



SNC • LAVALIN

BEAR HEAD LNG

UPDATED REGISTRATION DOCUMENT

BEAR HEAD LNG CORPORATION



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REGISTRATION DOCUMENT

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- E: ACCDC Data Report
- F: Archaeological Assessment
- G: Air Quality Assessment
- H: Noise Assessment
- I: Mi'kmaq Ecological Knowledge Study

LIST OF ACRONYMS

AADT	Annual Average Daily Traffic
ACCDC	Atlantic Canada Conservation Data Centre
ASME	American Society of Mechanical Engineers
BACT	Best Available Control Technologies
BOG	Boil off Gas
C ₂ H ₆	Ethane
C ₃ H ₈	Propane
CAAQS	Canadian Ambient Air Quality Standards
CCG	Canadian Coast Guard
CCGT	Combined Cycle Gas Turbines
CCME	Canadian Council of Ministers of the Environment
CCTV	Closed Circuit Television
CEAA	<i>Canadian Environmental Assessment Act</i>
CEPA	<i>Canada Environment Protection Act</i>
CH ₄	Methane
CHB	Community Health Boards
CIP	Calling in Point
CNG	Compressed Natural Gas
CO	Carbon Monoxide
CO ₂	Carbon Dioxide
COS	Carbonyl Sulphide
COSEWIC	Canadian Committee on the Status of Endangered Wildlife in Canada
CS ₂	Carbon Disulphide
CSA	Canadian Standards Association
DFO	Fisheries and Oceans Canada
DIM	Direct Inspection and Maintenance
DMR	Dual Mixed Refrigerant
ECREG	Eastern Canada Vessel Traffic Services Zone Requirements
EMO	Emergency Management Office
EMP	Environmental Management Plan
ENGO	Environmental Non-Governmental Organizations
EPA	Environmental Protection Agency
EPP	Environmental Protection Plan
ESA	Environmental Site Assessment
FEED	Front End Engineering Design
FWAL	Freshwater Aquatic Life
GASHA	Guysborough Antigonish Strait Health Authority
GHG	Green House Gas
GWP	Global Warming Potential
H ₂ S	Hydrogen Sulfur
Ha	Hectare
HSE	Health, safety and Environment
ISO	International Standards Organizations

ISQG	Interim Sediment Quality Guidelines
IUCN	International Union for the Conservation & Nature
KMKNO	Kwilmu'kw Maw-klusqn Negotiation Office
KO	Knockout
LDAR	Leak Detection and Repair
LFL	Lower Flammability Limit
LNG	Liquefied Natural Gas
LNGL	Liquefied Natural Gas Limited
M ³	Cubic Meters
MBBA	Maritime Breeding Birds Atlas
MCTS	Marine Communications and Traffic Services
MDEA	Methyldiethanolamine
MEKS	Mi'kmaq Ecological Knowledge Study
MFC	Mixed Fluid Cascade
MOU	Memorandum of Understanding
MR	Mixed refrigerant
MSDS	Material Safety Data Sheet
MTPA	Million Tonnes Per Annum
MW	Mega Watt
N	Nitrogen
NAPS	National Air Surveillance Program
NEB	National Energy Board
NFPA	National Fire Protection Association
Ni	Nickel
N ₂ O	Nitrous Oxide
NO ₂	Nitrogen Dioxide
NPA	<i>Navigation Protection Act</i>
NPIR	National Pollutant Release Inventory
NS	Nova Scotia
NSBI	Nova Scotia Business Inc.
NSCC	Nova Scotia Community College
NSDNR	Nova Scotia Department of Natural resources
NSE	Nova Scotia Environment
NSPI	Nova Scotia Power Inc.
NSTIR	Nova Scotia Transportation and Infrastructure Renewal
NSUARB	Nova Scotia Utilities and Review Board
NTU	Nephelometric Turbidity Units
O ₃	Ozone
OCIMF	Oil Companies International Marine Forum
OSMR [®]	Optimized Single Mixed Refrigerant
OTSG	Once Through Steam Generators
PCB	Polychlorinated Biphenyl
PIRI	Partners in RBCA Implementation
PLC	Programmable Logic Controller
PM	Particulate Matter

PM _{2.5}	Fine Particulates
POL	Petroleum, Oil and Lubricants
RBCA	Risk Based Corrective Action
RBSL	Risk Based Screening Level
SAR	Species at Risk
SARA	<i>Species at Risk Act</i>
SCGT	Single Cycle Gas Turbine
SIGTTO	Society of International Gas Tanker and Terminal Operators
SIS	Safety Instrument System
SMR	Single Mixed Refrigerant
SO _x	Sulphur Oxide
SO ₂	Sulphur Dioxide
SOLAS	International Convention for Safety of Life at Sea
SSIP	Scotian Shelf Ichthyoplankton Program
TDC	Transportation Development Centre
TRC	Technical Review Committee
TSS	Total Suspended Solids
VEC	Valued Ecosystem Component
VOCs	Volatile Organic Compound
VTS	Vessel Traffic Services
WHMIS	Workplace Hazardous Materials Information System
WHR	Waste Heat Recovery

Parameters	Units	EQL	CCME ISQG – PEL	ODCA	Bear Head	Strait of Canso ¹
Benzene	mg/kg	0.025			All <0.025	
Toluene	mg/kg	0.025			All <0.025	
Ethylbenzene	mg/kg	0.025			All <0.025	
Xylene	mg/kg	0.05			All <0.05	
PCDD/Fs ²	pg/g		0.85-21.5		0.31-0.41	
¹ Stewart and White 2001 ² Pesticides, PAHs, and PCDD/Fs are grouped to simplify table EQL = Estimated Quantitation Limit Calibration CCME = Canadian Council of Ministers of Environment ISQG = Interim Sediment Quality Guideline PEL = Probable Effects Limit ODCA = Ocean Disposal Chemistry Analysis						

4.4.2.3 Plankton

Plankton includes a diverse group of organisms that are linked by their reliance on water column properties and availability of sunlight and nutrients. They live in the water column and are transported by water movements and other physical processes such as stratification, mixing and nutrient exchange. Plankton includes bacterioplankton, phytoplankton, zooplankton and ichthyoplankton (fish larvae and eggs). Their concentration and diversity vary markedly over both temporal and spatial scales as a consequence of a variety of physical, chemical and biological factors. Bacterioplankton are an important group that are rarely studied in coastal waters; they are one of the most important groups overall, forming, together with phytoplankton, the base of the marine ecosystem food chain and accounting for a large proportion of planktonic biomass in the ocean as a whole.

4.4.2.4 Ichthyoplankton

The majority of fish in Nova Scotia coastal waters including Chedabucto Bay and the Strait of Canso reproduce through the release of eggs and larvae, which spend some time in the water column during early development. Comparatively little information exists on the temporal and spatial distribution of fish eggs and larvae in the inshore waters (Chedabucto Bay). On the Scotian Shelf, the greatest abundance occurs from March to June and is lowest during the winter months, December to February (Shackell and Frank, 2000; Breeze et al, 2002) (Table 4-20). Individual species also appear to have multiple, or at least protracted spawning periods (possibly indicating variable contributions from different fish stocks).

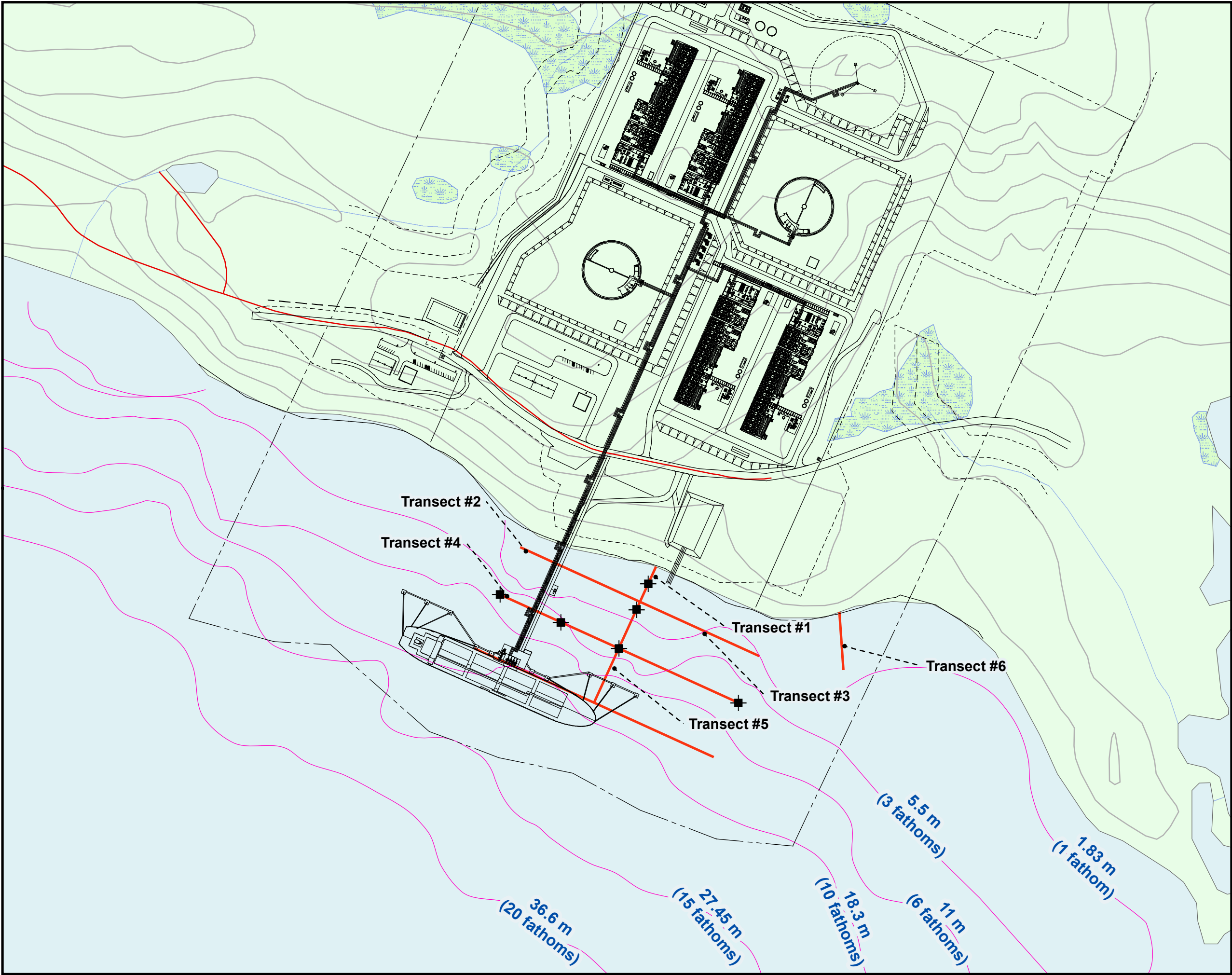
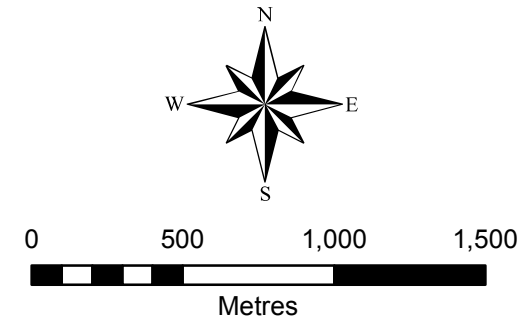


Figure 4-17
Benthic Habitat
Survey
(JWEL, 2004a)

- Sediment Sampling Locations
- Bathymetry
- Bear Head LNG Site Features
- Elevation
- Underwater Video Transect
- Waterbodies
- Wetlands



Map Parameters
Projection: Universal Transverse Mercator (UTM)
Datum: NAD83
Zone: 20
Scale: 1:5,000
Project Numer: 622560
Date: April 1, 2015

Data Source:
-Canvec (2013) Digital National Topographic System (NTS) topographic dataset for Port Hawkesbury (011F11)
-Site Preparation As-built, J & T Van Zutphen for Bear Head LNG Corp., April 7, 2006, PN 6143
-Plot Plan, LNG International Limited, March 5, 2015, BH-DG-00-002 Rev C1

On the Scotian Shelf, the eggs and larvae of cod, haddock, pollock, and silver hake are mostly concentrated on the shallow outer banks of the Shelf (Browns, Western, Emerald, Sable Island and Banquereau) (O'Boyle et al, 1984). Fish larvae appeared to be retained on the central and southwestern banks, in particular Sable Island Bank, Western Bank and Browns Bank (O'Boyle et al 1984). Sable Island Bank and Western Bank areas have the highest overall fish larvae diversity and abundance (Shackell and Frank, 2000).

Table 4-20: Monthly Distribution of Fish and Invertebrate Larvae by Species on the Scotian Shelf, From the Scotian Shelf Ichthyoplankton Program (SSIP), 1978-1982

Species	J	F	M	A	M	J	J	A	S	O	N	D	
Herring													
Cod													
Haddock													
Pollock													
Silver hake													
White hake													
Sand lance													
Mackerel													
Redfish													
Cusk*													
Yellowtail													
N. shrimp													
Lobster													
Crabs													
Scallop													
		Represents times of peak larval density											
		Represents larval presence											
* Cusk larvae were rare to absent Modified from JWEL, 2004a (which was adapted from Breeze et al 2002)													

4.4.3 Marine Benthic Habitat and Communities

The waters of the Strait of Canso and Chedabucto Bay support seaweed and seabed animal communities typical of moderately exposed coastal inlets on the Nova Scotia coast. Information on benthic habitat in the vicinity of the proposed marine terminal was obtained from a drop camera video survey in 2003 to a depth of about 20 m (Figure 4-17). Similar surveys were carried out for the proposed Melford International Terminal at a comparable depth and provided comparable information (AMEC 2008). Deeper softbottom areas typically lack seaweeds and are dominated by animal communities (Tay et al 2010; Parrott et al 2005).

4.4.3.1 Sediments

Characteristic marine benthic communities develop on particular bottom substrates, in combination with other factors such as depth and temperature. Knowledge of the local distribution of sediments can therefore help to determine the types and distribution of benthic organisms and plants. The distribution of sediments in the outer Strait of Canso and in Chedabucto Bay reflects erosion of the coast and the redistribution of fine sediments by wave activity and currents from intertidal and shallow areas to deeper areas of the Strait and the Bay. At the Bear Head LNG site, nearshore sediments consist of a rocky intertidal zone with mixed boulder, cobble, gravel, sand and mud. The coarse substrate extends below the low water mark to depths greater than 10 m where it is replaced on a gradually sloping bottom by silt and clay; this finer sediment forms a veneer over the Strait and fills seabed depressions.

Typical sediments in the footprint of the Bear Head LNG terminal jetty are dominated by gravel and sand fractions. Sediments deeper in the central parts of the Strait of Canso tend to be finer with higher percentages of fine material (silt and clay), typically clayey sandy silt (sand, 11.7%; silt, 62.9%; clay, 23.4%)(Tay et al 2010). A similar general distribution of sediments can be observed in Chedabucto Bay, with the shallower margins of the Bay occupied by coarser sediments (rock, bedrock, gravel and sand), which is replaced by silt and clay in the deeper areas.

4.4.3.2 Intertidal

The marine portion of the Project site is characterized by a cobble beach; kelp and rockweed were observed at the low tide mark (Figure 4-18). Intertidal substrate at the site is typically coarse, consisting of pebbles, cobbles and the occasional boulder. Dominant seaweeds include fucoid species (*Fucus vesiculosus*, *F. evanescens* and *Ascophyllum nodosum*) with *A. nodosum* occurring in the upper intertidal and *F. vesiculosus* and *F. evanescens* in the lower intertidal. Irish moss (*Chondrus crispus*) occurs in the understory below dominant seaweed species and fine and filamentous surface-living seaweeds (epiphytes) such as *Ceramium* sp. and *Bonnemaisonia hamifera*, as well as diatoms, cover larger algae. Encrusting species such as *Corallina officinalis* and *Lithothamnion* sp. are common on rocks, occurring also into the subtidal zones at the Project site. Toothed wrack (*Fucus serratus*) is common intertidally on the southwest shore of the Strait (AMEC 2008), but was only observed subtidally at the Bear Head site (JWEL, 2004a).

4.4.3.3 Subtidal

The upper subtidal to a depth of about 2 m (e.g., Transects 3 and 6, Figure 4-17) is occupied predominantly by eelgrass (*Zostera marina*), green algae (*Cladophora* sp.), and bladder wrack fucoid algae (*Fucus serratus*). Intertidal snails (the common periwinkle, *Littorina littorea*) and barnacles (*Balanus balanoides*) are common and the most frequent species observed (JWEL, 2004a).

Eelgrass and *Littorina* sp. are also dominants in the subtidal zone across the Strait (AMEC, 2008). The zone from 3 to 12 m contains the most diverse community of organisms including: red coralline algae (*Corallina officinalis*); rockweeds (*Fucus* spp. and *Ascophyllum nodosum*); kelp (*Laminaria* spp.); red seaweed (*Phyllophora* spp.); and Irish Moss (*Chondrus crispus*). At depths greater than about 12 m to the limit of the video survey (18.3 m), seaweeds are absent and the bottom is predominantly coarse gravel and cobble with a thin surface layer of finer sediment that is suspended by storms and settles during calmer periods. Animal communities include polychaete worms burrowed in sediments, as well as larger invertebrates including rock and green crabs (*Cancer irroratus* and *Carcinus maenas*), lobster (*Homarus americanus*), sea scallops (*Placopecten magellanicus*) and sea stars (*Asterias* spp. and *Henricia sanguinolenta*) (JWEL, 2004a; Stewart and White, 2001). Deeper mud bottoms below about 20 m and extending to the maximum depth (44 m) at the site support a moderately diverse benthic invertebrate community, dominated in terms of biomass by the brittle star *Ophiura sarsi* and numerically by polychaete worms (Tay et al 2010).



Figure 4-18: View of beach and upper intertidal at jetty location, May 2014. Drainage ditch for site runoff management is in the foreground.

4.4.4 Marine and Estuarine Fish and Fish Habitat

The Strait of Canso and Bear Head LNG site are connected through Chedabucto Bay with the Atlantic Ocean, the Scotian Shelf and the Atlantic Coast of Nova Scotia. Many of the fish and commercial invertebrate species that occur in the study area are shared with the other areas. This is due to the

exchange of water and transport of egg and larval stages, seasonal movements in response to temperature and feeding and breeding requirements, migratory movements and chance occurrences. Coastal waters such as Chedabucto Bay are occupied at times by species that use the local marine areas for only part of the year, including anadromous (e.g., Atlantic salmon) and catadromous fish (e.g., American eel). Pelagic fish such as mackerel and bluefin tuna which migrate through the area to and from the Gulf of St. Lawrence, while others are present virtually year-round. More than 538 species of fish occur in the Atlantic Ocean off the East Coast of Canada (Scott and Scott 1988, Breeze *et al.* 2002).

The study area contains many types of marine habitat, which increase its suitability for a large number and a higher diversity of fish species. This overview focuses on some of the more common and important fish and invertebrate species in the area; commonly occurring species observed in the Project area are listed in Tables 4-21 and 4-22.

Table 4-21: Fish Species Observed in Strait of Canso, Inhabitants Bay, Chedabucto Bay Area

Common Name	<i>Scientific Name</i>
Three-spine Stickleback (B)	<i>Gasterosteus aculeatus</i>
Four-spine Stickleback (B)	<i>Apeltes quadracus</i>
Wolfish (D)	<i>Anarhichas ssp</i>
Winter Flounder (D)	<i>Pseudopleuronectes americanus</i>
Gaspereau (P)	<i>Alosa pseudoharengus</i>
Smelt (P)	<i>Osmerus mordax</i>
Shad (P)	<i>Alosa sapidissima</i>
Mummichog (B)	<i>Fundulus heteroclitus</i>
Rock Gunnel (D)	<i>Pholis gunnellus</i>
Atlantic Cod (B)	<i>Gadus morhua</i>
Atlantic Herring (P)	<i>Clupea harengus</i>
Atlantic Mackerel (P)	<i>Scomber scombrus</i>
Cunner (BP)	<i>Tautoglabrus adspersus</i>
Snake Blenny (D)	<i>Lumpenus lumpretaeformis</i>
Arctic Shanny (D)	<i>Stichaeus punctatus</i>

Common Name	Scientific Name
Smooth Flounder (D)	<i>Liopsetta putnami</i>
Longhorn Sculpin (D)	<i>Myoxocephalus octodecemspinosus</i>
Winter Skate (D)	<i>Raja ocellata</i>
Viviparous Blenny (D)	<i>Zoarces viviparus</i>
Tom Cod (D)	<i>Microgadus tomcod</i>
American Plaice (D)	<i>Hypoglossoides platessoides</i>
Pollock (D)	<i>Pollachius virens</i>
Wrymouth (D)	<i>Cryptacanthodes maculatus</i>
Salmon (P)	<i>Salmo salar</i>
Radiated Shanny (P)	<i>Ulvaria subbifurcata</i>
Capelin (P)	<i>Mallotus vilosus</i>
Haddock (D)	<i>Melanogrammus aeglefinus</i>
Hake (D)	<i>Urophycis ssp</i>
Redfish (D)	<i>Sebastes fasciatus</i>
Atlantic Halibut (D)	<i>Hippoglossus hippoglossus</i>
Yellowtail Flounder (D)	<i>Limanda ferruginea</i>
Cusk (D)	<i>Brosme brosme</i>
American Eel (P)	<i>Anguilla rostrata</i>
P-pelagic; D-demersal; B-benthic (bottom dwelling)	
Source: Scott and Scott 1988; Breeze et al. 2002. Table modified from JWEL 2004a.	

Table 4-22: Common and important benthic invertebrate species in Strait of Canso, Inhabitants Bay, Chedabucto Bay Area

Common Name	Scientific Name
American Lobster	<i>Homarus americanus</i>
Sea Scallop	<i>Placopecten magellanicus</i>
Snow Crab	<i>Chionoecetes opilio</i>
Rock Crab	<i>Cancer irroratus</i>
Hermit Crab	<i>Pagurus</i> spp
Green Crab	<i>Carcinus maenas</i>
Northern Shrimp	<i>Pandulus borealis</i> , <i>P. montagui</i>
Oysters	<i>Crassostrea virginica</i>
Soft shell clams	<i>Mya arenaria</i>
Bar clams	<i>Spisula solidissima</i>
Blue mussel	<i>Mytilus edulis</i>
Horse mussel	<i>Modiolus modiolus</i>
Source: Breeze et al. 2002.	

4.4.4.1 Demersal and Benthic Fish

Abundant or commercially important demersal fish occurring in the study area include: Gadidae or Cod Family (Atlantic Cod; Tomcod, Haddock; Pollock; Red, White and Silver Hake and Cusk); Flounders (in particular American plaice, Yellowtail, Witch and Winter flounder, and Atlantic Halibut); Sandlance (*Ammodytes* spp); Redfish (*Sebastes* spp); and Skates (Little Skate; Winter Skate; Smooth Skate; Barndoor Skate; and Thorny Skate). Demersal species spend most of their time at or near the seabed, but can occur off the bottom. Important demersal species are identified in Table 4-21.

4.4.4.2 Pelagic Fish

Pelagic fish are those that live primarily in the water column; these make up a large proportion of the species occurring in Nova Scotia coastal waters. Of the many species in these waters, some occur commonly in the area, while others, comprising a long list of species, can be found occasionally. Among the most common fish are herring and mackerel, cunner, and silversides, which occur regularly in the Strait of Canso and Chedabucto Bay. Atlantic Salmon, American eel and trout are found in

both coastal and freshwater environments. Other species, such as bluefin tuna, swordfish and several species of sharks, which are typically seen offshore, occur occasionally in the study area. Pelagic fish are typically carnivorous, feeding on zooplankton and other fish, fish eggs and larvae, and invertebrate larvae. Pelagic species in turn are food for higher levels of the food chain.

Atlantic herring are an important pelagic species, occurring as adults seasonally in the study area, but with different life stages present year-round. Herring spawn on the seabed either in spring or fall; populations in different areas show different preferences. No spawning beds are found in the study area (Stewart and Arnold 1994a). Atlantic Mackerel are migratory and seasonal visitors to the Scotian Shelf and Slope as well as to coastal areas, en route to the Gulf of St. Lawrence. Schools of mackerel are commonly found in the Strait of Canso and Chedabucto Bay (Breeze et al 2002). Common coastal species found in seaweed beds and shallow subtidal environments in both the Strait of Canso and Chedabucto Bay include sticklebacks (Three-spine, *Gasterosteus aculeatus*, and Four-spine, *Apeltes quadracus*) and cunner (*Tautoglabrus adspersus*).

4.4.4.3 Invertebrates

Several important mollusc and crustacean species are common to the study area and inhabit coastal areas throughout much of their life cycles (Breeze et al 2002). American lobster (*Homarus americanus*) is a major fishery species for which good habitat occurs around the coast of the study area. Several species of crab occur in nearshore areas, in particular rock crab (*Cancer irroratus*) and the invasive Green Crab (*Carcinus maenas*), both of which are abundant in the study area. The larval stages of these species, as well as those of the Sea scallop (*Placopecten magellanicus*) spend periods of time in the plankton and are distributed throughout the area by water movements (Stewart and Arnold, 1994b). Blue mussel (*Mytilus edulis*) and horse mussel (*Modiolus modiolus*) commonly form dense beds on suitable rocky bottoms in the shallow waters around the coast.

4.4.5 Coastal and Water Associated Birds

4.4.5.1 Seabirds

Seabirds found in the study area include both coastal (neritic) species that spend most of their lives in coastal areas and occasionally forage in inland areas; and pelagic species that frequent the open ocean and only return to coastal waters and land to breed. Common coastal species include cormorants, gulls, terns, and guillemots. Pelagic seabirds include storm petrels, alcids such as dovekeys, puffins and murres, shearwaters and kittiwakes. Most seabird species breed in colonies, usually on islands or cliffs, and are at their most vulnerable at these sites.

The Bear Head LNG facility is located in nearshore waters and most of the seabirds likely to be present are neritic seabirds. Pelagic seabirds generally occur near the mouth of Chedabucto Bay with some

brought further inland by storms.

Common Tern and Double-crested Cormorant are neritic seabirds which have been recorded as nesting in the general vicinity of the site (JWEL, 2004a). Only marginal common tern breeding habitat occurs at the site, and no tern nesting was observed; only occasional sightings were made during the summer breeding season at the site (JWEL, 2004a). Two tern nesting colonies are known in the general area: Scanlan's Island in Inhabitants Bay and Long Pond in the Strait of Canso area; these are located 10 km and 15 km respectively from the Project site. Three colonies of Double-crested Cormorant are located on islands off Janvirn Island and Isle Madame in Chedabucto Bay east, and colonies of both Double-crested and Great Cormorant occur in coastal areas in the approaches to Chedabucto Bay (Figure 4-19). Herring Gull and Great Black-backed Gull nest throughout the study area, particularly along the south shore of Chedabucto Bay (Erskine, 1992). A colony of Leach's Storm Petrel, a pelagic species, is known near Canso (Erskine, 1992).

Common Loons are found in the Strait of Canso in most seasons, but particularly during spring and fall migrations when they are often in large groups. Loons, however, were only occasionally seen during the surveys conducted at the Bear Head facility site (JWEL, 2004a). Various tern species, including Common terns, are also found along the coast in the Strait of Canso and Chedabucto Bay areas. Common Terns do not use the coastal waters adjacent to the Bear Head LNG site extensively based on earlier surveys (JWEL, 2004a).

Several common pelagic seabirds migrate through the area during summer and fall migrations; they are found near the mouth of, and often in, Chedabucto Bay. Greater Shearwaters and Sooty Shearwaters arrive in Nova Scotian waters in late May and remain through the summer, leaving in September (Sooty Shearwater) and November (Greater Shearwater). Wilson's Storm-petrels are present from April to October with peak numbers occurring between June and August. Northern Gannets migrate along the Atlantic coast during the spring and fall, to and from breeding colonies in the Gulf of St. Lawrence, and non-breeding juveniles can be present in Chedabucto Bay in summer. Gannets typically arrive in March, and peak movements occur from mid-April to mid-May. Fall migration begins in early September and peaks between mid-October and early November. Alcids which include Common Murre, Thick-billed Murre, Razorbill, Atlantic Puffin and Dovekie, are northern-breeding species that move south to overwinter on the continental shelf off Newfoundland and Nova Scotia; they can be seen in Chedabucto Bay from November-December to April. Murres are present in local shelf waters from early December to April; Dovekies from November to April; Razorbills from mid-October to mid-May; and Atlantic Puffins during the fall between October and December.

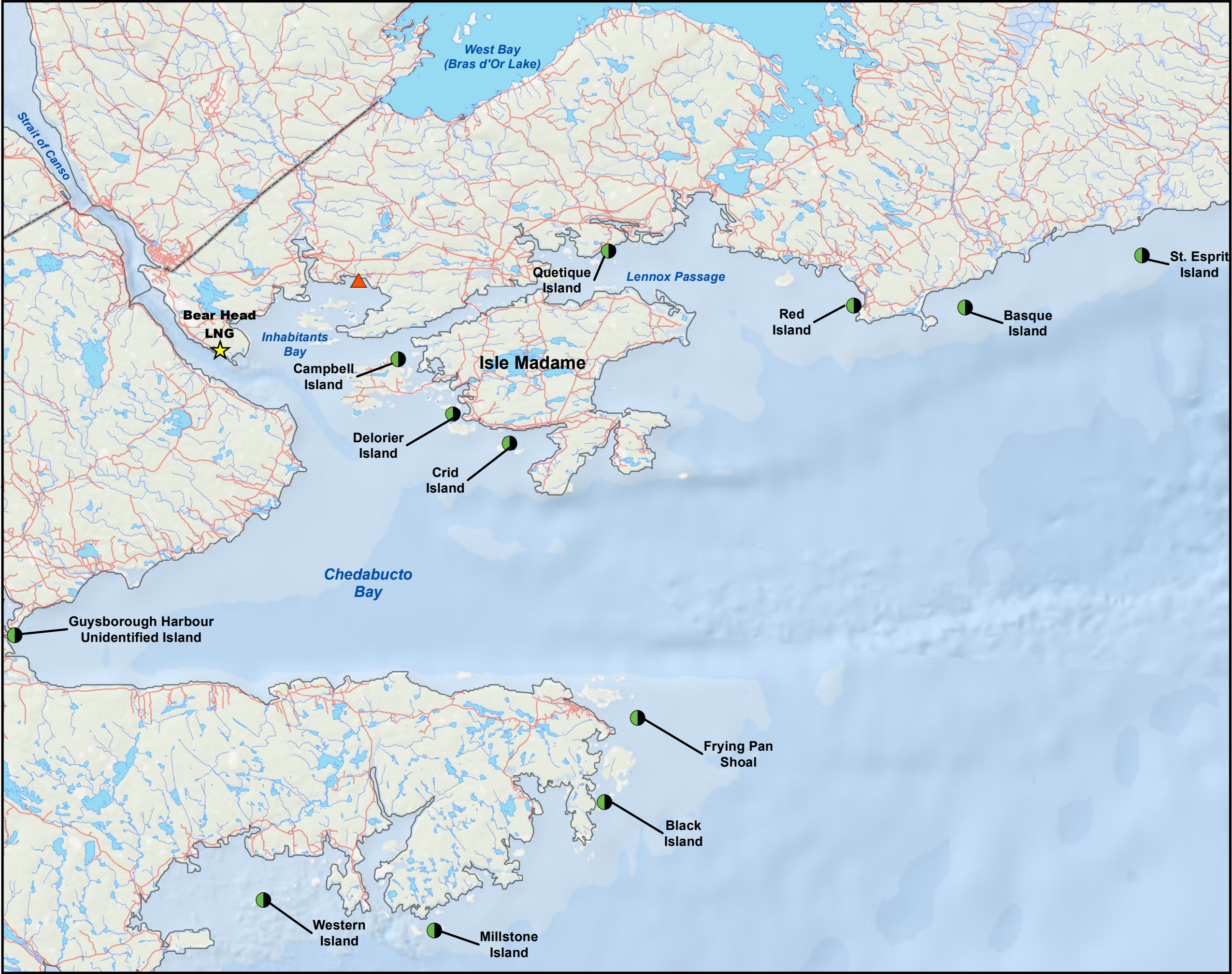




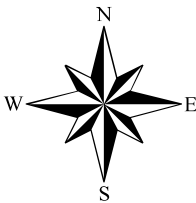


Figure 4-19
Seabirds Colonies

-  Cormorant Colony
-  Tern Colony
-  Rivers and Streams
-  Waterbodies



0 5 10 15
Kilometres

Map Parameters
Projection: Universal Transverse Mercator (UTM)
Datum: NAD83
Zone: 20
Scale: 1:250,000
Project Numer: 622560
Date: April 1, 2015

Data Source:
-Canvec (2013) Digital National Topographic System (NTS) topographic dataset
-ANEI Bear Head LNG Terminal Environmental Assessment 2004 (Jacques Whitford)



SNC • LAVALIN

4.4.5.2 Coastal Waterfowl and Divers

Various sea duck, loon and grebe species are regularly seen in the study area. Most of these species breed in freshwater habitats and spend the fall, winter and early spring in coastal waters. They occur most frequently in Nova Scotia during the spring and fall migration. The species most frequently encountered include Common Eider, Black Scoter, White-winged Scoter, Surf Scoter, Red-breasted Merganser, Long-tailed Duck, Common Goldeneye, Common Loon, Horned Grebe, and Red-necked Grebe. Dabbling ducks such as American Black Duck are also present in relatively large numbers, but are largely restricted to shallow sheltered waters such as salt marshes, barachois ponds and sheltered coves. The number of coastal waterfowl present in the study area varies seasonally with the largest number of waterfowl present during the spring migration and the lowest numbers present during the summer months (Figure 4-20; Lock et al., 1994).

4.4.6 Marine Mammals

Coastal and offshore regions of Nova Scotia attract a wide variety of marine mammal species throughout the year. Twenty-one (21) species of cetaceans (dolphins, porpoises and whales) and six (6) species of pinnipeds (seals) have been recorded; however, many of these species are only occasional visitors to the area (Breeze et al 2002). SARA-listed fin whales were once known to aggregate in Chedabucto Bay in winter, but it is uncertain if this continues (Doherty and Horsman (2007) in Gromack et al (2010)). Aggregations of Harbour porpoise, White-sided Dolphin, Atlantic Pilot Whale and Minke Whale have been found in the Canso Ledges area (on the southeast side of Chedabucto Bay) (Gromack et al (2010)).

Marine mammals are important components of North Atlantic coastal and pelagic ecosystems. They are intelligent, warm-blooded species of particular interest to the general public; they also have an important role near the top of the marine food chain. Due to past whaling activities and low reproductive rates, many of the larger cetaceans are considered globally endangered or vulnerable. Although commercial whaling has largely ceased, cetaceans are still threatened by habitat destruction, accidental vessel strikes, entanglement in fishing gear, mortality from humans, and impacts of chemical and noise pollution in their marine habitats.

Nova Scotian seal populations are healthy and not considered threatened or vulnerable.

Interest in marine mammals extends beyond their ecological and economic importance. They have become a symbol for ocean conservation and their protection is of concern to both the scientific community and the general public. A map of generalized whale and dolphin concentrations and migration patterns is presented in Figure 4-21.

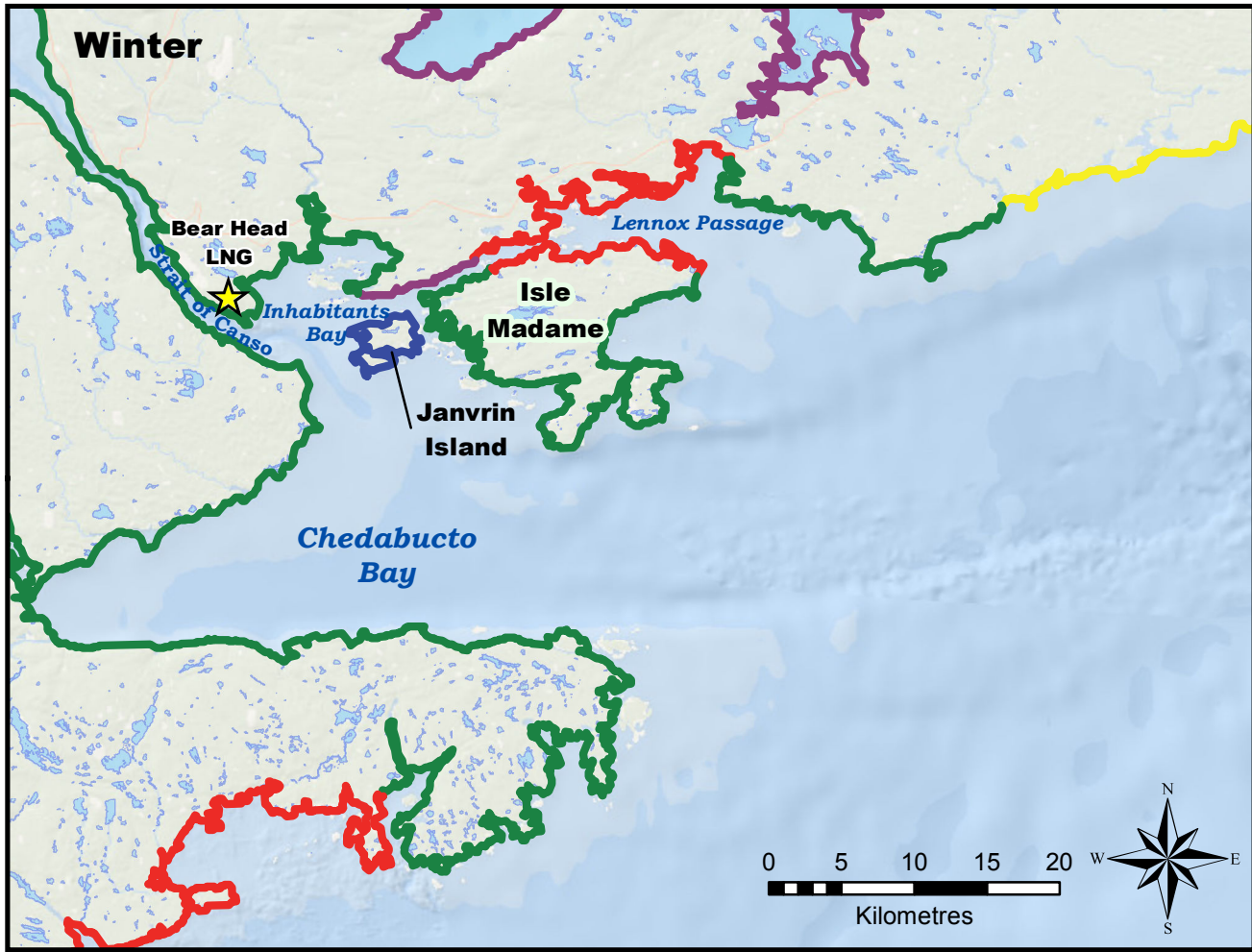
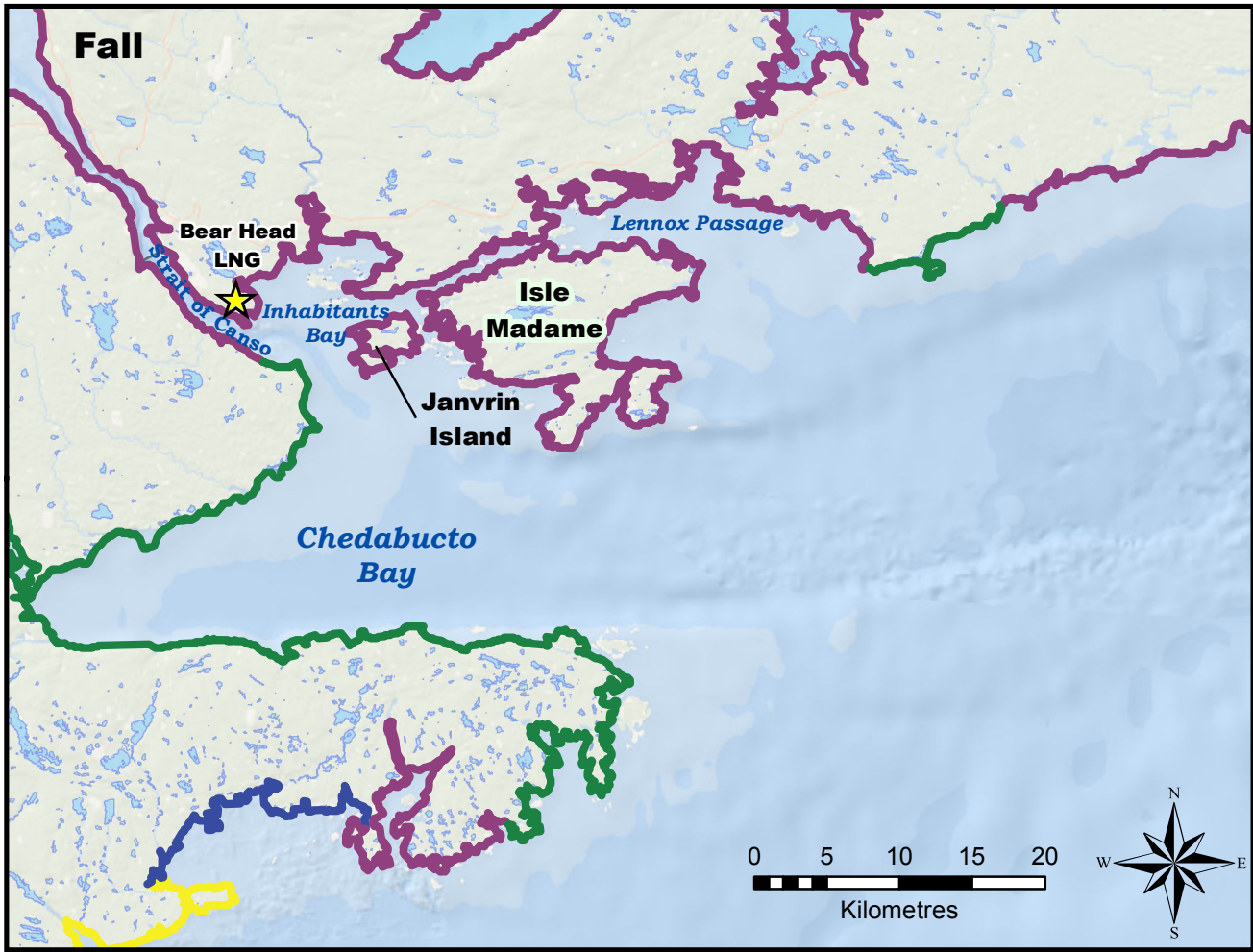
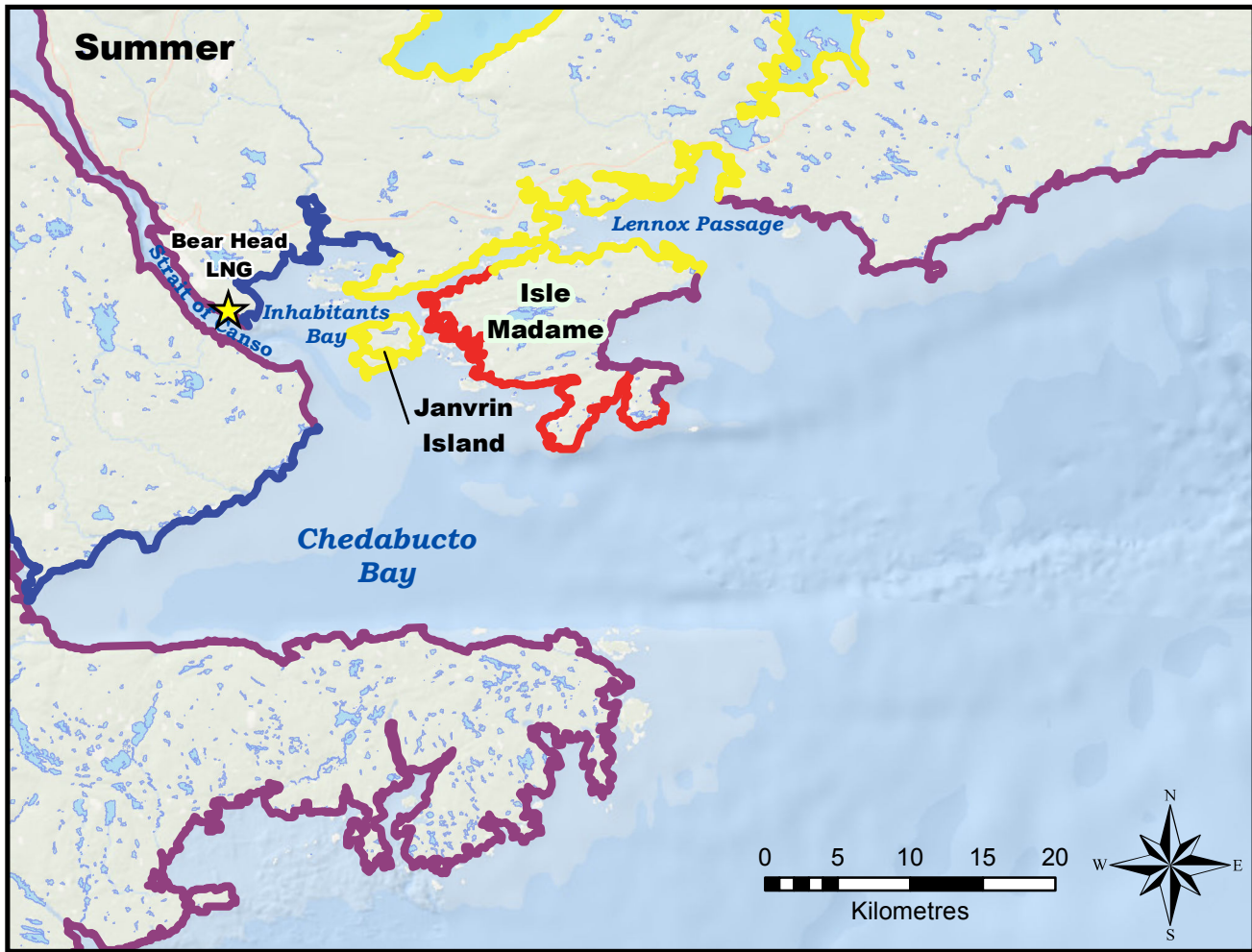
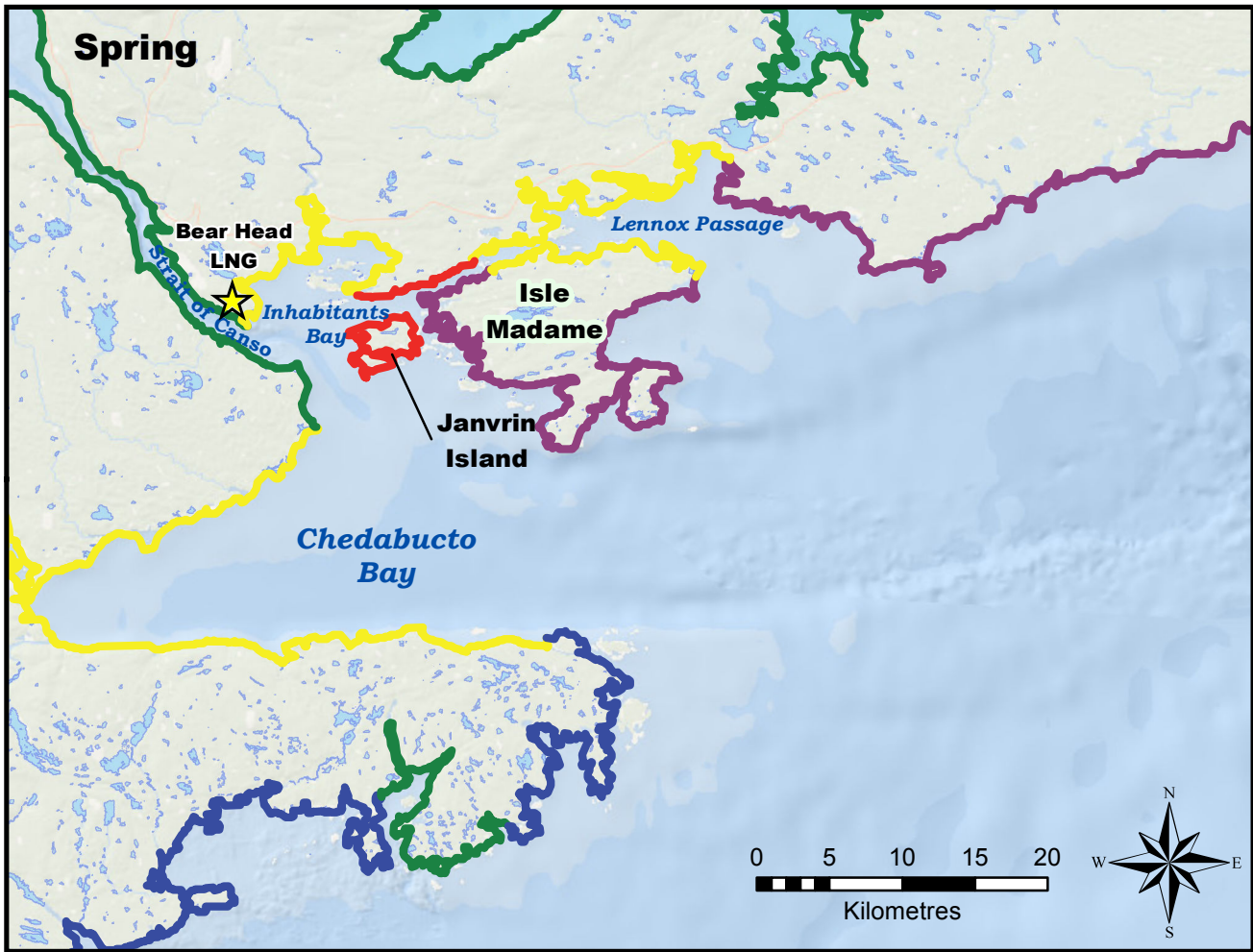


Figure 4-20
Coastal Waterfowl

Spring (Waterfowl/km)

- 12.00 to 51.06
- 2.50 to 11.99
- 0.50 to 2.49
- 0.03 to 0.49
- unsurveyed

Summer (Waterfowl/km)

- 1.00 to 17.23
- 0.50 to 0.99
- 0.05 to 0.49
- 0.025 to 0.04
- unsurveyed

Fall (Waterfowl/km)

- 4.00 to 133.7
- 2.00 to 3.99
- 1.00 to 1.99
- 0.03 to 0.99
- unsurveyed

Winter (Waterfowl/km)

- 7.50 to 66.06
- 5.00 to 7.49
- 2.00 to 4.99
- 0.06 to 1.99
- unsurveyed

Map Parameters
Projection: Universal Transverse Mercator (UTM)
Datum: NAD83
Zone: 20
Scale: 1:500,000
Project Number: 622560
Date: April 1, 2015

Data Source:
-Canvec (2013) Digital National Topographic System (NTS) topographic dataset
-ANEI Bear Head LNG Terminal Environmental Assessment 2004 (Jacques Whitford)



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4.4.6.1 Cetaceans

The order Cetacea is composed of dolphins, porpoises, and whales. Within this order there are two subgroups, the mysticeti whales, known as “baleen whales”, and the odontoceti, known as “toothed whales”. Baleen whales, e.g., humpback whale and northern right whale, use specialized keratin plates to sieve prey items from the water column and bottom sediments, whereas toothed whales, e.g., Orca have teeth for actively hunting and grasping individual prey items. Many of the species recorded in Nova Scotian waters are offshore species which are unlikely to be found within the coastal study area. Characteristics of cetaceans found in Nova Scotia waters are presented in Table 4-23.

4.4.6.2 Pinnipeds

Seals are common to coastal and offshore waters in Atlantic Canada. They are important as top predators in the ecosystem and have been commercially harvested. The main species in Nova Scotian waters are the Grey Seal (*Halichoerus grypus*), a large seal commonly seen in coastal areas and the smaller Harbour Seal (*Phoca vitulina*) (Table 4-23). Both are common in the study area. The Harp seal (*Pagophilus groenlandicus*) is also found in most areas, but is associated with the seal harvest which takes place on ice floes in the Gulf of St. Lawrence and in Newfoundland waters. The Hooded seal and the more northerly Ringed Seal (*Pusa hispida*) may occasionally be found along the coast; the Bearded Seal (*Erignathus barbatus*) may sometimes stray from Newfoundland waters. The Canso Ledges are an important area for harbour and grey seal feeding (Gromack et al 2010). Breeding is not known to occur in the study area.

4.4.6.3 Sea Turtles

Four (4) sea turtle species, the Leatherback, Atlantic Ridley, Loggerhead and Green Sea Turtle, occur offshore in the western north Atlantic and might be seen in the study area. The most common is the Leatherback, which is found in offshore areas off the continental shelf in the summer and has been documented in and around the Chedabucto Bay⁵. Further information on sea turtles is provided in Table 4-24. Though Green turtles typically occur in tropical or subtropical waters, a juvenile turtle was observed in Chedabucto Bay in August of 1999 (James et al 2004).

⁵ James et al 2005 reported results of 38 satellite tagged leatherback turtles utilizing the area of Chedabucto Bay and areas around Cape Breton Island.

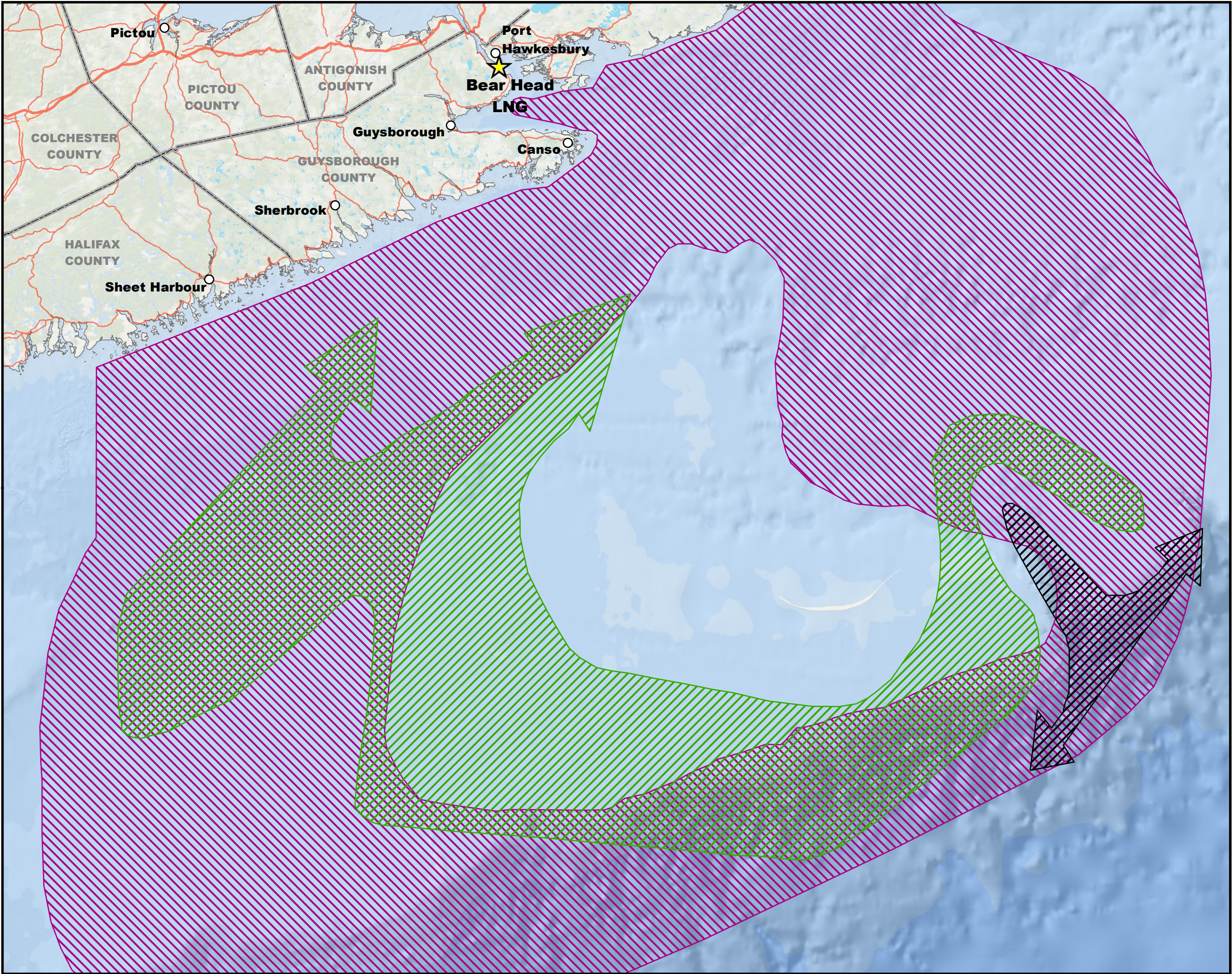
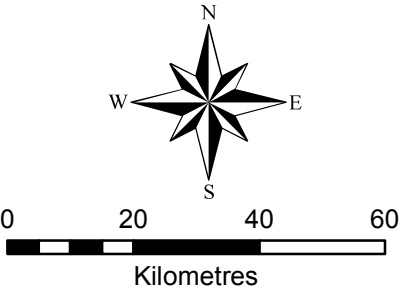


Figure 4-21

Generalized Whale & Dolphin Concentrations & Migration Patterns

Highest Concentration of Species Distribution

- Tooth Whales**
- Northern Bottlenose Whale
 - Pilot Whale
- Baleen Whales**
- Minke
 - Fin
 - Blue
 - Humpback
 - Right (Rare Occurrence)
 - Sei



Map Parameters
Projection: Universal Transverse Mercator (UTM)
Datum: NAD83
Zone: 20
Scale: 1:1,200,000
Project Number: 622560
Date: April 1, 2015

Data Source:
-Canvec (2013) Digital National Topographic System (NTS) topographic dataset
-ANEI Bear Head LNG Terminal Environmental Assessment 2004 (Jacques Whitford)

Table 4-23: Characteristics of Cetacean (dolphins, whales and porpoises) and Seal Species occurring in Eastern Canadian Waters

(Shading indicates species at risk)

Species	Characteristics
CETACEANS	
Commonly occurring species throughout the year ¹	
Harbour Porpoise (<i>Phocoena phocoena</i>)	The Harbour Porpoise (<i>Phocoena phocoena</i>) is a small distinctive porpoise found in coastal areas from summer to fall. It commonly breeds in July - August and found alone or in small groups of 2 - 20. It moves to offshore waters in the winter. It is designated as a species of <i>special concern</i> under COSEWIC (2006), federally listed as a <i>Threatened</i> species (SARA-schedule 2 species) and is listed on the IUCN Red list of Threatened species. Species abundance is largely impacted by fishing activities (caught as bycatch).
Long-finned pilot whale (<i>Globicephala melaena</i>)	Long finned Pilot Whale (<i>Globicephala melaena</i>) occur off coastal Nova Scotia and the Scotian Shelf from mid-March to late November and are often observed in groups of 10 - 50 and up to 500 individuals.
Fin whale (<i>Balaenoptera physalus</i>)	The Finback Whale (<i>Balaenoptera physalus</i>) is found in all oceans and throughout the area year-round. Several stocks are known to occur in the Maritimes; one stock winters off the Atlantic coastline, while another stock can be seen in the summer along the Scotian Shelf, both feeding on capelin and krill. The species were known to congregate in the Chedabucto Bay area in winter but it is not clear if this still occurs (Doherty and Horsman (2007) in Gromack et al (2010)). They can be found alone, in pairs, 3 - 7 and up to 100 or more on feeding grounds and are listed by COSEWIC and federally listed by SARA as species' of <i>special concern</i> . Species abundance is impacted by entanglement in fishing gear and collisions with vessels.
Minke whale (<i>Balaenoptera acutorostrata</i>)	The Minke Whale (<i>Balaenoptera acutorostrata</i>) is one of the most commonly seen whales on the east coast and is the smallest of the baleens whales. It is observed in groups of 1 - 3 and in large groups when feeding as well as noted with the bay from May until late fall and generally in east coast waters year-round.
Atlantic white-sided dolphin (<i>Lagenorhynchus acutus</i>)	White-sided dolphins (<i>Lagenorhynchus acutus</i>) are common during the summer (June-September) in areas with high seabed relief and along the edge of the continental shelf. They are often seen traveling in groups of 5 - 50 or larger group sized offshore as well as with other dolphins and whales. They are known as fast swimmers and for their aerobatics and calving occurs during June and July.
Occasionally occurring and/ or transient species in the area	
White-beaked dolphin (<i>Lagenorhynchus albirostris</i>)	White-beaked Dolphin (<i>Lagenorhynchus albirostris</i>) is a common dolphin in the North Atlantic found widely in cooler continental shelf waters, especially along the shelf edge year round. It can be noted in groups of 2 - 30, up to 150 and can reach 1,500 in numbers.
Striped Dolphin (<i>Stenella caeruleoalba</i>)	Striped Dolphin (<i>Stenella caeruleoalba</i>) is a common dolphin in the northwest Atlantic, reported typically in deep water along and seaward of the continental shelf edge often in groups of 10 - 500 (1 - 3,000).
Risso's Dolphin (<i>Grampus griseus</i>)	Risso's Dolphin (<i>Grampus griseus</i>) occurs worldwide in tropical and warm temperate waters, principally deep offshore waters. They are found in groups of 3 - 50 (less common 1 - 150 or even several thousand).
Short-beaked Common Dolphin (<i>Delphinus delphis</i>)	Common Dolphin (<i>Delphinus delphis</i>) is seasonally present (summer-fall) throughout and common on Scotian Shelf and along shelf edge in groups of 10 - 500.
Bottlenose Dolphin (<i>Tursiops truncatus</i>)	Bottlenose Dolphin (<i>Tursiops truncatus</i>) is observed occasionally in east coast waters in summer but a more or less regular occupant (year round) of the shelf edge south of Cape Sable. They are found in groups of 1 - 10 inshore and 1 - 25 or up to 500 offshore.
Blue Whale (<i>Balaenoptera musculus</i>)	Blue Whale (<i>Balaenoptera musculus</i>) is a large whale, which migrates throughout the Maritime waters from mid-spring to winter and found in groups of 1 - 2 and up to 60. It is associated with coastal, shelf and oceanic waters. It is listed by COSEWIC and SARA as an <i>endangered</i> species.
Blainville's Beaked Whale (<i>Mesoplodon densirostris</i>)	Blainville's Beaked Whale (<i>Mesoplodon densirostris</i>) is a warm water species likely linked to warm current systems such as the North Atlantic Gulf Stream as well as deep slope waters (1600 - 3300 feet) (Folkens <i>et al.</i> 2002). They may stray into study area in the summer, are often observed in groups of 1 - 6 and up to 12 and are distributed in offshore waters in the winter.
Cuvier's Beaked Whale (<i>Ziphius cavirostris</i>)	Cuvier's Beaked Whale (<i>Ziphius cavirostris</i>) occurs worldwide except polar waters and is regularly seen in deep Atlantic waters including the edge of the Scotian Shelf and the Grand Bank. It is usually alone or in small groups (up to 7).

Sowerby's Beaked Whale (<i>Mesoplodon bidens</i>)	North Beaked Whale otherwise known as the Sowerby's Beaked Whale (<i>Mesoplodon bidens</i>) is a poorly known species, which inhabits cold temperate and sub-arctic deep offshore waters in the North Atlantic. It has been observed in groups of 1 - 2 and 3 - 10 in Sable Gully. It is listed by COSEWIC and SARA as a species of <i>special concern</i> (schedule 1).
Humpback Whale (<i>Megaptera novaeangliae</i>)	Humpback Whale (<i>Megaptera novaeangliae</i>) is a whale found over most east coast waters most of the year (May-Dec). They would be most commonly found in Nova Scotia waters while they are feeding during the summer and often observed in groups of 1 - 3 to numerous on breeding or feeding grounds. The species is federally listed as a species of <i>special concern</i> (SARA, schedule 3).
North Atlantic Right Whale (<i>Eubalaena glacialis</i>)	The North Atlantic Right Whale (<i>Eubalaena glacialis</i>) is a large whale occasionally seen off southern Nova Scotia and in the Bay of Fundy and US east coast waters from June to November. It can be found alone or in small groups with occasional high concentrations (5 - 30) and typically feeds in the Bay of Fundy (NB and NS sides), along the Scotian Shelf, and in the Gulf of St. Lawrence from summer to fall. They are federally listed and by COSEWIC as an <i>endangered</i> species (SARA, schedule 1).
Sei Whale (<i>Balaenoptera borealis</i>)	The Sei Whale (<i>Balaenoptera borealis</i>) can be found year-round in shelf and oceanic waters of the east coast. They are observed in groups of 2 - 5 or occasionally in larger large groups.
Sperm whale (<i>Physeter macrocephalus</i>)	The Sperm whale (<i>Physeter macrocephalus</i>) occurs worldwide and is regularly sighted in deepwater off the continental shelf of Nova Scotia and New England year round. It can be found in groups of 1 - 50.
Northern Bottlenose Whale (<i>Hyperoodon ampullatus</i>)	Northern Bottlenose Whale (<i>Hyperoodon ampullatus</i>) is found in localized populations associated with the continental shelf edge from Labrador throughout Maritime waters (<i>i.e.</i> , Gully Marine Protected Area and Whale Sanctuary) year round and in groups of 4 - 10 individuals. It is not abundant and is listed by COSEWIC and SARA (schedule 1) as <i>endangered</i> .
Orca Whale (<i>Orcinus orca</i>)	Orca Whale (<i>Orcinus orca</i>) is a broadly distributed species; occasionally sighted in Maritime waters year round and often observed in groups of 3 - 25. They are abundant globally but would be unlikely to occur in the study area. It is listed under COSEWIC as a species of <i>special concern</i> .
Pygmy Sperm Whale (<i>Kogia breviceps</i>)	Pygmy Sperm Whale (<i>Kogia breviceps</i>) is a widely-distributed species with occurrences most likely in warm water and deep water at the shelf edge. They are often seen in groups of 3 - 6 (less commonly 1 - 10).
True's Beaked Whale (<i>Mesoplodon mirus</i>)	True's Beaked Whale (<i>Mesoplodon mirus</i>) is a rarely seen whale of deep waters occurring in the North Atlantic and several other areas often found in groups of 1 - 3.
SEALS	
Commonly occurring species throughout the year ¹.	
Grey Seal (<i>Halichoerus grypus</i>)	The Grey Seal (<i>Halichoerus grypus</i>) is a large seal with concentrations in Gulf of St. Lawrence, coastal Nova Scotia and Sable Island. It can be seen alone, in small groups at sea or up to hundreds on land and ice floes.
Harbour Seal (<i>Phoca vitulina</i>)	The Harbour seal (<i>Phoca vitulina</i>) is a small coastal seal occurring throughout the Nova Scotia coastline including shelf. It can be found alone, or in small groups breeding groups (May - June) and larger groups on shore and is present in the Bay year round.
Occasionally occurring species in the area.	
Harp Seal (<i>Phoca groenlandicus</i>)	Harp Seal (<i>Phoca groenlandicus</i>) is a common seal of northern parts of the Canadian east coast, at sea, around ice edges and on ice from winter to spring. It can be found in groups of 2 - 5, occasionally 1 - 12 and in large groups on ice when pupping or moulting and when feeding in water.
Hooded Seal (<i>Cystophora cristata</i>)	Hooded Seal (<i>Cystophora cristata</i>) is a northern species which ranges south along pack ice to Gulf of St. Lawrence and off Newfoundland. It is solitary except during breeding and moulting season and unlikely to occur within the study area.
¹ . Marine species found in the Canso Ledges area (Koeller 2000; Koeller et al 2007 in Bundy et al 2007; Doherty and Horsman 2007; NSE 2002) In Gromack et al 2010.	

Table 4-24: Characteristics of sea turtles occurring in Eastern Canadian Waters occurring in Eastern Canadian Waters

(Shading indicates species at risk)

Species	Characteristics
Leatherback Sea Turtle (<i>Dermochelys coriacea</i>)	Leatherback Sea Turtle (<i>Dermochelys coriacea</i>) is a large sea turtle listed as <i>endangered</i> under the <i>Species at Risk Act</i> & COSEWIC and is listed under the IUCN as <i>critically endangered</i> (COSEWIC 2012). The species is occasionally sighted on the east coast between June and October, typically from the Bay of Fundy to Sydney Bight, feeding on jellyfish, during a summer migration into northern waters. It is threatened by fisheries activities (bycatch), entanglement in fishing gear, habitat degradation, vessel strikes as well as climate change and other variables.
Loggerhead Turtle (<i>Caretta caretta</i>)	This migratory turtle species is widely distributed in the Atlantic, Pacific and Indian Oceans. Juveniles have been documented in Atlantic Canadian waters often associated with warmer offshore waters of the Gulf Stream and on the Scotian Shelf, Scotian Slope, Georges Bank and Grand Banks. Species abundance is threatened by fisheries activities (bycatch), habitat degradation, vessel strikes as well as climate change and other variables. It is listed by COSEWIC (2010) as <i>endangered</i> .
Green Turtle (<i>Chelonia mydas</i>)	This species typically occurs in tropical and subtropical waters, however juveniles have been documented in temperate coastal waters as well. It is listed on the IUCN Red List as <i>endangered</i> .
Atlantic Ridley (<i>Lepidochelys kempi</i>)	Atlantic Ridley turtle occurs from Nova Scotia to Newfoundland to Bermuda. It frequents shallow coastal waters with muddy or sandy bottom substrates and occur in the open sea.

4.5 Socio-Economic Environment

4.5.1 Key Settlements, Land Use, Community Services and Infrastructure

The project site is located in the Point Tupper Industrial Park in the Municipality of the County of Richmond to the south of Port Hawkesbury; the industrial area is located on the Strait of Canso. The settlements in the area are Point Tupper and Port Hawkesbury (population approximately 3,350). Guysborough County and the Town of Mulgrave (population 900) are situated across the Strait of Canso. Point Tupper is a very small residential community, but has a large industrial presence. Port Hawkesbury is the nearest urban service center.

Historically, Point Tupper was an important coastal village with homes, a hotel, two churches, a railroad station and a few stores. In the late seventies, much of the private land was purchased to make way for new industries wishing to locate in the area due to the deep ice free water afforded by the Strait of Canso. Today there are fewer than 10 homes. One of the churches is used by the Point Tupper Heritage Association as a museum. The emergence of Port Hawkesbury as the principal urban center coupled with the area's potential for industry and shipping has led to a decline in the Point Tupper population.

Port Hawkesbury is the largest urban centre in the area. The town experienced its most significant population growth following the opening of the Canso Causeway in 1955 and the development of the Point Tupper Industrial Park in 1959. Between 1956 and 1976, the population nearly quadrupled from a little over a 1,000 to 4,000. Subsequent economic volatilities have had a negative impact on growth. Port Hawkesbury covers a land area of 8.11 km² with a population density of 414.8 per km². In 2011, the population was 3,366. Eighty-three percent (83%) is over the age of 15, with 23% of the