately 3 km long. During this survey, no other sites were identified; it did not appear to have ever been inhabited; there were no major watercourses running through the site and, although located close to the Strait of Canso, access is limited by a steep slope. Therefore, the area to the south of KP57.0, within the surveyed lands, is considered as having low potential for containing First Nation’s or historic heritage resources (Appendix H).

- **Salmon River:** The second area identified as having elevated potential was on the south bank of the Salmon River, near KP23.0 (Figure 1.1.2). This area has elevated potential due to its proximity to the river and from information gathered from historical research into the area. According to a map dated to 1893, there were two former buildings located in the area at that time (JWEL 2006); however, as noted in previous archaeology assessment reports, this area is now overgrown and there is no visible evidence of past occupation. In 2015, a small area on the south bank of the Salmon River located within the LAA from the Guysborough Trail north to approximately KP23.0 was examined. The overall area surveyed is considered to have low archaeological potential because the banks of the river were low and wet, and likely not suitable for habitation or similar activities that would leave recoverable archaeological resources. It is recommended, however, that where practicable, both banks of the Salmon River be subjected to a shovel testing program at 5 m intervals because it is a major, navigable, watercourse that would have provided the First Nation's with a transportation route from Chedabucto Bay to the interior for winter migration as well as food in the warmer months (Appendix H).

- **Eight Mile Lake Road:** This area is located along Eight Mile Lake Road north of KP22.0 (Figure 1.1.2). Previous archaeological assessments were conducted near this area because of elevated potential for historic resources due to the combination of the road and brook crossings; however, no evidence of heritage resources was observed. The 2015 survey was conducted on a 1 km section on the south half of the area (Crown land portion). No evidence of First Nation's and heritage resources was observed (Appendix H).

A review of heritage buildings was conducted using the Canada's Historic Places website. No heritage buildings were identified near Bear Paw (CHP 2015).

5.9.5 Potential Environmental Effects and Project-Related Interactions

Construction activities could interact with heritage resources through surficial or subsurface ground disturbance, potentially resulting in disturbance to heritage resource sites, if such sites are present.

In consideration of these potential interactions, the assessment of Project-related environmental effects on heritage resources is therefore focused on the following potential environmental effect:

- change in heritage resources.

The effect pathways and measurable parameters used for the assessment of this effect are provided in Table 5.9.1.

Table 5.9.1 Potential Environmental Effects, Effects Pathways and Measurable Parameters for Heritage Resources

Potential Environmental Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in Heritage Resources	• Construction resulting in surficial or subsurface ground disturbance.	• Presence or absence of a heritage resource.

Potential interactions with heritage resources could occur during activities that involve surface and subsurface ground disturbance. Therefore, interactions would occur during the construction phase (e.g., site preparation and pipeline installation). Without the implementation of mitigation, these disturbances could result in the loss of the resource and the potential knowledge from its interpretation.

As the operation and maintenance activities (e.g., vegetation control) will take place within the PDA that will already have been disturbed during construction activities, it is not anticipated that there will be additional interactions between heritage resources and the operation and maintenance phase. This phase will not be considered further in this assessment.

5.9.6 Mitigation

Potential adverse Project-related effects on heritage resources will generally be mitigated through standard measures noted in Section 2.5.3. Mitigation specific for heritage resources are provided in Table 5.9.2.

Table 5.9.2 Mitigation for Heritage Resources

Effect	Mitigation
Change in Heritage Resources	• As a result of the archaeological field survey, further study in the form of shovel testing is recommended at Salmon River, and monitoring may also be recommended in this area during construction activities depending on the results of the shovel testing. • Complete an archaeological field assessment in areas of high potential not completed in 2015 or in prior archeological field assessments. • If additional mitigation is required as a result of archaeological field assessments, this will be implemented prior to ground breaking construction activities. • Develop a Heritage Resource Contingency Plan for the unanticipated discovery of an archaeological or palaeontological resource, as part the ERCP, including requirements to stop work and consult with applicable authorities including the Nova Scotia Heritage Division.

5.9.7 Residual Environmental Effects and Significance Determination

5.9.7.1 Change in Heritage Resources

Construction

Construction activities resulting in ground disturbance could affect heritage resources that may exist within the PDA. Three areas were identified as having elevated potential for containing archaeological resources: Steep Creek, Salmon River and an area near Eight Mile Lake Road within the LAA. Following field surveys, however, these areas are considered as having low potential for archaeological resources. Pending the results of the completion of the archaeological survey and the recommended shovel testing at Salmon River, additional mitigation requirements may be identified.

Although heritage resources were not identified within the LAA, there is the potential to discover previously unknown archaeological resources and therefore a Heritage Resource Contingency Plan will be developed as part the ERCP. This Plan will include procedures for notification (e.g., Nova Scotia Heritage Division), and requirements for work stoppage and mitigation of resources that may be encountered during construction activities.

Summary of Change in Heritage Resources

In summary, the Project has the potential to result in a change in heritage resource sites, if present, from surficial or subsurface ground disturbance. Heritage resource sites of high potential were not identified during desktop research and field studies; however, there is the potential to discover previously unknown archaeological resources. These effects will be reduced through implementation of mitigation such as developing procedures for notification (e.g., Nova Scotia Heritage Division), and requirements for work stoppage should resources be encountered during construction activities. With the application of recommended mitigation and the overall low potential for heritage resources, residual effects of the Project on heritage resources are predicted to be not significant.

5.9.8 Monitoring and Follow-up

Assuming that the mitigation measures are implemented, no follow-up is recommended. Additional mitigation may be recommended once the remainder of the archaeological field survey is complete. Monitoring may be recommended at the Salmon River pending the results of the recommended shovel-testing program.

6.0 OTHER UNDERTAKINGS IN THE AREA

This chapter identifies projects or activities (other undertakings) with residual environmental effects that could interact cumulatively with the residual environmental effects of Bear Paw. Under Section 12 of the Nova Scotia *Environmental Assessment Regulations*, the Minister must consider other undertakings in the area in a review of a registration for a Class 1 Undertaking.

The environmental effects of past and present projects or activities on VCs have been considered in the description of existing conditions as applicable for each VC (Chapter 5, Environmental Assessment). For example, noise emissions produced by existing facilities, such as the SOEP Gas Plant, have been considered in the baseline acoustic environment and are discussed in the Atmospheric Environment VC (Section 5.1.4). Past and present activities include linear development (such as pipelines, highways, transmission lines); industrial development (including the Goldboro Industrial Park and Point Tupper Industrial Park), forestry management, and shipping.

Future projects and activities were considered if they are reasonably foreseeable as follows: have been publically announced with defined project execution period and with sufficient project details that allow for a meaningful assessment; are currently undergoing an environmental assessment; or are in a permitting process. The following list identifies future undertakings that have been considered in this assessment:

- Goldboro Liquefied Natural Gas (LNG) Project;
- Bear Head LNG Export Facility; and
- ongoing forestry activity.

The future undertakings listed above and past projects and activities are described in Section 6.1 and shown on Figure 6.1.1.

6.1 DESCRIPTION OF OTHER UNDERTAKINGS

This section describes the past, present and future projects and activities with the potential to overlap spatially or temporally with Bear Paw.

6.1.1 Linear Developments

Linear developments include roads, power transmission infrastructure and other pipeline corridors and are common in the area near Bear Paw.

Bear Paw crosses several existing roadways, including one heavily travelled rural highway (Highway 16), and some less travelled rural and resource roads. Currently, there are no road development projects planned in the area. The presence of roads in the area has potential for limited adverse effects on the environment including fragmentation and loss of habitat, and direct mortality of wildlife through vehicle strikes and strikes with transmission infrastructure.

Approximately 60 km of the Bear Paw assessment corridor follows the existing RoW. Planning for the decommissioning of the Sable Offshore Energy Project and associated infrastructure is currently underway, but a date for decommissioning has not been publicized. There are two other pipelines located near Bear Paw including the M&NP natural gas mainline and the SOEP onshore natural gas gathering pipeline, which connect to the SOEP Gas Plant in Goldboro. These existing pipelines are shown on Figure 6.1.1.

Potential residual environmental effects associated with the presence of linear features includes increased human access to remote areas (e.g., vehicle/ATV access, hunting), fragmentation and loss of wildlife habitat, and occasional disturbance from ongoing pipeline RoW maintenance. These potential environmental effects are anticipated to be limited and will return to near baseline conditions in areas not required for ongoing maintenance. In particular, where the existing pipelines cross the Strait of Canso, hard protective materials (e.g., rock and gravel) where used which likely increased the quality and productivity of benthic habitat in this portion of the RoW through the creation of complex, heterogeneous habitat for marine life (i.e., reef effect).

6.1.2 Forestry

Forestry activities in the area are widespread and ongoing with most forested areas near Bear Paw being harvested in the recent past or slated for harvesting in the future. Activities occur throughout the year and consist of harvesting of wood for commercial purposes on Crown and private lands (i.e., freeholds) and for domestic (i.e., personal) use. Clear-cutting is the dominant forestry practice in the area. Resource roads have been built to support the forestry industry, including a number that cross the assessment corridor.

Forest harvesting activities have the potential to result in the direct removal of terrestrial habitat and plant communities, wildlife disturbance, and loss of plant biomass from the forest ecosystem. Construction of access roads for forestry operations results in the loss and fragmentation of terrestrial habitat and the crossing of watercourses, which may lead to sedimentation and alteration of physical habitat units.

V:\1214\active\121413xxx\121413598_bear_head_lng_pipeline\geomatics\mapping\mxd\EIA\6_other_projects\ST NS_121413598-105_Fig6_1_OtherUndertakings.mxd cshupe

Sources: Base data provided by the Government of Canada and Nova Scotia. Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency. Note: Crown lands shown is limited to parcels within a relevant distance of the project.

BEAR PAW PIPELINE PROJECT

Other Undertakings Near Bear Paw

Figure 6.1.1

6.1.3 Industrial Developments

There is an industrial park located at either end of the assessment corridor; both of which are relocating a variety of industrial developments and industrial-related activities. The Goldboro Industrial Park is located at the southwest end of the assessment corridor and includes the SOEP Gas Plant. Proposed development in the Goldboro Industrial Park includes the Goldboro Liquefied Natural Gas (LNG) Project (Figure 6.1.1). This proposed undertaking includes the construction and operation of a LNG processing facility, storage tanks and marine works scheduled to be commissioned in 2020.

The Strait is home to several industrial developments including the Nova Scotia Power Coal Loading Terminal, NuStar Terminals, and Martin Marietta Materials. Proposed development in the Point Tupper Industrial Park includes the Bear Head LNG Export Facility, which consists of a LNG processing facility, storage tanks and associated marine works.

Historical and current industrial developments and activities in these areas have likely caused a variety of environmental effects such as low-grade contamination of water, air and sediments, and the disturbance of terrestrial and marine habitats. The construction of marine infrastructure (e.g., piers, riprap shoreline protection) has likely increased the productivity of benthic habitat along the nearshore zone through the creation of complex, heterogeneous habitat that attracts a variety of marine life.

The construction and operation of the two proposed LNG projects (Bear Head and Goldboro) have the potential to result in environmental effects, including the disturbance of terrestrial and marine habitats within their project footprints, and increased noise and air emissions from facility operation. Interactions with the marine environment associated with the construction of marine jetties at both locations include the disturbance of the seabed during construction, and potentially permanent loss or alteration of habitat. Residual effects will likely be offset by an increase in the quality and productivity of habitat along the nearshore zone through the creation of complex, heterogeneous habitat for marine life. These LNG projects will also increase commercial vessel traffic in their respective areas potentially causing noise disturbance, chemical and hydrocarbon inputs, and the introduction of non-native marine species via ballast water. These proposed LNG projects are located in areas designated for marine industrial uses which can accommodate a considerable amount of commercial marine traffic.

These planned future developments are anticipated to result in positive social and economic changes in the region due to increased economic activity. This economic activity could result in modest increases in property values, increased demand for products and services, and increased tax revenues for municipal governments and the Province.

6.2 OVERLAPPING EFFECTS BETWEEN BEAR PAW AND OTHER UNDERTAKINGS

This section describes the potential overlapping effects (i.e., cumulative environment effects) between the VCs identified for the Bear Paw environmental assessment and the VCs affected by other undertakings in the area discussed above.

6.2.1 Atmospheric Environment

Bear Paw has the potential to affect the atmospheric environment through the generation of air emissions and noise disturbance. The proposed Goldboro LNG Plant is noted as having the greatest potential for overlapping effects on this VC.

6.2.1.1 Air Quality

Bear Paw has the potential to result in emissions of CACs (particulate matter and combustion gases) during construction, but these will be temporary and localized. The compressor station has the most potential for overlapping effects and therefore forms the focus of this assessment. Operation of the compressor station will result in emissions of $PM_{2.5}$, NO_2 and CO. The residual environmental effects will include an increase in CACs above current conditions; however with the implementation of mitigation (Section 5.1.6), the resulting levels will not exceed the Nova Scotia *Air Quality Regulations* at the nearest discrete receptors.

An environmental assessment was completed in 2013 for the construction and operation of the proposed Goldboro LNG Project. The results of the Goldboro LNG Project assessment indicate that the construction and operation of the facility would be compliant with Nova Scotia *Air Quality Regulations*. Commissioning is scheduled for Bear Paw and the Goldboro LNG Project in 2019 and 2020, respectively.

Although neither of these projects will exceed ambient air quality standards in isolation, there is potential for exceedances by the combined emissions resulting from the operation of both projects. The CACs of greatest concern for exceeding ambient air quality standards are NO_2 and $PM_{2.5}$.

Air emissions from each site are not strictly additive, but are highly dependent on meteorological conditions. For Bear Paw, the maximum predicted concentrations of NO_2 and $PM_{2.5}$ during the operation of the compressor station will occur within a few meters of the site fenceline, and are well below ambient air quality standards. For the Goldboro LNG Project, the maximum predicted concentrations of NO_2 and $PM_{2.5}$ generally occur near the marine terminal facilities and over water, and are well under ambient standards (Pieridae 2013). The areas with the greatest potential for exceedance of regulatory criteria for each project do not overlap geographically; therefore it is unlikely that ambient air quality standards will be exceeded due to cumulative effects, at nearby receptors.

6.2.1.2 Acoustic Environment

Sound pressure levels from the operation of the Bear Paw compressor station plus existing background noise (inclusive of the SOEP Gas Plant) will meet applicable noise limits at the nearest receptors to the compressor station (Section 5.1.7). The highest sound pressure levels are predicted to occur within 500 m of the fenceline of the compressor station.

The operation of the Goldboro LNG Project is expected to result in levels that exceed applicable nighttime noise limits at the receptors located closest to the facility. The Environmental Assessment conditions of approval for the Goldboro LNG Project indicate that a Noise Monitoring Program be developed and approved by NSE. The incremental change in the operation of the Goldboro LNG facility with Bear Paw will be less than a few decibels at the nearest receptors.

6.2.2 Freshwater Environment

Bear Paw construction and operation activities have the potential to result in the loss or alteration of fish habitat, direct mortality of fish during in-water works, and potential changes in water quality. These effects will be reduced with the implementation of mitigation outlined in Section 5.2.6, including conducting in-water works outside of the higher biological risk period (July 1 to September 30) when practicable, the installation of sediment and erosion control measures, and implementation of spill prevention measures. The assessment of environmental effects (Section 5.2, Freshwater Environment) determined these effects would be localized and temporary; following pipeline installation and RoW reclamation, it is anticipated that freshwater habitats will return to near baseline conditions.

Other undertakings in the area have the potential to result in similar environmental effects on the freshwater environment. For example, the use and maintenance of roadways, ongoing industrial operations and forestry activities, all have the potential to contribute to sediment or other contaminants accumulating in the freshwater environment. Forestry activities also have potential to conduct in-water works associated with the construction of road watercourse crossings. It is expected that other undertakings in the area will meet required regulations with respect to in-water construction timing restrictions, follow government and industry guidelines for sediment control, implement spill prevention and response procedures and abide by the *Fisheries Act,* among other requirements. Therefore, it is not anticipated that environmental effects from other undertakings in the area will cumulatively interact with Bear Paw to exceed regulatory thresholds for the protection of the freshwater environment.

6.2.3 Marine Environment

There is potential for construction of the two marine pipeline crossings for Bear Paw to result in adverse effects on the marine environment, specifically with respect to fish mortality, benthic habitat, and water and sediment quality near the construction activities. Potential adverse effects on the marine environment would occur only in those cases where bottom lay and open cut construction methods are used, and not with trenchless methods. These effects will be reduced by the mitigation outlined in Section 5.4.6; including use of clean well maintained equipment for in-water works, using HDD for watercourse crossings where technically feasible, scheduling in-water work to avoid adverse weather, and installing in-water infrastructure in proximity to the existing submarine pipeline corridor. Based on design and planned mitigation for Bear Paw, adverse effects would be localized and temporary (until benthic communities are naturally re-established) and not result in changes to populations of marine organisms.

Other past or present undertakings in the area have been considered as part of the review of existing conditions in the Marine Environment VC (Section 5.4) including the influence of the development of the Canso causeway and extensive shipping and industrial activity occurring in the Strait of Canso. There is potential for cumulative effects related to future projects or activities such as the planned development of the Bear Head LNG Export Facility, which includes the construction of a marine terminal. Construction of this terminal is anticipated to have similar environmental effects in the Strait of Canso as Bear Paw. Bear Head and Bear Paw will both implement mitigation to reduce Project-related effects on the marine environment to mitigate any serious harm, as defined by the *Fisheries Act*, to commercial, recreational and Aboriginal fisheries. Other undertakings in the area are therefore predicted to not result in environmental effects that would act cumulative with Bear Paw to exceed regulatory thresholds for the protection of the marine environment, or the sustainability of marine populations.

6.2.4 Vegetation and Wetlands

Potential Project-related environmental effects on vegetation and wetlands includes the potential for a loss of vegetation SOCI and vegetation communities during the clearing, and the potential for a loss of wetland area or change in wetland function. These effects will be reduced through the implementation of mitigation (Section 5.5.6), which includes reducing the area of physical disturbance where practicable, mitigating for SOCI, and allowing portions of the RoW to regenerate, where possible. Bear Paw will result in a change in vegetation and wetlands during construction; however, with the implementation of recommended mitigation, the environmental effects will be localized and are unlikely to affect the sustainability of habitats and populations.

Other undertakings in the area, such as forestry operations or the development of the Goldboro LNG Project, have potential to cause a loss of plant SOCI. It is expected that the Goldboro LNG Project will be required to mitigate any losses to plant SOCI and wetlands, and no long term overlapping effects with Bear Paw on vegetation and wetlands is expected.

6.2.5 Wildlife and Wildlife Habitat

Potential Project-related environmental effects on wildlife and wildlife habitat include a change in habitat availability, habitat connectivity and mortality risk from construction and operation activities. These effects will be reduced through the implementation of mitigation (Section 5.6.6), which includes paralleling the existing RoW where feasible; implementing construction best management practices to reduce conflicts with sensitive species and life cycle phases; and developing mitigation strategies to promote habitat benefits for wildlife. As well, pre-construction surveys, monitoring for trapped wildlife during trenching, clearing and grubbing outside of the breeding season for migratory birds when practicable (April 1 to August 31), and the installation of access control measures on the RoW, are expected to reduce potential increases in the mortality risk to wildlife. With the implementation of recommended mitigation, Bear Paw is unlikely to limit the movement of wildlife species within the landscape in such a way as to threaten their long-term sustainability.

Future developments and ongoing forestry activities may increase wildlife mortality risk through a number of mechanisms including the removal of nests, dens, burrows and hibernacula; vehicle collisions; and increased access by hunters and poachers. Forestry activities are likely to continue at or below historical levels of intensity within the region and are therefore unlikely to interact cumulatively with Bear Paw to increase effects to wildlife and wildlife habitat connectivity beyond the levels currently experienced. It is assumed mitigation to reduce wildlife mortality risk will also be implemented as part of other undertakings.

6.2.6 Land and Resource Use

Bear Paw will result in changes to existing land uses including the loss of or change to land and resource access. Potential interactions during construction may include noise disturbance to nearby receptors, temporary increase in traffic, permanent loss of merchantable forest resource, and temporary reduction in access to recreational land use. Potential interactions during operation may include restrictions on the permissible uses of RoW lands and a potential increase in the non-permitted use of lands within the RoW. Mitigation will be implemented for these effects (Section 5.8.6), and include consulting and accommodating landowners where possible, communicating construction schedules, and implementing access control measures on the RoW. It is expected that the change in land and resource use attributable to Bear Paw will provide an important component of energy infrastructure in Nova Scotia including the resultant economic benefits.

Cumulative effects on land and resource use in conjunction with other projects or activities could be expected for landowners along the RoW that parallels the existing pipeline RoW. Those landowners may have already been or continue to be affected by changes in land and resource use as a result of the construction and operation of the existing pipelines, and could see further effects as a result of Bear Paw. These cumulative effects can be limited with the implementation of recommended mitigation including access and other accommodation for landowners. Bear Paw activities are not anticipated to cause disruption, wide spread restrictions, or the degradation of land and resource use to a point where it cannot generally continue at current levels. Economic benefits from increased industrial development will create long term economic and land use benefits for nearby communities.

6.3 SUMMARY

In summary, the Project will result in environmental effects on VCs that will potentially overlap with similar effects on those VCs from other undertakings in the area. However, in all cases, these cumulative effects are similar to the environmental effects presented in Chapter 5 (Environmental Assessment). Residual environmental effects from routine Bear Paw activities are predicted to be not significant. It is understood that other undertakings will also be required to reduce potential environmental effects through compliance with government standards and permit stipulations, further reducing the potential for cumulative effects. No additional mitigation is recommended. It is expected that Bear Paw will contribute to regional and provincial economic benefits that will overlap with economic activity created by other undertakings at a regional and provincial level.

7.0 ACCIDENTS AND MALFUNCTIONS

7.1 INTRODUCTION

Pipeline infrastructure is rigorously regulated, has a sound safety record in Canada and considered a safe means of transporting natural gas between two points. However, like any infrastructure, accidental events can occur. This section provides an assessment of potential Project-related accidents and malfunctions with a focus on events that are considered to have a reasonable probability of occurring and may have an adverse environmental effect or consequence. These potential accidental events, selected based on the nature of the Project, professional knowledge of the Study Team and experience with similar EAs, include:

- pipeline ruptures resulting in explosion or fire;
- forest fires;
- spills of dangerous goods; and
- releases of drilling fluid during HDD.

These types of events are described in the following sections and include information on the probability of occurrence and the engineering and safety controls that will be incorporated into Project planning and design to reduce the likelihood of any events.

The environmental effects assessment parameters for each VC that could be affected by accidents and malfunctions are described in Section 7.2. Thresholds for significant residual effects are defined in the respective sections for each VC in Chapter 5.

7.1.1 Pipeline and Associated Equipment Ruptures Resulting in Explosion or Fire

Although unlikely, there is a possibility of mechanical failure of the pipeline and associated equipment (such as equipment at the compressor station) that may result in high-pressure gas escaping into the atmosphere. When LNG vaporizes, the gas is lighter than air and would rise upward and dissipate, with wind affecting the area of dissipation.

If the escaping gas were to ignite, this could cause a localized explosion and fire. Although possible, the potential for a gas leak resulting in a localized explosion or fire is considered to have a low probability of occurring based on historical data. The NEB regulates approximately 73,000 km of natural gas pipelines across Canada (NEB 2015), many of which are of similar size to Bear Paw. Within a ten-year period between 2000 and 2009, the NEB reported approximately 0.1 gas releases from a pipe body per 1,000 km of regulated pipeline and 0.9 unplanned gas releases per 1,000 km of regulated pipeline from other operational equipment (e.g., flanges, valves, gaskets). During this ten year period time, no serious injuries from an explosion or fire have been reported (NEB 2011). A review of data available since 2009 indicates that the total number of accidents has remained relatively consistent, and suggests that the data for 2000 to 2009 are representative of current conditions (NEB 2015).

As described in more detail in Section 2.5.1, to minimize the potential effects should a leak or fire occur the compressor station will be installed with safety protection systems such as a safety system to monitor the facility operation and shutdown as well as isolate either an individual compressor unit, or the entire station in the event of a detection of an abnormal operating condition or emergency. Additionally, the electrical power for the safety system will be backed-up by an Uninterruptible Power Supply (UPS) to provide adequate power for the safety system to complete an orderly a shutdown and to initiate a shutdown in the event that it detects a low voltage level from the UPS system. The pipeline will have three valve stations located intermittently along its alignment. Each valve station will be equipped to close automatically, isolating targeted sections of the pipeline in the event of a leak or fire.

7.1.2 Forest Fires

Fires within the RoW and surrounding area could result from the following causes:

- natural lightning;
- welding or grinding;
- hot engines;
- human carelessness (e.g., cigarettes); or
- pipeline fire or explosion due to a rupture or leak with an ignition source.

The potential causes of fires vary between construction and operation. During construction, there will be more hot work and construction activity; however, there will be no risk from pipeline explosions during construction as the pipeline will not be carrying gas until the operation phase. Bear Paw Pipeline will develop implement plans and procedures to minimize potential for causes of fire within its control (e.g.,welding, air grinding, hot works, etc.).

The responsibility for fighting wildland fires in Nova Scotia resides with the NSDNR. This responsibility will be the same during both construction and operation. Other firefighting units (e.g., municipal units) cooperate extensively in fighting these fires. NSDNR firefighting techniques include specially designed fire trucks, fire foam (approved by NSE) and water. Depending on the nature and severity of a forest fire, foam and water are applied with equipment ranging from portable pumps to helicopters. Typical response time for NSDNR deployment to the scene of a forest fire is under 20 minutes (NSDNR 2015i). Volunteer or municipal firefighters may arrive earlier because of their numbers and provincial distribution. Six fire departments have been identified that are located 12 km from the assessment corridor.

7.1.3 Spills of Dangerous Goods

During pipeline construction and operation, dangerous goods, primarily fuels, oils and lubricants, could accidentally spill into the environment. Such spills would be limited to relatively small quantities (e.g., from broken hydraulic systems) from construction or maintenance vehicles or equipment. Prior to construction, an ERCP will be developed to address promptly and efficiently minimize environmental effects should a spill occur. This plan, for example, would specify the clean-up materials to be kept on site as well as clean-up procedures, notifications and worker training as well as specific procedures to be followed in the event of a spill occurring near watercourse crossings.

The probability of large spills occurring during the construction or operation and maintenance of the pipeline is considered low. Only eight liquid spills with a volume greater than 1,500 L have been recorded as part of construction or operation and maintenance activities between 2000 and 2009 on liquid and gas pipelines regulated by the NEB (NEB 2011). These incidents exclude product leaks from liquid pipelines. The NEB also reported 634 smaller spills (i.e., less than 1,500 L) over the same ten year period, with an average spill volume of approximately 200 L.

Standard mitigation for the management of dangerous goods and spill prevention (Section 2.5.3) will be implemented to reduce probability of a spill occurring or to minimize potential environmental effects in the event a spill occurs.

7.1.4 Drilling Fluid Release during HDD

HDD is being considered for the watercourse crossings at the Milford Haven River, the Strait of Canso and the Salmon River. If this crossing method is selected, there is potential for a release of drilling fluid. Drilling fluid used during the HDD process is composed of two basic elements: water and clay particulates including bentonite in the clay particulates. Spills of drilling fluid at the surface are expected to be limited to the drill pads, where they are easily identified and cleaned up quickly with minimal adverse effects to the environment.

During typical HDD operations, some drilling fluids are absorbed by the lateral and subterranean fractures within the formation. This is a normal occurrence during HDD operations that does not necessarily mean the drilling fluid is rising to the surface or migrating great distances from the borehole. However, it is possible that drilling fluids may reach the surface by following a vertical fracture in the formation. This event is commonly referred to as a hydro-geologic fracture. The release of drilling fluid from fractures in the earth's surface may be terrestrial or aquatic in nature and vary in quantity. Terrestrial hydro-geologic fractures occurring in upland areas are typically simpler to contain and therefore result in relatively minor effects to the surrounding environment. Hydro-geologic fractures occurring in aquatic environments are more difficult to contain primarily because bentonite readily disperses in flowing water and quickly settles in standing water.

In the event of a hydro-geologic fracture, procedures will be in place to address the event as part of the ERCP.

7.2 ASSESSMENT OF ACCIDENTS AND MALFUNCTIONS

The objective of this assessment is to determine if an accidental event or malfunction may result in a residual environmental effect after consideration of the implementation of controls, prevention measures and mitigation. Recommended environmental and safety protection systems are described in Section 2.5 and include mitigation of regular construction and operation activities, but also encompass management measures to address accidents and malfunctions (e.g., ESD system, ERCP). A Hazardous Operations review by knowledgeable engineering, operations, safety and environmental design personnel will be performed on the Bear Paw design during detailed engineering to further identify hazards that may be associated with the construction and operation of the pipeline. The final design and the operating procedures will include additional measures deemed necessary as a result of that review.

Accidents and malfunctions identified above are expected to be temporary nature, and considering the systems and management measures planned for Bear Paw (Section 2.5), accidents and malfunctions are expected to be rare events (except for very small spills), short-term and subject to immediate clean-up and corrective measures. Public health and safety, as well as the VCs that may be affected by accidents and malfunctions, are discussed below.

7.2.1 Public Health and Safety

In the extremely unlikely case of a pipeline release and fire or explosion, there is potential for the Project to result in adverse effects to health and the safety of employees and public located in proximity to the site or the future RoW at the time of the incident. These potential effects are anticipated to be limited to the immediate vicinity of the assessment corridor.

During the operation and maintenance, the pipeline could result in an unplanned ignition of natural gas released in an uncontrolled fashion from a pipeline rupture or leak. Pipeline rupture and containment loss could occur from mechanical contact (i.e., a crew digging for another project is not aware of the existence of the pipeline and inadvertently strikes it with excavation equipment) or by corrosion. To mitigate the probability of occurrence, signs will be installed along the route advising of the presence of the Bear Paw high-pressure gas pipeline and operator inspections will note construction activity in the area, as well as nearby residents will be made aware of the existence, and be advised of the activities that can and cannot be conducted near the pipeline. Corrosion will be controlled by the use of pipeline coatings, impressed current cathodic protection systems with annual inspections for proper operation, and proper design and installation techniques. The natural gas in the pipeline is non-corrosive, so the primary corrosion risk is from external factors. The implementation of these mitigation measures will reduce the likelihood of an incident.

In the highly unlikely event of a pipeline or facility gas leak resulting in a fire or associated explosion, there could be a risk to nearby employees or members of the public and would be considered a significant adverse effect to public health and safety. This significant effect, however, is considered highly unlikely as demonstrated by the low historical probability of such accidents. The potential for significant environmental effects on health and safety would require a large release of natural gas resulting in a fire. A major accident, such as a release of gas and fire due to a mechanical failure, is highly unlikely, given:

- the exemplary safety record of CAN/CSA Z662 – Oil and Gas Pipeline Systems; and
- the planned environmental and safety protection systems (Section 2.5) and an associated ERCP.

Given these provisions, it is highly improbable that a fire or explosion of substantial size will occur. With the implementation of mitigation and the environmental protection measures described, it is predicted that significant adverse effects of accidents and malfunctions on public health and safety are highly unlikely. Ongoing communication and pipeline safety education with stakeholders, particularly landowners in the immediate vicinity, are among the means to address public concern with respect to safety concerns. The dialogue with potentially affected landowners has been initiated and there will be follow-up by land agents as Bear Paw nears construction and throughout the development process (Chapter 3).

7.2.2 Atmospheric Environment

Accidents or malfunctions could have adverse effects on the atmospheric environment resulting from the following events: dangerous goods spills during pipeline construction; the mechanical failure of the pipeline during operation resulting in the release of natural gas; or forest fires resulting from ignition after release.

Air contaminants could arise from an accidental spill of dangerous goods during construction. This would most likely be due to small spills during vehicle refuelling or leaks. The significance of an accidental release would depend on the chemical characteristics of the product released, the volume released and the length of time before the release is remediated. Standard mitigation measures for the management of dangerous goods and spill prevention (Section 2.5.3) will be implemented, including the development and implementation of an ERCP.

An accidental release of natural gas during pipeline operation may affect air quality by increasing the concentration of methane near the point of the release. Depending on the size and duration of the release and potential ignition source, the concentrations of methane could result in an explosion and/or fire. A system will be in place to automatically shut off the flow of gas if a release is detected, and therefore the duration of an accidental release will typically be short. Methane is a GHG which, depending on the volume of an unignited release, will increase the amount of GHGs in the atmosphere. Even in the highly unlikely case of a large release of methane (e.g., the contents of the pipeline prior to the shut off valves closing), the total contribution to provincial or national GHG emissions would be very small.

Forest fires resulting from careless brush burning, disposal of smoking materials, or a pipeline rupture could also adversely affect air quality. As Nova Scotia has well-developed forest firefighting capabilities, the response to a fire would be prompt, and it is unlikely that a forest fire would persist long-term; air quality would be expected to return to pre-fire conditions quickly (i.e., in days or weeks). In the unlikely event of a large and prolonged forest fire, it is possible that concentrations of criteria air contaminants (CACs) resulting from a Project-related fire might exceed the Nova Scotia *Air Quality Regulations* for NO_2 and CO, and the Canada Ambient Air Quality Standard for $PM_{2.5}$, resulting in significant adverse effects to the atmospheric environment.

Serious efforts will be made to reduce the probability and magnitude of a forest fire including the implementation of mitigation described in Section 2.5, such as:

- training of personnel in firefighting techniques and the provision of firefighting equipment;
- regular inspections of the pipeline;
- the development of a contingency plan to deal with fire and explosion; and
- establishment of response protocols with first responders.

Given these provisions, it is highly unlikely that a fire of substantial size and duration would occur from Project activities; a significant adverse effect to the atmospheric environment is therefore unlikely.

7.2.3 Groundwater Resources

Accidents or malfunctions could have adverse effects on groundwater resources, including spills of dangerous as well as from the use of firefighting chemicals, if required. Spills that could reasonably be expected to occur would typically be limited to relatively small quantities. Natural gas releases would not affect groundwater.

Accidental releases of dangerous goods or firefighting chemicals could degrade local and down-gradient groundwater quality to below acceptable criteria specified by the Guidelines for Canadian Drinking Water Quality (Health Canada 2014). The significance of an accidental release would depend on the chemical characteristics and volume of the release, proximity to wells and the hydraulic properties of the aquifer affected. For example, a spill in an area of thick, poorly permeable soil is less likely to affect aquifers or down-gradient wells than a spill in an area of highly permeable overburden or permeable fractured bedrock.

Several mitigation measures can be applied during the construction and operation stages to prevent the release of dangerous goods to the environment. In the event of a spill, depending on the size and type, the contractor or operator would be expected to:

- notify NSE for spills exceeding reportable quantities;
- carry out emergency clean-up and isolation of the release;
- carry out an hydrogeological assessment of contaminant fate and mobility if wells are at risk;
- install down-gradient groundwater monitoring between the source and receptors (wells, streams etc.) depending on distance; and
- provide treatment or replacement of affected water supply, if determined to be required through regulatory engagement.

Emergency response measures will be described in detail in the ERCP.

Provided the above mitigation measures are followed, the residual environmental effects to groundwater resources due to accidental releases during construction and operation are predicted to be not significant.

7.2.4 Aquatic Environment

Accidents or malfunctions could cause adverse effects on the freshwater and marine aquatic environments if such events occurred close to watercourses. These could occur from spills of dangerous goods during pipeline construction and operation, from the use of firefighting chemicals, or the release of drilling fluid during HDD activities.

Accidental spills near or in fish bearing waters could cause a degradation of fish habitat and possible fish mortality. The severity of an accidental release would depend on the chemical characteristics and volume of the release, the proximity to a watercourse, and the hydraulic properties of the aquifer between the spill site and the watercourse. Spills that could reasonably be expected to occur would typically be limited to relatively small quantities.

Relatively small amounts of fuel and hydraulic fluid spilled during equipment operation are the most likely types of accidental releases of dangerous goods. During most spills of this kind, construction equipment would not be operating near the stream. Several mitigation measures can be applied during construction and operation to reduce the potential release of dangerous goods to the environment (Section 2.5.3). In the event of a serious release, emergency response procedures described in the ERCP will be implemented (Section 2.5.2.2).

Adverse effects could occur from the use of firefighting foams and other accident response activities. However, these effects would be naturally mitigated over time, and would likely only temporarily affect the immediate area.

If HDD is selected as a watercourse crossing method, it is possible that a hydro-geologic fracture could release drilling fluid into a watercourse. Hydro-geologic fractures occurring in aquatic environments would be more difficult to contain, primarily because bentonite readily disperses in flowing water and quickly settles in standing water. Bentonite, although is non-toxic, when dispersed in the water can inhibit the respiration of fish; however, effects are believed to be short-lived. If the release occurs in calm waters, a layer of bentonite can cover egg masses on the riverbed and inhibit the flow of dissolved oxygen to them. If HDD is selected as a construction method for the three potential watercourse crossings, Bear Paw Pipeline will conduct visual inspections along the bore path of the alignment during drilling operations, and monitor drilling fluid return volumes. Hydro-geologic fracture procedures will be detailed and documented in an ERCP. Additionally, the following materials used to control a hydro-geologic fracture may include straw bales, straw waddle, silt fencing and gravel bags. These materials will be kept at the boring site in quantities sufficient to contain a 15 m perimeter around a hydro-geologic fracture.

The likelihood of significant residual environmental effects on the aquatic environments due to malfunctions and accidents is predicted to be low, provided accidental releases are discovered early through routine monitoring and maintenance and are remediated or repaired in a timely manner. If an adverse effect to fish and fish habitat that supports a CRA fishery occurs, it is considered "serious harm" as defined under DFO policy, and habitat offsetting would likely be required to provide for no net loss of the productive capacity of this habitat. With the application of effective mitigation and the development of appropriate contingency planning, the residual environmental effects due to accidents and malfunctions on the aquatic environment are predicted to be not significant.

7.2.5 Vegetation and Wetlands

During the construction phase, vegetation Species of Conservation Interest (SOCI), particularly those growing in wetlands or aquatic habitats, could be adversely affected by accidental discharges of dangerous goods. Spills associated with construction activity are typically small; however, since the distribution of rare plant populations is generally highly localized, there is a possibility that a spill could have an adverse effect on a local population. Mitigation to prevent or manage spills are provided in Section 2.5.3, and spill response procedures will be included in the ERCP.

Accidental discharges of dangerous goods during construction are unlikely to significantly affect wetlands and vegetation SOCI since the amount of these substances spilled in a wetland would be small, and generally reversible. The time required for wetland systems to recover would depend on several factors, including the type and amount of the material spilled, and the type of wetland or vegetation SOCI affected.

Forest fires resulting from careless brush burning, the disposal of smoking materials, or a pipeline rupture could also adversely affect wetlands and vegetation SOCI along the route. A fire could have a significant adverse effect on a vegetation SOCI population if it affected a large proportion of the provincial population. This would require a very large fire or a species that is concentrated in only a few locations. Given that Nova Scotia has well-developed forest firefighting capabilities and that the plant species of conservation interest potentially affected by the Project occur in a number of locations in the province, it is unlikely that the provincial population of rare species would be significantly adversely affected by forest fire.

Although forest fires could affect wetland habitat, wetlands are relatively resistant to fire compared to surrounding forest habitats. The extent to which wetlands may be affected is dependent on the size of the fire and the character of the wetland. Small treed swamps surrounded by forest habitat would be the most susceptible to fire, while large un-treed wetlands with a high interspersion of open water and vegetation would be less susceptible. It is important to note that wetlands often provide habitat for birds and other wildlife species, including Species at Risk (SAR) and other SOCI. A forest fire has the potential to reduce wildlife habitat availability for wetland-associated SOCI and cause direct mortality of wildlife species, particularly smaller species with a limited ability to flee fast-moving fires, including the flightless young and unborn eggs of migratory birds.

Overall, given the mitigation in place, the residual environmental effect on vegetation and wetlands from accidents and malfunctions is predicted to be not significant.

7.2.6 Wildlife and Wildlife Habitat

Accidents or malfunctions could cause adverse effects on wildlife and wildlife habitat from spills of dangerous goods and from the use of firefighting chemicals, if required. The magnitude and spatial extent of effects is dependent on the location, time of year and severity of the event. In the event of a spill, cleanup efforts would begin immediately in accordance with the ERCP and contaminated soil and/or water would be remediated to the appropriate standards (Section 2.5.3).

Forest fires could occur during construction and operation due to human activities or lightning and has the potential to affect wildlife habitat and cause direct mortality of wildlife species, particularly smaller species, including flightless young and unborn eggs of migratory birds or bird SOCI, with a limited ability to flee fast-moving fires. Forest fires; however, are often natural events, and periodic burns can contribute to overall forest health. After a fire burns down a swath of woodland, a sequence of ecological succession begins. While the ecological effects and benefits of regular forest fire are debated among terrestrial ecologists and managers, terrestrial ecosystems of the RoW would eventually recover from forest fires. Factors influencing the severity of environmental effects include time of year, extent of fire damage and type of fire. Mitigation to prevent fires and reduce their potential influence are provided above in Section 7.1.2.

Overall, the residual environmental effect on wildlife and wildlife habitat resulting from accidents and malfunctions is predicted to be not significant.

7.2.7 Land and Resource Use

Uncontrolled releases of dangerous goods and fires have the potential to interact with soils, water supplies and other resources, which could cause loss of crops, timber, and property damage. Spills would typically be limited to relatively small quantities. Clean-up efforts would begin immediately in accordance with the ERCP and contaminated soil and water would be remediated to the appropriate standards. Bear Paw will have fire prevention and response procedures in place as described in Section 7.2.2.

Communications with potentially affected landowners is an important part of addressing the potential effects. Landowners would be compensated for long-term effects including loss of water supply and agricultural capacity or other property damage.

Given the mitigation in place to respond to and mitigate negative effects, the residual environmental effect on land and resource use from accidents and malfunctions is predicted to be not significant.

7.3 SUMMARY

In summary, pipeline ruptures, fires, and spills of dangerous goods have been identified as potential accidents or malfunctions that may occur over the life of the Project. Due to stringent regulatory requirements associated with pipeline design and the comprehensive health, safety and environmental procedures adopted for Bear Paw, the probability of accidents or malfunctions that could lead to serious public health and safety or environmental consequences is considered very low. This prediction is supported by Canada wide statistics for the pipeline industry (NEB 2011).

Bear Paw will be designed and built according to the latest Canada-wide design standards. The most probable accidents are small spills (e.g., from construction equipment) that are readily cleaned up with typical no lasting environmental effects. Various types of mitigation measures are planned, which are intended to prevent accidental events from occurring (e.g., "call before you dig" programs, setbacks from environmental features, inspection protocols, etc.). An Emergency Response and Contingency Plan will be developed to efficiently respond to accidental events should they occur, thereby reducing adverse effects and facilitating remediation and restoration. It is noted that the contents of the pipeline is natural gas, which will rapidly disperse if accidentally released.

In the highly unlikely event of a large spill, fire, explosion, or large forest fire, adverse effects to public health and safety, atmospheric environment, groundwater resources, fish and fish habitat, wildlife, wetlands, vegetation and land and resource use, could result. Some of these effects may require substantial remedial efforts, habitat offsetting or landowner compensation. Despite these risks, it is concluded that significant adverse effects associated with accidental events and malfunctions, are not likely.

8.0 SUMMARY AND CONCLUSIONS

Bear Paw Pipeline Corporation Inc. proposes to construct a 62.5 km natural gas pipeline from Goldboro, NS, for the sole purpose of supplying natural gas to the Bear Head LNG export facility.

An approximately 100 m-wide assessment corridor has been selected for this EA. The assessment corridor location was selected to parallel, with some deviations, an existing pipeline RoW to reduce the area of new disturbance. Identification of a final pipeline RoW within the preferred corridor will occur during detailed design. The pipeline will be designed and constructed in accordance with the *Pipeline Regulations* (*Nova Scotia Reg. 66/98*) promulgated under the *Pipeline Act*, R.S.N.S 1989, c. 345, the latest edition of CAN/CSA Z662 - Oil and Gas Pipeline Systems, and all other applicable regulatory requirements.

Bear Paw activities will be similar to those of other natural gas transmission pipeline projects in Nova Scotia. Construction will include site preparation (i.e., clearing, grubbing, topsoil stripping and grading, trenching), pipe installation, RoW restoration, and pipeline cleaning and testing. Operation and maintenance will include maintenance of the RoW (e.g., occasional vegetation cutting), and regular inspections and testing. The Bear Paw facilities are designed and will be operated and maintained to provide safe and efficient service for a minimum of 25 years.

This environmental assessment was completed to meet the requirements of a Registration under the Nova Scotia *Environment Act* and *Environmental Assessment Regulations* as Class I Undertaking. Nine Valued Components (VCs) have been included in this assessment to focus the EA on the most important Project-environment interactions. The assessment included an evaluation of the potential Project-related environmental effects for construction, operation and maintenance, and accidents and malfunctions. Project-related effects were assessed within the context of temporal and spatial boundaries established for the assessment and mitigation was recommended to reduce adverse environmental effects. Monitoring programs have been proposed in some cases to verify the accuracy of effects predictions for effectiveness of mitigation.

Potential Project-related effects from Project construction of Project components include direct and indirect affects to the terrestrial, freshwater and marine environments through loss or alteration of habitat and/or mortality of wildlife species including species at risk and species of concern. Construction activities may also restrict access to lands and resources used by the Mi'kmaq and public for fishing, hunting, and harvesting. In general, potential effects from construction activities are anticipated to be localized and temporary with much of the construction RoW being allowed to return to pre-disturbance conditions following cessation of construction. During operation, there will be emissions of $PM_{2.5}$, NO_2 and CO, from the compressor station as well as GHG and noise emissions; however, it is anticipated these emissions will meet applicable regulatory limits, standards and guidelines.

Pipeline ruptures, fires, and spills of dangerous goods have been identified as potential accidents or malfunctions that may occur over the life of the Project. Due to stringent regulatory requirements associated with pipeline design and the comprehensive health, safety and environmental procedures adopted for Bear Paw, the probability of accidents or malfunctions that could lead to serious public health and safety or environmental consequences is considered very low.

With the implementation of the recommended mitigation identified in the assessment, it is the conclusion of this report that adverse residual environmental effects of routine activities are predicted to be not significant (based on regulatory standards, where applicable and/or using professional judgement) for all VCs. The environmental effects of potential accidents or malfunctions that may occur can be addressed with appropriate environmental management and contingency response planning. Based on that the mitigation outlined in the assessment and appropriate response plans in place. It is anticipated that significant adverse environmental effects are not likely to occur as a result of Project-related accidents and malfunctions.

Positive effects from Bear Paw are likely, particularly those related to increased economic activity through opportunities in labour and skills development. Bear Paw will provide direct and indirect economic benefits to local communities and the region including jobs and training; use of local goods and services, where applicable, and local employment during construction and operation and maintenance. Bear Paw will add to the property tax base of Guysborough and Richmond Counties. The development of Bear Paw is consistent with provincial objectives for development and the upgrading of efficient energy infrastructure.

Based on Bear Paw Pipeline's committment to adhere to applicable regulations and conditions and the implementation of recommended mitigation identified herein, it is the conclusion of this assessment that no significant adverse residual environmental effects are predicted from the construction and operation of the Bear Paw Pipeline Project. Bear Paw will be designed and developed to reduce adverse effects on the environment and is anticipated to provide economic benefits to Guysborough and Richmond County and the Province of Nova Scotia.

9.0 REFERENCES

9.1 Literature Cited

AANDC (Aboriginal Affairs and Northern Development Canada). 2011. First Nation Profiles. Available online at: http://pse5-esd5.ainc-inac.gc.ca/fnp/Main/Index.aspx?lang=eng. Last accessed November 18, 2015.

AANDC (Aboriginal Affairs and Northern Development Canada). 2011. First Nation Profiles. Available online at: http://pse5-esd5.ainc-inac.gc.ca/fnp/Main/Index.aspx?lang=eng. Last accessed November 18, 2015.

AC CDC (Atlantic Canada Conservation Data Centre). 2014a. Species Ranks. Updated December 2014. Accessed December 2015.

AC CDC (Atlantic Canada Conservation Data Centre). 2014b. Data report 5393: Guysborough, NS. Data obtained for Bear Paw July 2015.

AC CDC (Atlantic Canada Conservation Data Centre). 2015a. Data Report 5393: Guysborough, NS. Prepared July 8, 2015.

AC CDC (Atlantic Canada Conservation Data Centre). 2015b. Understanding Ranks. Available at: http://www.accdc.com/enNew/rank-definitions.html. Updated 2015. Accessed: December 2015.

AGRA Earth & Environment Ltd. 1999. Sable Offshore Energy Project Natural Gas Liquids Pipeline Construction Heritage Resource Monitoring Project.

Alberta Energy Regulator. 2007. Directive 038: Noise Control.

Alberta Government. 1996. Code of Practice for Compressor and Pumping Stations and Sweet Gas Processing Plants.

AMEC. 2008. Melford International Terminal EIS Section 5.8 – Marine Environment. Final Report. 71pp. Available online at: https://www.novascotia.ca/nse/ea/melford.international.terminal/MIT_Section%2005.0.Description.ExistingEnvironment.Section-5.8-5.10.pdf.

Assembly of Nova Scotia Chiefs. 2007. Mi'kmaq Ecological Knowledge Study Protocol. Second edition. Available online at: http://novascotia.ca/abor/aborlearn/docs/MEK%20Protocol%20Second%20Edition.pdf. Last accessed on November 16, 2015.

Assembly of Nova Scotia Chiefs. 2007. Mi'kmaq Ecological Knowledge Study Protocol. Second edition. Available online at: http://novascotia.ca/abor/aborlearn/docs/MEK%20Protocol%20Second%20Edition.pdf. Last accessed on November 16, 2015.

Bartzke, G. S. 2014. Effects of power lines on moose (*Alces alces*) habitat selection, movements and feeding activity. Thesis for the degree of Philosophiae Doctor. Norwegian University of Science and Technology, Faculty of Natural Sciences and Technology, Department of Biology.

Bartzke, G. S., R. May, E. J. Solberg, C. M. Rolandsen, and E. Røskaft. 2015. Differential barrier and corridor effects of power lines, roads and rivers on moose (*Alces alces*) movements. Ecosphere 6:art67. Available online at: http://dx.doi.org/10.1890/ES14-00278.1.

Baxter, C.V., F.R. Hauer. 2000. Geomorphology, hyporheic exchange, and selection of spawning habitat by bull trout (*Salvelinus confluentus*). Canadian Journal of Fisheries and Aquatic Sciences, 2000, 57: 1470-1481.

Bayne, E.M., S.L van Wilgenburg, S. Boutin, and K.A. Hobson. 2005. Modeling and field-testing of Ovenbird (*Seiurus aurocapillus*) responses to boreal forest dissection by energy sector development at multiple spatial scales. Landscape Ecology 20: 203-216.

Bayne, L.M., L. Habib, and S. Boutin. 2008. Impacts of chronic anthropogenic noise from energy-sector activity on abundance of songbirds in the boreal forest. Conservation Biology 22: 1186-1193.

Beazley, K.F., T.V. Snaith, F. Mackinnon and D. Colville. 2004. Road density and potential impacts on wildlife species such as American moose in mainland Nova Scotia. Proceedings of the Nova Scotia Institute of Science 42(2); 339-357.

Berger, R.R. & Assoc. Ltd. 1980. Survey of Blasting effects on GW Supplies in Appalachia Part 1. Bureau of Mines Open File Report No. 188-83, Washington DC, November 1980, 160p.

Bigelow, H.B., W.C. Schroeder. 1953. Fishes of the Gulf of Maine. Fishery Bulletin of the Fish and Wildlife Service. Fisheries Bulletin 74 Vol 53 Updated 2002

Blann, K., J.F. Nerbonne, and B. Vondracek. 2002. Relationship of riparian buffer type to water temperature in the driftless area ecoregion of Minnesota. North American Journal of Fisheries Management 22: 441-451.

Bowyer, R.T., V. Van Ballenberghe, and J.G. Kie. 2003. Chapter 45 Moose: *Alces alces* in Wild Mammals of North America: Biology, Management, and Conservation. 2nd edition. G.A. Feldhammer, B.C. Thompson, and J.A. Chapman, eds. 1216pp.

Broders, H.G., A.B. Coombs, and J.R. McCarron. 2012. Ecothermic responses of moose (*Alces alces*) to thermoregulatory stress on mainland Nova Scotia. Alces 48: 53-61.

Brodo, I.M., S.D. Sharnoff, and S. Sharnoff. 2001. Lichens of North America. Yale University Press. New Haven, Conn.

Burton T.M. and G.E. Likens. 1973. Effect of strip-cutting on stream temperatures in Hubbard Brook Experimental Forest, New Hampshire. BioScience 23: 433–35.

Canada Trails. n.d. Guysborough Nature Trail. Available online at: http://www.canadatrails.ca/tct/ns/guysborough.html. Last accessed November 20, 2015.

Canadian Standards Association, National Standard of Canada (ISO 1996-1:2003). 2003. Acoustics – Description, Measurement, and Assessment of Environmental Noise.

Canadian Standards Association. 2006. National Standard of Canada, CAN/CSA-ISO 14064-1:06, Greenhouse Gases – Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals.

CAPP (Canadian Association of Petroleum Producers), CEPA, and CGA (Canadian Energy Pipeline Association and Canadian Gas Association). 2005. Pipeline Associated Watercourse Crossings. Prepared by TERA Environmental Consultants and Salmo Consulting Inc. Calgary, AB.

CBCL. 2015. Bear Head LNG Terminal. 2015 Metocean Study. Draft Report. Prepared for Bear Head LNG. January 2015.

CCME (Canadian Council of Ministers of the Environment). 1999. Canadian Environmental Quality Guidelines. Available online from: http://ceqg-rcqe.ccme.ca/download/en/95. Last Accessed November 26, 2015.

CCME (Canadian Council of Ministers of the Environment). 2007. *Water Quality Guidelines for Freshwater Aquatic Life*. Accessed August 2013 http://st-ts.ccme.ca/.

CEPA (Canadian Energy Pipeline Association). No Date. Facts. Available online at: http://www.cepa.com/library/factoids. Last accessed on November 25, 2015.

CHP (Canada's Historic Places). 2015. Canadian Registered Sites. Available online from: http://www.historicplaces.ca/en/results-resultats.aspx?m=2&Keyword=guysborough&ProvinceId=100025. Accessed January 7, 2016.

Cole, E., M. Newton. 2013. Influence of streamside buffers on stream temperature response following clear-cut harvesting in western Oregon. Canadian Journal of Forest Research 43: 993–1005.

Colescott, J.H. and M.P. Gillingham. 1998. Reaction of moose (*Alces alces*) to snowmobile traffic in the Greys River Valley, Wyoming. Alces 34: 329-338.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2002. COSEWIC assessment and status report on the boreal felt lichen *Erioderma pedicellatum* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2005. COSEWIC assessment and update status report on the fin whale Balaenoptera physalus in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. ix + 37 pp. Available online at: www.sararegistry.gc.ca/status/status_e.cfm.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2006a. COSEWIC assessment and update status report on the harbour porpoise *Phocoena phocoena* (Northwest Atlantic population) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 32 pp. Available online at: http://www.registrelep-sararegistry.gc.ca/sar/assessment/status_e.cfm.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2006b. COSEWIC assessment and status report on the Rusty Blackbird *Euphagus carolinus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 28 pp. (www.sararegistry.gc.ca/status/status_e.cfm).

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2007a. COSEWIC assessment and update status report on the Peregrine Falcon *Falco peregrinus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 45 pp.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2007b. COSEWIC assessment and status report on the Common Nighthawk *Chordeiles minor* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 25pp. (www.sararegistry.gc.ca/status/status_e.cfm).

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2007c. COSEWIC assessment and status report on the Chimney Swift *Chaetura pelagica* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 49 pp.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2007d. COSEWIC assessment and status report on the Olive-sided Flycatcher *Contopus cooperi* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 25 pp.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2007e. COSEWIC assessment and update status report on the Wood Turtle *Clemmys insculpta*, in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 42 pp.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2008a. COSEWIC assessment and update status report on the Short-eared Owl *Asio flammeus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 24 pp. (www.sararegistry.gc.ca/status/status_e.cfm).

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2008b. COSEWIC assessment and status report on the Canada Warbler *Wilsonia canadensis* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 35 pp. (www.sararegistry.gc.ca/status/status_e.cfm).

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2009. COSEWIC assessment and status report on the Brook Floater Alasmidonta varicosa in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 79 pp. (www.sararegistry.gc.ca/status/status_e.cfm).

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2010a. COSEWIC assessment and status report on the Atlantic Salmon Salmo salar (Nunavik population, Labrador population, Northeast Newfoundland population, South Newfoundland population, Southwest Newfoundland population, Northwest Newfoundland population, Quebec Eastern North Shore population, Quebec Western North Shore population, Anticosti Island population, Inner St. Lawrence population, Lake Ontario population, Gaspé-Southern Gulf of St. Lawrence population, Eastern Cape Breton population, Nova Scotia Southern Upland population, Inner Bay of Fundy population, Outer Bay of Fundy population) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xlvii + 136 pp. (www.sararegistry.gc.ca/status/status_e.cfm).

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2010b. COSEWIC assessment and status report on the blue felt lichen *Degelia plumbea* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2010. COSEWIC assessment and status report on the Bobolink *Dolichonyx oryzivorus* in Canada. Ottawa. vi + 42 pp. (www.sararegistry.gc.ca/status/status_e.cfm).

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2011. COSEWIC assessment and status report on the Barn Swallow *Hirundo rustica* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. ix + 37 pp. (www.registrelep-sararegistry.gc.ca/default_e.cfm).

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2012a. COSEWIC assessment and status report on the American Eel Anguilla rostrata in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xii + 109 pp. Available online at: www.registrelep-sararegistry.gc.ca/default_e.cfm.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2012b. COSEWIC assessment and status report on the Eastern Wood-pewee *Contopus virens* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. x + 39 pp. (www.registrelep-sararegistry.gc.ca/default_e.cfm).

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2013. COSEWIC assessment and status report on the North Atlantic Right Whale Eubalaena glacialis in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xi + 58 pp. Available online at: www.registrelep-sararegistry.gc.ca/default_e.cfm.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2015. Wildlife Species Search. Available online at: http://www.cosewic.gc.ca.

CRRP (Caribou Range Restoration Project). 2005. Caribou Range Restoration Project: Guidelines for Planning and Implementation. Grande Prairie, AB.

Curry, A., M. Gautrea, G. Yamazaki. No date. Inland Fish of New Brunswick. Accessed December 1st, 2015. Online at: http://www.unb.ca/research/institutes/cri/links/inlandfishesnb/index.html.

Davis, D., Browne, S. (Eds.) 1996. Natural history of Nova Scotia. Volume 1: topics and habitats. Halifax: Nimbus/Nova Scotia Museum. 518.

DFO (Fisheries and Oceans Canada). 2000. Effects of sediment on fish and their habitat. DFO Pacific Region Habitat Status Report 2000/01.

DFO (Fisheries and Oceans Canada). 2007a. High-Pressure Directional Drilling. Northwest Territories Operational Statement.

DFO (Fisheries and Oceans Canada). 2007b. DFO/FSRS Inshore Ecosystem Project Data Synthesis Workshop; 19-20 March 2007. DFO Can. Sci. Advis. Sec. Proceed. Ser. 2007/028. Available online at: http://publications.gc.ca/collections/collection_2011/mpo-dfo/Fs70-4-2007-028-eng.pdf.

DFO (Fisheries and Oceans Canada). 2009. Underwater World: Rainbow Trout. Revised October 2009. Available http://www.dfo-mpo.gc.ca/science/publications/uww-msm/articles/rainbowtrout-truitearcenciel-eng.html.

DFO (Fisheries and Oceans Canada). 2010a. Aquatic Species – Details for White Sucker. Modified 2010-11-17. Available: http://www.dfo-mpo.gc.ca/species-especes/aquatic-aquatique/white-sucker-meunier-noir-eng.htm.

DFO (Fisheries and Oceans Canada). 2010b. Pathways of Effects: Vegetation Clearing. Modified 2010-03-02. Available http://www.dfo-mpo.gc.ca/pnw-ppe/pathways-sequences/vegetation-eng.html.

DFO (Fisheries and Oceans Canada). 2010c. Pathways of Effects: Streamside Livestock Grazing. Modified 2010-03-02. Available http://www.dfo-mpo.gc.ca/pnw-ppe/pathways-sequences/streamside-riverains-eng.html.

DFO (Fisheries and Oceans Canada). 2013a. Fisheries and Protection Policy Statement. October 2013. Published by Ecosystems Programs Policy. Available online at: http://www.dfo-mpo.gc.ca/pnw-ppe/pol/PolicyStatement-EnoncePolitique-eng.pdf.

DFO (Fisheries and Oceans Canada). 2013b. Aquatic Species – Details for Brook Floater. Modified 2013-11-26. Available: http://www.dfo-mpo.gc.ca/species-especes/species-especes/brookfloater-alasmidonte-eng.htmm.

DFO (Fisheries and Oceans Canada). 2014. Fishery Openings and Closures. Prohibition Order MAR-SSN-2013-140. Available online at: http://www.mar.dfo-mpo.gc.ca/Maritimes/Orders-Registry/Report?order_id=3858.

DFO (Fisheries and Oceans Canada). 2015. Fishery Openings and Closures Variation Order MAR-VAR-2015-027. Available online at: http://www.mar.dfo-mpo.gc.ca/Maritimes/Orders-Registry/Report?order_id=4109.

DFO (Fisheries and Oceans Canada). n.d. Underwater World: The Alewife. Available http://www.dfo-mpo.gc.ca/science/publications/uww-msm/articles/alewife-gaspareau-eng.htm.

Ducharne, T. 2008. Importance of stream temperature to climate change impact on water quality. Hydrology and Earth System Sciences 12: 797-810.

Environment Canada. 2013a. Canadian Ambient Air Quality Standards. Available online at: http://www.ec.gc.ca/default.asp?lang=En&n=56D4043B-1&news=A4B2C28A-2DFB-4BF4-8777-ADF29B4360BD.

Environment Canada. 2013b. National Air Pollution Surveillance Program, Monitoring Results, Available online at: http://maps-cartes.ec.gc.ca/rnspa-naps/data.aspx?lang=en.

Environment Canada. 2014. Weather Glossary. Available online at: https://ec.gc.ca/meteoaloeil-skywatchers/default.asp?lang=En&n=7884CDEA-1#wsglossaryE. Last accessed: November 23, 2015.

Environment Canada. 2015a. Canadian Climate Normals. Available online at: http://climate.weather.gc.ca/climate_normals/index_e.html. Last accessed: November 23, 2015.

Environment Canada. 2015b. The National Inventory Report 1990-2013. Greenhouse Gas Sources and Sinks in Canada. The Canadian Government's Submission to the UN Framework Convention on Climate Change. Environment Canada, Gatineau, Quebec. Available online at: http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/8812.php. Last accessed: November 23, 2015.

Environment Canada. 2015c. News Release-Government of Canada announces 2030 emissions target. Available online at: http://news.gc.ca/web/article-en.do?nid=974959. Last accessed on November 19, 2015.

Environment Canada. 2015d. Facility based data. Available online at: http://www.ec.gc.ca/ges-ghg/8044859A-3843-4832-B161-B5C12E1A500A/GHGRP%20Facility%20Data%202004-2013.xlsx, accessed on August 31, 2015.

Environmental Protection Agency (EPA). 2001. Issue Paper 3: Spatial and Temporal Patterns of Stream Temperature. Prepared as part of EPA region 10 temperature water quality criteria guidance development project.

Erskine, Anthony J., 1992: Atlas of Breeding Birds of the Maritime Provinces. Nova Scotia Museum and Nimbus Publishing Limited. 270 pp.

Federal-Provincial-Territorial Committee on Climate Change and Environmental Assessment. 2003. Incorporating Climate Change Considerations in Environmental Assessment: General Guidance for Practitioners. November 2003.

Gilkinson, K.D., D.C.J. Gordon, K.G. MacIsaac, D.L. McKeown, E.L.R. Kenchington, C. Bourbonnais and W.P. Vass. 2005. Immediate impacts and recovery trajectories of macrofaunal communities following hydraulic clam dredging on Banquereau, eastern Canada. ICES Journal of Marine Science 62:925-947.

Giraudo, A.R., S.D. Matteuci, J. Alonso, J. Herrera, and R.R. Abramson. 2008. Comparing bird assemblages in large and small fragments of the Atlantic Forest hotspots. Biodiversity and Conservation 17: 1251-1265.

Gleason, H.A. and A. Cronquist. 1991. Manual of Vascular Plants of Northeastern United States and Adjacent Canada. New York Botanical Garden. Bronx, NY.

GNS (Government of Nova Scotia). 2009. Nova Scotia Temporary Traffic Control Manual. Reference No. 2012.06.01. Available online at: http://novascotia.ca/tran/tcm/Traffic-Control-Manual-20120601.pdf. Last accessed on November 26, 2015.

Government of Canada. 2015. Canadian Coast Guard. Available online at: http://www.ccg-gcc.gc.ca/Waterways/Canso-Canal-Operations. Last accessed on December 1, 2015.

Government of Nova Scotia. 2009. Toward a Greener Future, A Climate Action Plan, January 2009, Nova Scotia Environment Department.

Government of Nova Scotia. 2014. NS Anglers' Handbook and 2014 Summary of Regulations. Available online at: http://novascotia.ca/fish/documents/2014anglingguide.pdf.

Gravelle, J.A., and T.E. Link. 2007. Influence of timber harvesting on headwater peak stream temperatures in a northern Idaho watershed. Forest Science 53: 189–205.

Haines, A. 2011. Flora Novae Angliae. New England Wild Flower Society. Yale University Press. New Haven, CT.

Health Canada. 2010. Useful Information for Environmental Assessments.

Health Canada. 2014. Guidelines for Canadian Drinking Water Quality. Available online from: http://www.hc-sc.gc.ca/ewh-semt/alt_formats/pdf/pubs/water-eau/sum_guide-res_recom/sum_guide-res_recom_2014-10_eng.pdf. Last accessed on November 26, 2015.

Holm, E., N. Mandrak, M. Burridge, 2009.The Royal Ontario Museum Field Guide to Freshwater Fishes of Ontario. Royal Ontario Museum. 462 pp

INGAA (Interstate Natural Gas Association of America). 2005, Greenhouse Gas Emission Estimation Guidelines For Natural Gas Transmission and Storage Volume 1 – GHG Emission Estimation Methodologies and Procedures http://www.ingaa.org/File.aspx?id=5485.

IPCC (Intergovernmental Panel on Climate Change). 2013. Climate Change 2013: The Physical Science Basis. Working Group I Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press.

IPCC (Intergovernmental Panel on Climate Change). 2014. Summary for Policymakers, In: Climate Change 2014, Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Jalkotzy MG, Ross PI, Nasserden MD. 1997. The effects of linear developments on wildlife: a review of selected scientific literature. Arc Wildlife Services Ltd, prepared for Canadian Association of Petrolroleum Producers, Calgary.

Johnson, D.H. 2001. Habitat fragmentation effects on birds in grasslands and wetlands: a critique of our knowledge. Great Plains Research 11: 221-231.

Joyal, R., P. Lamothe, and R. Fournier. 1984. L'utilisation des emprises de lignes de transport d'e´nergie e´lectrique par l'orignal (*Alces alces*) en hiver. Canadian Journal of Zoology 62: 260–266.

JWEL (Jacques Whitford Environment Limited). 1998. Environmental Field Surveys – Natural Gas Pipeline. Report to Sable Offshore Energy Inc. on Proposed Natural Gas Liquids Pipeline Project Environmental Field Surveys – 25 m Easement. Report to Sable Offshore Energy Inc. JWEL Project No. 13141. September 1998.

JWEL (Jacques Whitford Environment Limited). 1999. An Archaeological Resource Impact Assessment for the Point Tupper Natural Gas Lateral Pipeline Route.

JWEL (Jacques Whitford Environment Limited). 2004. Report to Access Northeast Energy Inc. on Environmental Assessment for the Proposed Bear Head LNG Terminal, Bear Head Nova Scotia, May 2004. Available online at: http://www.gov.ns.ca/enla/ess/ea/bearHeadLNGTerminal.asp.

JWEL (Jacques Whitford Environment Limited). 2006. Archaeological Impact Assessment of a Proposed Natural Gas pipeline from Bear Head, Richmond County to Goldboro, Guysborough County. Heritage Research permit A 2005NS93.

Kemker, Christine. 2014. "Turbidity, Total Suspended Solids and Water Clarity." Fundamentals of Environmental Measurements. Fondriest Environmental, Inc. 13 Jun. 2014. Available online at: http://www.fondriest.com/environmental-measurements/parameters/water-quality/turbidity-total-suspended-solids-water-clarity/#Turbid2.

Kenchington, E. 2014. A General Overview of Benthic Ecological or Biological Significant Areas (EBSAs) in Maritimes Region. Can. Tech. Rep. Fish. Aquat. Sci. 3072: iv+45p. Available online at: http://www.researchgate.net/profile/Ellen_Kenchington/publication/261709018_A_General_Overview_of_Benthic_Ecological_or_Biological_Significant_Areas_(EBSAS)_in_Maritimes_Region/links/00b7d53526843eab26000000.pdf.

Kennedy, G.W., K.G. Garroway, and D. S. Finlayso. 2010. Estimation of Regional Groundwater Budgets in Nova Scotia. Nova Scotia Department of Natural Resources Open File Illustration ME 2010-2.

Keppie, J. D. 2000. Geological Map of the Province of Nova Scotia. N.S. Department of Natural Resources. Minerals and Energy Branch. Map ME2000-1. Scale 1: 500,000.

Lewis, L.J., J. Davenport, and T.C. Kelly. 2002. A Study of the Impact of a Pipeline Construction on Estuarine Benthic Invertebrate Communities. *Estuarine, Coastal and Shelf Science* 55:213–221.

Marks, J. S., D. L. Evans and D. W. Holt. 1994. Long-eared Owl (*Asio otus*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America. Available online at: http://bna.birds.cornell.edu/bna/species/133doi:10.2173/bna.133.

McCracken, F.D. 1979. Canso Marine environment Workshor Part 2 of 4 Parts – An Overview. Fisheries & Marine Service technical Report No. 834. Available online at: http://www.dfo-mpo.gc.ca/Library/69910.pdf.

McMahon, T. E. 1982. Habitat suitability index models: Creek chub. U.S.D.I. Fish and Wildlife Service. FWS/OBS-82/10.4 23 pp.

McNeil, J. 2013. Action Plan for the Recovery of Eastern Moose (*Alces alces americana*) in Mainland Nova Scotia. Mainland Moose Recovery Team and Mersey Tobeatic Research Institute, Kempt, Nova Scotia.

MGS (Membertou Geomatics Solutions). 2016. Mi'kmaq Ecological Knowledge Study.

Millbrook First Nation. n.d Community Profile. Available online at: http://millbrookfirstnation.net/about-us/. Last accessed February 18, 2016.

MODG (Municipality of the District of Guysborough). 2011. Noise Control By-Law.

Monthey. R.W. 1984. Effects of Timber Harvesting on Ungulates in Northern Maine. The Journal of Wildlife Management 48 (1): 279-285.

Morris, A.D., D. A. Miller, and M.C. Kalcounis-Rueppell. 2008. Use of Forest Edges by Bats in a Managed Pine Forest. Landscape 74: 26-34.

Munro, M.C.; R.E. Newell; and N.M. Hill. 2014. Nova Scotia Plants. Available at: https://ojs.library.dal.ca/NSM/pages/view/Plants.

NEB (National Energy Board). 2011. Focus on Safety and Environment A Comparative Analysis of Pipeline Performance 2000–2009. Cat. No. NE2-2/2009E-PDF ISSN 1719-6183.

NEB (National Energy Board). 2015. Safety Performance Portal – Pipeline Incidents - Dashboard. Available online at: https://www.neb-one.gc.ca/sftnvrnmnt/sft/dshbrd/index-eng.html. Last accessed December 16, 2015.

Nedeau, E.J., M.A. McCollough, and B.I. Swartz. 2000. The freshwater mussels of Maine. Maine Department of Inland Fisheries and Wildlife, Augusta, Maine, 118 pp.

Neily, P., Basquill, S., Quigley, E., Stewart, B., Keys, K. 2011. Forest Ecosystem Classification for Nova Scotia, Part I: Vegetation Types (2010). Nova Scotia Department of Natural Resources, Renewable Resources Branch.

Neily, P., Quigley, E., Benjamin, L., Stewart, B. and Duke, T. 2003. Ecological land classification for Nova Scotia, Volume 1: Mapping Nova Scotia's terrestrial ecosystems. DNR 2003-2. Nova Scotia Department of Natural Resources, Available at: http://www.gov.ns.ca/NATR/forestry/ecosystem/pdf/ELCrevised2.pdf.

Newcombe, C.P. and J.O.T. Jensen. 1996. Channel suspended sediments and fisheries: a synthesis for quantitative assessment of risk and impact. North American Journal of Fisheries.

Newell, R.C., L.J. Seiderer and D.R. Hitchcock. 1998. The impact of dredging works in coastal waters: a review of the sensitivity to disturbance and subsequent recovery of biological resources on the sea bed. Oceanography and Marine Biology 36:127−178.

Newmaster, S.G., R.J. Belland, A. Arsenault, D.H. Vitt, T.R. Stephens. 2005. The ones we left behind: Comparing plot sampling and floristic habitat sampling for estimating bryophyte diversity. Diversity and Distributions 11(1): 57-72.

NOAA (National Oceanic and Atmospheric Administration). 2015, United States National Oceanic and Atmospheric Administration, Ed Dlugokencky and Pieter Tans, NOAA/ESRL. Available online at: www.esrl.noaa.gov/gmd/ccgg/trends/.

Nova Scotia Department of Mines and Energy 2015. On-Line Interactive Groundwater Resources Map. gis4.natr.gov.ns.ca/website/nsgroundwater.

Nova Scotia Environment and Labor. 1999. Pit and Quarry Guidelines. May 4, 1999. Rev. Aug 20, 2003.

NSDNR (Nova Scotia Department of Natural Resources). 2007a. Recovery Plan for Moose (*Alces alces americana*) in Mainland Nova Scotia. Available online at: http://www.novascotia.ca/natr/wildlife/large-mammals/mainlandmoose.asp. Last accessed December, 2015.

NSDNR (Nova Scotia Department of Natural Resources). 2008. The Nova Scotia Abandoned Mine Openings (AMO) Database. Available online at: http://novascotia.ca/natr/meb/geoscience-online/about-database-amo.asp.

NSDNR (Nova Scotia Department of Natural Resources). 2012. Endangered Mainland Moose Special Management Practices.

NSDNR (Nova Scotia Department of Natural Resources). 2014. General Status Ranks of Wild Species in Nova Scotia. Available online at: http://novascotia.ca/natr/wildlife/genstatus/ Accessed December 2015.

NSDNR (Nova Scotia Department of Natural Resources). 2015a. Forest Inventory Data. Forest Inventory Data. Renewable Resources Branch. Based on aerial photography and satellite imagery from 1993+.

NSDNR (Nova Scotia Department of Natural Resources). 2015b. Wetland Inventory Data.

NSDNR (Nova Scotia Department of Natural Resources). 2015c. Moose observation data from the province via email December 2015.

NSDNR (Nova Scotia Department of Natural Resources). 2015d. Species at Risk Overview, NS *Endangered Species Act*: Legally Listed Species. Available online at: http://novascotia.ca/natr/wildlife/biodiversity/species-list.asp.

NSDNR (Nova Scotia Department of Natural Resources). 2015e. Significant Habitats Database.

NSDNR (Nova Scotia Department of Natural Resources). 2015f. Crown Land in Nova Scotia. Available online at: http://novascotia.ca/natr/land/. Last accessed on December 1, 2015.

NSDNR (Nova Scotia Department of Natural Resources). 2015g. Hunting. Available online at: http://novascotia.ca/natr/land/. Last accessed on November 29, 2015.

NSDNR (Nova Scotia Department of Natural Resources). 2015h. A Designated Trails System. Available online at: http://novascotia.ca/natr/ohv/designatedtrails.asp. Last accessed on November 29, 2015.

NSDNR (Nova Scotia Department of Natural Resources). 2015i. Wildfire Protection. Available online at: http://novascotia.ca/natr/forestprotection/wildfire/detection.asp. Last accessed December 8, 2015.

NSDNR (Nova Scotia Department of Natural Resources). n.d. Nova Scotia's Limited Entry Hunts Antlerless Deer Draw. Available online at: http://novascotia.ca/natr/draws/deerdraw/background.asp. Last accessed December 1, 2015.

NSDNR (Nova Scotia Department of Natural Resources. 2005. Freshwater Mussel Database, version November 2005.

NSDOE (Nova Scotia Department of Environment). 2015. 1998. "The State of the Nova Scotia Environment 1998". July 1998. Halifax, Nova Scotia.

NSE (Nova Scotia Department of Environment). 1989. Guideline for Environmental Noise Measurement and Assessment.

NSE (Nova Scotia Environment). 2010a. Guide to Groundwater Withdrawal Approvals. Available online from: http://www.novascotia.ca/nse/water/docs/guideToGroundwaterWithdrawalApprovals.pdf. Last Accessed November 25, 2015.

NSE (Nova Scotia Environment). 2010b. Boreal Felt Lichen predictive Habitat Model GIS Shapefile. Obtained from NSE July 2010.

NSE (Nova Scotia Environment). 2011a. Nova Scotia Wetland Conservation Policy. Available at: http://www.novascotia.ca/nse/wetland/conservation.policy.asp.

NSE (Nova Scotia Environment). 2011b. Nova Scotia Wetland Evaluation Technique (NovaWET). Version 3.0.

NSE (Nova Scotia Environment). 2012. Nova Scotia Treatment Standards for Municipal Drinking Water Systems. Available online from: https://www.novascotia.ca/nse/water/docs/Treatment_Standards_for_Municipal_Drinking_Water_Systems.pdf. Last Accessed November 25, 2015.

NSE (Nova Scotia Environment). 2015a. Nova Scotia Watercourse Alterations Standard. Watercourse Alteration Program.

NSE (Nova Scotia Environment). 2015b. Well Logs Database (1960 to present). http://www.novascotia.ca/nse/welldatabase/wellsearch.asp.

NSE (Nova Scotia Environment). 2015c. Well Logs Database (1975 to present); maintained by NSDNR.

NSE (Nova Scotia Environnent). 2013. Wetlands of Special Significance. Shapefile provided by NSE in February 2013.

NSOAA (Nova Scotia Office of Aboriginal Affairs). 2012. Proponents' Guide: The Role of Proponents in Crown Consultation with the Mi'kmaq of Nova Scotia. Office of Aboriginal Affairs. Available online at: http://www.gov.ns.ca/abor/docs/Proponents%20Guide%20November%202011%20ecopy.pdf. Last accessed on November 16, 2015.

NSOAA (Nova Scotia Office of Aboriginal Affairs). 2012. Proponents' Guide: The Role of Proponents in Crown Consultation with the Mi'kmaq of Nova Scotia. Office of Aboriginal Affairs. Available online at: http://www.gov.ns.ca/abor/docs/Proponents%20Guide%20November%202011%20ecopy.pdf. Last accessed on November 16, 2015.

NWWG (National Wetlands Working Group). 1997. The Canadian Wetland Classification System. Second Edition. Wetlands Research Centre. University of Waterloo, Waterloo, ON.

Page, L.M., B.M. Burr. 2002. A Field Guide to Freshwater Fishes: North America North of Mexico. Houghton Mifflin, 1991.

Paqtnkek. n.d. Community Profile. Available online at: http://paqtnkek.ca/community/our-community/community-profile/. Last accessed November 18, 2015.

Paqtnkek. n.d. Community Profile. Available online at: http://paqtnkek.ca/community/our-community/community-profile/. Last accessed November 18, 2015.

Parker, G. 2003. Status Report on The Eastern Moose (*Alces alces americana* Clinton) in Mainland Nova Scotia.

Parrott, D. R, M.B. Parsons, M.B.,V. Kostylev, V., Shaw, J., Shawn, and K-L Tay, K.L. 2005. *Seafloor Character* character *of Canso Strait, Nova Scotia -– 50 Years*years *after* completion *of the Canso Causeway*. Canadian Coastal Conference 2005. Published by Natural Resources Canada and Environment Canada. 19pp. Available online at: http://www.straitofcansostudies.ca/adobe/bio01.pdf.

Pieridae Energy (Canada) Ltd. 2013. Environmental Assessment Report (Class 2 Undertaking) Goldboro LNG – Natural Gas Liquefaction Plant and Marine Terminal. Available online at: http://www.novascotia.ca/nse/ea/goldboro-lng.asp. Last accessed: November 24, 2015.

Popper, A.N. 2003. *Effects of anthropogenic sounds on fishes*. Fisheries 28(10): pp. 24-31.

Potlotek First Nation. N.d. Community Profile. Available online at: http://potlotek.ca/. Last accessed November 18, 2015.

Potlotek First Nation. N.d. Community Profile. Available online at: http://potlotek.ca/. Last accessed November 18, 2015.

Potvin, F., R. Courtois, and L. Bélanger. 1999. Short-term response of wildlife to clear-cutting in Québec boreal forest: multiscale effects and management implications. Canadian Journal of Forest Research 29:1120-1127.

Province of Nova Scotia. 2013. Our Parks and Protected Areas – A Plan for Nova Scotia. Available online at: http://novascotia.ca/parksandprotectedareas. Last accessed November 24, 2015.

Raesly, R. L. and J. E. Gates. 1987. Winter habitat selection by north temperate cave bats. The American Midland Naturalist 118:15-31.

Rex, J.F., D.A. Maloney, P.N. Krauskpf, P.G. Beaudry, and L.J. Beaudry. 2012. Variable-retention riparian harvesting effects on riparian air and water temperature of sub-boreal headwater streams in British Columbia. Forest Ecology and Management 269: 259–270.

Robertson, D.A., Gould, J.A., Straw, J. A. and M. A. 1982. Dayton, Survey of Blasting effects on GW Supplies in Appalachia Volumes 1 and 2. US Bureau of Mines Open File Report No. 8(1)-82; NTIS PB-82-152125.

Robinson, C.L.K. and I.D. Cuthbert. 1996. *The impacts of backshore 1 developments on nearshore biota and their habitats.* Nanaimo, Triton Environmental Consultants Ltd.: 1-37pp.

Sable Offshore Energy Inc. 1996. Addendum 3, Natural Gas Liquids Pipeline and Liquids Facilities Assessment.

Sauter, S.T., J. McMillan, J. Dunham. 2001. Salmonid Behaviour and Water Temperature: EPA Region 10 Temperature Water Quality Criteria Guidance Development Project. 38 pp.

Scott, W. B., & Crossman, E. J. 1998. Freshwater Fishes of Canada. Oakville, Ont., Canada: Galt House 966p.

Sedell, J.R., G.H. Reeves, F.R. Hauer, J.A. Stanford, C.P. Hawkins. 1990. Role of refugia in recovery from disturbances: Modern fragmented and disconnected river systems. Journal of Environmental Management 14: 711-724.

Service Nova Scotia. 2015. Mineral Exploration : Special License. Available online at: https://www.novascotia.ca/sns/paal/dnr/paal138.asp. Last accessed December 9, 2015.

Sherrington, P.M. 2003. Measuring boreal forest fragmentation change in response to seismic line, wellsite and road revegetation with scanned false-colour infrared aerial photography. Master of Science Thesis, Department of Geography, University of Calgary, Calgary, AB.

Snaith, T.V. 2001. The status of moose in mainland Nova Scotia: population viability and habitat suitability. MSc., Dalhousie University, Halifax, Nova Scotia.

SNC. 2015. Bear Head LNG Updated Registration Document. Prepared for Bear Head LNG Corporation.

Stantec (Stantec Consulting Ltd.). 2012a. Alton Natural Gas Pipeline Environmental Assessment Registration. Prepared for Alton Natural Gas Storage LP. July 2012.

Stantec (Stantec Consulting Ltd.). 2012b. Environmental Impact Assessment for the Donkin Export Coking Coal Project. Prepared for Xstrata Coal. July 2012.

Stantec (Stantec Consulting Ltd.). 2015. Draft Report: Request for *Fisheries Act,* 2012 Regulatory Review for Bear Paw Pipeline Project – Marine Environment. November 2015.

Stea, R.R. and J.H. Fowler. 1979. Minor and Trace Element Variations in Wisconsinan Tills, Eastern Shore Region, Nova Scotia. (Sheets 1, 2, 3). N.S. Dept. of Mines and Energy and Canada DREE Paper 79-4.

Stea, R.R., H. Conley & Y. Brown. 1992. Surficial Geology of the province of Nova Scotia. NSDME Map 92-3. Scale 1: 500,000.

Stephens, S.E., D.N. Koons, J.J. Rotella, and D.W. Willey. 2004. Effects of habitat fragmentation on avian nesting success: a review of the evidence at multiple spatial scales. Biological Conservation 115: 101-110.

Strahler, A.N. 1952. Hypsometric (area-altitude) analysis of erosional topography. Bulletin of the Geological Society of America 63: 1117–1142.

Strait of Canso Environment Committee. 1975. Strait of Canso Natural Environmental Inventory Reports and Maps (Scale 1:125,000). Commissioned by the Canada-Nova Scotia Strait of Canso Environment Committee. Prepared by Maritime Resource Management Service (MRMS) Council of Maritime Premiers. 5 Vol: Socio-Economic Environment; Socio-Economic Features; Fish and Wildlife Resources; Geological Resources; Water Resources.

Switalski, T.A. and C.R. Nelson. 2011. Efficacy of road removal for restoring wildlife habitat: Black bear in the Northern Rocky Mountains, USA. Biological Conservation 144: 2666 – 2673.

Teti, P. 1998. The effects of forest practices on stream temperature: A review of the literature. B.C. Ministry of Forests. 10 pp.

Tufts, R. W. 1986. Birds of Nova Scotia. 3rd ed. Nimbus Publishing Ltd. N.S. Museum. Halifax, N.S. 478 p.

US Army Corps of Engineers. 1987. Wetlands Delineation Manual. Technical Report Y-87-1.

US EPA (United States Environmental Protection Agency. 1996a. AP-42. 1996a. Chapter 3.3 Gasoline and Diesel Industrial Engines.

US EPA (United States Environmental Protection Agency. 1996b. AP-42. Chapter 3.4 Large Stationary Diesel and All Stationary Dual-fuel Engines.

US EPA (United States Environmental Protection Agency. 2008a. NONROAD Model (nonroad engines, equipment, and vehicles). Available online at: http://www3.epa.gov/otaq/nonrdmdl.htm.

US EPA (United States Environmental Protection Agency. No Date. Heavy Duty Highway Compression Ignition Engines and Urban Buses – Exhaust Emission Standards. Accessed on February 24, 2016 from http://www3.epa.gov/otaq/standards/heavy-duty/hdci-exhaust.htm.

US EPA (United States Environmental Protection Agency. 1974. Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety.

US EPA (United States Environmental Protection Agency. 1998. Emissions Factors & AP 42, Compilation of Air Pollutant Emission Factors – Chapter 1.4, Natural Gas Combustion.

US EPA (United States Environmental Protection Agency. 2000a. Emissions Factors & AP 42, Compilation of Air Pollutant Emission Factors – Chapter 3.1, Stationary Gas Turbines.

US EPA (United States Environmental Protection Agency. 2000b. Emissions Factors & AP 42, Compilation of Air Pollutant Emission Factors – Chapter 3.2., Natural Gas-fired Reciprocating Engines.

Vogwill, R.I.J. 1979. An evaluation of the effects of Seismic Detonations on Water Wells. Alberta Research Council; Groundwater Division; April 1979; 48 Pages. April 1979.

Wagmatcook. N.d. Community Profile. Available online at: http://www.wagmatcook.com/community/index.php. Last accessed November 18, 2015.

Wagmatcook. N.d. Community Profile. Available online at: http://www.wagmatcook.com/community/index.php. Last accessed November 18, 2015.

Washburn & Gillis Associates Ltd. 1999. Sable Offshore Energy Project natural Gas Liquids Pipeline Archaeological Assessment for 1996, 1997, 1998 and 1999.

Waycobah First Nation. N.d. Community Website. Available online at: http://www.waycobah.ca/Community/. Last accessed November 18, 2015.

Waycobah First Nation. N.d. Community Website. Available online at: http://www.waycobah.ca/Community/. Last accessed November 18, 2015.

WCI (Western Climate Initiative). 2011, Western Climate Initiative Final Essential Requirements of Mandatory Reporting 2011 Amendments for Harmonization of Reporting in Canadian Jurisdictions December 21, 2011. Available online at: http://www2.gov.bc.ca/assets/gov/environment/climate-change/stakeholder-support/reporting-regulation/amended-quantification-methods/final-essential-requirements-mandatory-reporting_second-update_21dec2011.pdf.

Wiggins, D. A., D. W. Holt and S. M. Leasure. 2006. Short-eared Owl (*Asio flammeus*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America. Available online at: http://bna.birds.cornell.edu/bna/species/062doi:10.2173/bna.62.

Wilber, D.H. and D.G. Clarke. 2001. Biological effects of suspended sediments: A review of suspended sediment impacts on fish and shellfish with relation to dredging activities in estuaries. North American Journal of Fisheries Management. 21:855–875.

Wilkerson, E., Hagan, J.M., Siegel, D., and Whitman, A.A. 2006. The effectiveness of different buffer widths protecting headwater stream temperatures in Maine. Forest Science. 52: 221–231.

Woinarski, J.C.Z., M.Armstrong, K. Brennan, G. Connors, D. Milne, G. McKenzie and K. Edwards. 2000. A different fauna: captures of vertebrates in a pipeline trench compared with conventional survey techniques and a consideration of mortality patterns in a pipeline trench. Australian Zoologist 31: 421-431.

World Health Organization (WHO). 1999. Guidelines for Community Noise.

WRI (World Resources Institute). 2015. Climate Analysis Indicators Tool (CAIT) Climate Data Explorer. Washington, DC. Available online at: http://cait.wri.org/. Last accessed: November 23, 2015.

Wright, D.G., and G.E. Hopky. 1998. Guidelines for the use of explosives in or near Canadian fisheries waters. Can. Tech. Rep. Fish. Aquat. Sci. 2107: iv + 34p.

Zinck, M. 1998. Roland's Flora of Nova Scotia. Nova Scotia Museum. Halifax, NS.

9.2 PERSONAL COMMUNICATIONS

Crowell, M. 2015. Personal communication, December 10, 2015. Senior Terrestrial Ecologist, Stantec Consulting Ltd., Dartmouth, Nova Scotia.

NSDNR (Nova Scotia Department of Natural Resources). 2015. Personnel communication with NSDNR on September 1, 2015.

Gaudet, J. Regional Program Specialist, MCTS, Halifax, NS. January, 2015.

Torrey, Deborah. Personal communication, November 12, 2015. Development Officer, Municipality of the District of Guysborough, Nova Scotia.