9.5 Freshwater Environment

The Atlantic coast is dissected by many fault-controlled river and lake systems that drain into the ocean. At the mouths of most rivers, wetlands receive both tidal and freshwater influences. Surface waters tend to be soft and acidic. Many small to medium-sized lakes are scattered throughout the Sedimentary Lowlands District, and pH ranges between 6.0 and 7.0 (NSMNH, 1996). The Project site is located near the coastal waters of Stormont Bay, within a coastal ecological zone characterized by long, narrow inlets with steep valley sides. The coastline is submerged, with parallel inlets and estuaries separated by headlands. Stormont Bay is predominantly covered with fine sand and silt with scattered rock shoals. Freshwater inflow to Stormont Bay from the Country Harbour and Isaac's Harbour watersheds gives the harbours their estuarial characteristics (AMEC, 2006).

Considerable work was conducted on the watercourses and waterbodies on the proposed Project site as part of the 2006 Keltic Project EA document.

There is no freshwater habitat within the proposed Work Camp location.

9.5.1 Waterbodies and Watercourses

9.5.1.1 LNG Facility

The Project site, in its current configuration, encompasses three freshwater or brackish ponds and one mapped unnamed watercourse. A second watercourse, Betty's Cove Brook, flows in a southerly direction to the east of the Project site, and, while it does not occur directly on the main Project site, it is fed by runoff from the Project site.

The three waterbodies are all located on Red Head Peninsula (Figures 9.5-1 and 9.2-5). Only one, Dung Cove Pond (referred to as Pond 6 in older documents), is actually a freshwater pond. The remaining two waterbodies, Pond 4 and Pond 5, are brackish, and are actually coastal saline ponds. While they support brackish fish species, (Threespine Stickleback (*Gasterosteus aculeatus*), Fourspine Stickleback (*Apeltes quadracus*), and Ninespine Stickleback (Pungitius *pungitius*) (AMEC, 2006)), these ponds are considered to be wetlands under the Nova Scotia Wetland Policy, and so are treated as such in Section 9.4.2.

Dung Cove Pond

The largest pond on site, Dung Cove Pond (Pond 6 in some older documents) is a tannin-laden freshwater pond (Figure 9.5-1). With its close proximity to Betty's Cove, it is possible that some seawater may flow into Dung Cove Pond on occasion during very high tide or storm events, though the vegetation community present suggests it is predominately freshwater. The substrate in this pond is dominated by organic silt with scattered boulders around the perimeter. The shoreline is dominated by woody debris and grasses, with the exception of the eastern shore which is dominated by gravel, cobble, and boulder. Aquatic and riparian vegetation consists of Common Mare's Tail (*Hippuris vulgaris*), Tape Grass, Yellow pond lily (*Nuphar lutea*), Common Cattail (*Typha latifolia*), Sweet Flag (*Acorus americana*), various grasses, Marsh Cinquefoil (*Comarum palustre*), Cinnamon Fern, Sheep Laurel, Smooth Serviceberry (*Amelanchier laevis*), Speckled Alder, Eastern Larch, White Spruce, and Black Spruce.

One of these species, Tape Grass is a red-listed species. Surveys in June 2013 will provide a population estimate for this species within Dung Cove Pond. This species is discussed further in Section 9.7.1.

Pond 4

Pond 4 is a small pond located to the south of Dung Cove Pond, situated very near the shoreline (Figure 9.2-5). It is a brackish pond with salinity measured at 24.83 parts per thousand (ppt) during a sampling event in 2005 (though this presumably fluctuates with precipitation levels). The substrate is dominated by cobble and gravel overlain by organic silt. A thick mat of filamentous algae was noted during a field survey in 2005. Aquatic and riparian vegetation included: Slender Naiad (*Najas flexilis*), grasses, wild raspberry (*Rubus* sp.), Sea Lavender, Scotch Lovage, Common Dandelion (*Taraxacum officinale*), thistle (*Cirsium* sp.), Beach Pea, Speckled Alder, Smooth Serviceberry, and White Spruce. As this is a coastal saline pond, it is considered a wetland in NS and therefore is assessed further in Section 9.4.2.

No Priority List species are known to occur in Pond 4.

Pond 5

Pond 5 is a small pond also located to the south of Dung Cove Pond, situated very near the shoreline (Figure 9.2-5). It is also a brackish pond, with a measured salinity of 15.32 ppt during a sampling event in 2005, (though this presumably fluctuates with precipitation levels. The substrate is dominated by cobble and gravel overlain by organic silt. A thick mat of filamentous algae was noted during surveys in 2005. Aquatic and riparian vegetation included: Slender Naiad, grasses, wild raspberry, Sea Lavender, Scotch Lovage, Common Dandelion, thistle, Beach Pea, Speckled Alder, Smooth Serviceberry, and White Spruce. As this is a coastal saline pond, it is considered a wetland in NS and therefore is assessed further in Section 9.4.2.

Unnamed Tributary

An unnamed tributary of Dung Cove Pond (Figure 9.5-1) is the only mapped watercourse within the Project footprint. A few other small, mostly ephemeral streams, exist, but this is the only one mapped and the only one large enough to support fish. The upstream portion of this tributary is adjacent to (and flows under), the SOEI road. It is a low flow narrow stream which flows through a forested area dominated by spruce. Banks are mossy and highly undercut. The substrate consists of rock, gravel, silt with high levels organic materials, particularly decomposing needles from the plentiful deadwood falls. Water pH is more acidic than downstream, measuring 5.8 (Dillon, 2008a).

The downstream portion of this tributary (downstream of Highway 316) was characterized by Dillon (2008a) as riffles and runs, with substrate of rock, cobble, gravel and organic debris. Shade is moderate (25 to 49%), and the stream is bordered by low shrubs and deciduous trees. pH is 6.2. Both sections of this stream had very low flows during the June and September 2008 sampling events (Dillon, 2008a). It appears that no fish sampling was conducted in this unnamed tributary prior to the 2008 Dillon survey.

Betty's Cove Brook

Betty's Cove Brook (Figure 9.5-1) drains nearby Crane Lake and flows in a southwesterly direction to Betty's Cove. The upstream portion of Betty's Cove Brook was described by Dillon in 2008. The sampling location was located in a deep narrow channel of the brook in a mature beaver meadow. Riparian vegetation is mostly black spruce with the occasional larch. Substrate consists of sand and debris overlying bedrock. Banks are grassy and undercut, with low shade. Water pH measured 6.3.

The downstream section was sampled by Dillon in 2008, and described as a wide riffle/run section with boulders cobbles and gravel, with low levels of fine grained materials. Instream vegetation is present, while riparian vegetation includes alder and spruce. Water pH measured 5.8.

9.5.1.2 Meadow Lake and Water Supply Pipeline

With respect to Meadow Lake, the main water body is Meadow Lake with nine tributaries. Meadow Lake is considered to be a shallow lake with two dominant riparian habitat types: forest and bog. The water supply pipeline will cross one known freshwater watercourse.

Meadow Lake

Meadow Lake is also known locally as Isaac's Harbour Lake. The headwaters of the Meadow Lake watershed originate in Garry Lake and Garry River located approximately 10 km north of Meadow Lake. The Garry River discharges to Big Stillwater Lake along with several other smaller tributaries; and from that lake, the discharge becomes Isaac's Harbour River which flows to Meadow Lake. The only other major tributary to Meadow Lake is that from Little Beach Hill and Beach Hill lakes located about 2 km north of Meadow Lake.

Meadow Lake is a shallow lake, with the deepest sections of the lake reaching approximately 2 m. There are essentially two dominant riparian habitat types associated with Meadow Lake forest and bogs. The forest is dominated by Black Spruce, White Spruce, Eastern Larch, Leather-leaf, and Sheep Laurel. The bogs are dominated by Eastern Larch, Bog Laurel, Tussock Cotton Grass (*Eriophorum vaginatum*), Northern Pitcher Plant, Bog Rosemary, Rhodora, Small Cranberry, Sweet Gale (*Myrica gale*), Steeplebush (*Spirea tomentosa*), peat moss and by a variety of grasses and sedges (*Carex* sp.). Due to the shallow depth of the lake, aquatic macrophytes were present throughout most of the lake, with observed species including Yellow Pond Lily, Fragrant White Water Lily (*Nymphaea odorata*), Common Cattail, and Horned Bladderwort.

Substrates in the shallow waters around the lake are dominated by boulder and cobble, with occasional patches of sand and gravel. In deeper waters, the substrate is virtually all silt. Sand and gravel beaches are located along several stretches of the shoreline. Nine tributaries discharge to Meadow Lake, the locations of which are illustrated in Figure 9.2-6. Following is a summary of key characteristics of each, derived from the Environmental Assessment Screening Report prepared for the Meadow Lake Intake Structure proposed as part of the Keltic Project (AMEC, 2008a):

Tributary 1- Isaac's Harbour River

Tributary 1, the Isaac's Harbour River, originates 10 km north of Meadow Lake in the vicinity of Garry Lake. The Isaac's Harbour River is sinuous in nature and is generally characterized by riffle-pool-run sequences, undercut banks, and overhanging riparian vegetation. The substrates in the channel are dominated by gravel and sand. In the lowermost reaches of the watercourse, riparian vegetation consists of: grasses, sedges (*Carex* sp.), Rhodora, Speckled Alder, and Black Spruce.

Tributary 2

Tributary 2 originates approximately 1.5 km northwest of its discharge on the west side of Meadow Lake. The channel associated with this first-order watercourse is well defined with a bank-full width and depth of approximately 2.9 m and 0.35 m respectively. Channel substrates in the lower reaches are dominated by organic fines and sands where the watercourse meanders through open wetland meadow habitat. Riparian vegetation includes: White and Black Spruce, Rhodora, Sweet Gale, Leather-leaf, grasses, moss and Northern Pitcher Plant.

Tributary 3

Tributary 3 is a very small first-order drainage feature discharging to the southwest shore of Meadow Lake. The channel is generally well defined with an average bank-full width and depth of about 0.4 m and 0.25 m. Substrates in the channel consist mostly of sand, with occasional isolated cobbles and gravel. Riparian vegetation includes: Sweet Gale, grasses, Leather-leaf, Rhodora, grasses, White and Black Spruce, Eastern Larch, Red Maple (*Acer rubrum*), White Birch (*Betula papyrifera*), and Speckled Alder.

Tributary 4

Tributary 4 is a small first-order watercourse originating approximately 300 m east of Meadow Lake. The channel is moderately well defined with an approximate bank-full width and depth of approximately 0.5 m and 0.3.m in the lower reaches. Throughout much of its length, it meanders through open wetland meadow. Substrates in the channel are dominated by sands and organic sediments. Riparian vegetation consists of: grasses, Leather-leaf, Rhodora, Sheep Laurel, Black Spruce, and Eastern Larch.

Tributary 5

Tributary 5 is a small first-order watercourse that originates about 350 m east of Meadow Lake. The channel appears moderately well defined with a maximum width and depth of approximately 0.4 m and 0.25 m in the downstream-most reaches. Channel substrates are dominated by organics, silt and sand. As with Tributary 4, this watercourse is almost entirely located in an open area of wetland meadow with riparian vegetation consisting of grasses, Leather-leaf, Rhodora, Speckled Alder, Black Spruce, and Eastern Larch.

Tributary 6

Tributary 6 is a first-order watercourse which originates approximately 650 m east of Meadow Lake. In the downstream-most reaches, the channel is well defined with an average bank-full width and depth of about 2.5 m and 0.6 m respectively. Substrates are dominated by organic

silts and sand with riparian vegetation including: grasses, sedges, Leather-leaf, Speckled Alder, and Eastern Larch. Except for the headwater sections, this tributary is located in open wetland meadow habitat.

Tributary 7

The headwaters of Tributary 7 are located northeast of Meadow Lake in the vicinity of Beech Hill Lake and Little Beech Hill Lake. This watercourse is the second largest draining to Meadow Lake after Isaac's Harbour River. The channel is well defined with an average bank-full width and depth of about 5.0 m and 0.6 m. Channel substrates in the downstream-most reaches are dominated by sand and gravel, with occasional deposits of silt. Riparian vegetation is dominated by Speckled Alder, spruce, and Eastern Larch. At the road crossing located approximately 1 km upstream, substrates consist of boulder, bedrock and cobble and riparian vegetation is almost entirely Speckled Alder.

Tributary 8

Tributary 8 is a first-order watercourse originating about 1 km north of Meadow Lake. The tributary appears to be relatively well defined in the vicinity of the lake, with substrates dominated by sand and organic silt. The downstream-most reaches of this watercourse are located mostly in woodland habitat, with riparian vegetation dominated by Black Spruce, Eastern Larch, and Speckled Alder.

Tributary 9

Tributary 9 originates about 1 km north of Meadow Lake. It is a first-order watercourse with a well defined channel and distinct meanders, particularly in the reaches upstream of the lake. For approximately the first 250 m upstream, the channel is located in an open wetland meadow and has substrates consisting mainly of fine organic silt with some sand. Riparian vegetation includes: grasses, sedges, Rhodora, Speckled Alder, Black Spruce, and Eastern Larch.

Water Supply Pipeline Watercourse Crossings

The water supply pipeline will cross two known freshwater watercourse, Branch Gold Brook and Betty's Cove Brook as shown in Figure 9.5-2. An aquatic habitat assessment was conducted for Branch Gold Brook by M&NP as a part of their 1997 Mainline Aquatic Habitat Assessment (Washburn & Gillis Associates Ltd. (WGA), 1998a). At the water supply pipeline crossing, Branch Gold Brook is approximately 2 m in width, and its erosion rating is stable with a dominant substrate of sand and fines. No fish species were found within this watercourse (WGA, 1998a). No aquatic habitat assessment has been conducted at the proposed water supply pipeline crossing for Betty's Cove Brook. It should be noted this watercourse crossing is located at Sable road within an existing pipeline ROW.

9.5.2 Fish and Fish Habitat

NS supports 21 obligate freshwater fish species, and a further 20 species that inhabit both freshwater and marine environments (Curry and Gatreau, 2010). Freshwater fish species diversity in the peninsula of NS shows a marked decrease moving away from the mainland. Species with some degree of tolerance to salt water tend to be more widely distributed, as they are more readily able to move between river systems via estuaries.

A review of the *Freshwater Fishes of Eastern Canada* (Scott, 1967), which includes diadromous species as well as some common inshore marine species, indicated that a total of 34 species occur in NS. A review of freshwater fish species distribution maps provided on the University of NBs web-site indicates that there are 23 species, both freshwater and diadromous, which may be found in or around the Project area in Guysborough County (Curry *et al.,* 2013).

9.5.2.1 Project Site

Fish habitat surveys were conducted for waterbodies and watercourse on the Project site for the 2006 Keltic Project EA (AMEC, 2006). Additional fish habitat surveys were conducted in the unnamed tributary, Betty's Cove Brook and Dung Cove Pond in June and September of 2008 (Dillon, 2008c). The Dillon surveys aimed to identify key fish habitat characteristics using standard DFO visual assessment protocols. Spot electrofishing was conducted in the streams, while minnow traps were used in Dung Cove Pond during the 2008 June and September surveys.

Full details of the fish habitat surveys conducted in the unnamed watercourse, Betty's Cove Brook, and Dung Cove Pond are provided in the full November 2008 Dillon report provided in Appendix I.

In conclusion, a total of seven species of freshwater or brackish fish have been documented to occur on the main Project site. These are summarized in Table 9.5-1.

Table 9.5-1 Freshwater and brackish fish known to occur on the Project Site

Common Name	Species Name	Location
Brook Trout	*Salvinelis fontinalis*	Dung Cove Pond Unnamed Watercourse Betty's Cove Brook
American Eel	*Anguilla rostrata*	Dung Cove Pond Unnamed Watercourse Betty's Cove Brook
Ninespine Stickleback	*Pungitius pungitius*	Dung Cove Pond Pond 4 Pond 5
Threespine Stickleback	*Gasterosteus aculeatus*	Pond 4 Pond 5
Fourspine Stickleback	*Apeltes quadracus*	Pond 4 Pond 5
Banded Killifish	*Fundulus diaphanus*	Dung Cove Pond
Mummichog	*Fundulus heteroclitus*	Dung Cove Pond

In 2008, Dillon also conducted benthic invertebrate sampling at several locations on or near the current Project site. These included the upstream and downstream sections of the unnamed watercourse, upstream and downstream reaches of Betty's Cove Brook, and Dung Cove Pond. The locations were sampled using a Surber sampler, with the exception of Dung Cove, which was sampled via grab sampler. The Ephemoptera Plecoptera Trichoptera (EPT) Index, an indicator of habitat quality, was calculated for each sample Dillon (2008c) found that

chironomids, stonefly nymphs and caddisfly larvae dominated the invertebrate communities during both the spring and fall sampling events. Diversity was similar in both Betty's Cove Brook and the unnamed tributary to Dung Cove. The EPT Index was high in the upstream sites and moderate in the downstream sites in spring, while it was moderate at all stream sites in the fall. Dung Cove exhibited low productivity and EPT indices during both sampling events (Dillon, 2008c). Invertebrate survey results are summarized, where available, for each waterbody and watercourse below, while full invertebrate results are provided in Appendix I.

Dung Cove Pond

A survey conducted by AMEC in 2006 found American Eel, Ninespine Stickleback, Banded Killifish, Mummichog, and juvenile and adult Brook Trout (AMEC, 2006). A survey by Dillon in 2008, failed to capture any fish in Dung Cove Pond, however this survey relied solely on minnow traps and it is unclear whether the traps were baited. Fish species captured during previous surveys are expected to still be present. While common snail species most likely occur, no freshwater bivalves have been reported from Dung Cove Pond (Dillon, 2008c). Fish habitat in Dung Cove Pond was found to be typical of a barrier beach pond.

Dillon (2008c) found that invertebrate productivity in Dung Cove Pond was similar to the stream sites and was dominated by chironomids. Mayfly nymphs and beetle larvae also occurred, Oligochaetes and leeches were present in low numbers, and overall diversity was low. The EPT Index was low at 17. No stonefly nymphs were recorded.

Two Priority List species occur in Dung Cove Pond, American Eel and Brook Trout, and are discussed further in Section 9.7.2. Since the Keltic Project EA (AMEC, 2006) was prepared, the American Eel has been listed as Threatened by COSEWIC (COSEWIC, 2012a).

Dung Cove Pond appears to support foraging habitat for adult Brook Trout, as well as juvenile foraging and rearing habitat. American Eel likely utilize habitat within Dung Cove Pond for foraging and/or nursery habitat. Ninespine Stickleback, Banded Killifish and Mummichog all likely complete their life histories within Dung Cove Pond.

Pond 4

A survey conducted by AMEC in 2006 found Threespine Stickleback, Fourspine Stickleback, and Ninespine Stickleback inhabiting this pond (AMEC, 2006). Dillon (2008c) did not conduct fish surveys in this pond.

No Priority List species are known to occur in Pond 4.

Pond 5

A survey conducted by AMEC in 2006 found Threespine Stickleback, Fourspine Stickleback, and Ninespine Stickleback inhabiting this pond (AMEC, 2006). Dillon (2008c) did not conduct fish surveys in this pond.

No Priority List species are known to occur in Pond 5.

Unnamed Watercourse

Brook Trout and American Eel were captured in the downstream reaches of the unnamed tributary site in 2008, while only American Eel was captured in the upstream sections, which had very low flows during both sampling events (Dillon, 2008c). No previous fish sampling was conducted in this unnamed tributary.

Chironomids and stonefly nymphs dominated the invertebrate fauna, while caddisfly, beetle, and fly larvae were also abundant (Dillon, 2008c). EPT ratio was moderate at 30.7.

The downstream portion of this tributary (downstream of Highway 316) was dominated by chironomids and stonefly, while caddisfly, beetle, and fly larvae were also abundant (Dillon, 2008c). The EPT Index was moderate at 30.7.

Upstream, the benthic invertebrate community was found to be similar to that observed downstream, dominated by stonefly nymphs and chironomids. Mayfly nymphs were present, while caddisfly and beetle larvae and amphipods were present but uncommon (Dillon, 2008c). The EPT Index was moderate at 33.5. One Priority List species, American Eel, has been documented in this section of stream (Dillon, 2008c).

Both sections of this stream had very low flows during the June and September 2008 sampling events (Dillon, 2008c).

Two Priority List species, American Eel and Brook Trout, occur in this stream (Dillon, 2008c). These are discussed further in Section 9.7.2. This unnamed watercourse provides some nursery/juvenile rearing habitat for both American Eel and Brook Trout.

Betty's Cove Brook

Dillon (2008c) stated that the benthic invertebrate community in the upstream portion of this stream consisted of mayfly and stonefly nymphs as well as chironomid and caddisfly larvae. Low numbers of amphipods were also present. Productivity was lower than at the downstream site. The EPT Index was moderate at 42.1.

The benthic invert community in the downstream section was represented mainly by chironomid, caddisfly, mayfly and stonefly nymphs. Beetle and alderfly larvae, bivalves and leeches were also present. The EPT Index was moderate at 42.5.

In 2008, Dillon captured Brook Trout and American Eel at both the upstream and downstream sampling locations in Betty's Cove Brook (Dillon, 2008c). A previous report (AMEC, 2006) reported Brook Trout, American Eel, and Ninespine Stickleback from Betty's Cove Brook. Brook Trout and Ninespine Stickleback likely spawn in this watercourse. It also provides feeding and migratory habitat for American Eel. This watercourse may contribute to the local fishery, which includes species such as Brook Trout, and American Eel.

Two Priority List species, American Eel and Brook Trout, occur in Betty's Cove Brook (Dillon, 2008c). These are discussed further in Section 9.7.2.

Betty's Cove Brook provides nursery/juvenile rearing habitat for American Eel, as juvenile eels likely reside in this watercourse until they are mature enough to head out to sea to spawn.

9.5.2.2 Meadow Lake

Fish surveys of Meadow Lake were conducted in 2001, 2004 and 2005 as part of the Keltic Project EA.
A summary of the eight fish species collected in Meadow Lake and its tributaries is presented in Table 9.5-2.

Table 9.5-2 Fish Species Collected in Meadow Lake 2001-2005

Scientific Name	Common Name
Anguilla rostrata	American Eel
Pungitius pungitius	Ninespine Stickleback
Catostomus commersonii	White Sucker
Salvelinus fontinalis	Brook Trout
Notemigonus crysoleucas	Golden Shiner
Perca flavescens	Yellow Perch
Salmo salar	Atlantic Salmon
Notropis heterolepis	Blacknose Shiner

The fish community in Meadow Lake is dominated by Yellow Perch. White Suckers are also a significant constituent of the community, with Brook Trout and Golden Shiners in relatively low abundance. An interesting result of the fish sampling in this lake was the capture during the 2001 surveys of a mature male Atlantic Salmon in spawning condition. Local residents report that this species has historically migrated up the Isaac's Harbour River from the Atlantic Ocean; and although Meadow Lake is not typical of Atlantic Salmon habitat, it is likely that the salmon use Isaac's Harbour River upstream, and perhaps downstream of Meadow Lake for spawning. Support for this statement comes from the fact that a juvenile Atlantic Salmon (12 cm in length) was captured in Isaac's Harbour River, near the north end of Meadow Lake, in 2004. In 2005, local residents indicated that the low flows of recent years had prevented upstream salmon migration in this watercourse.

Although juveniles of most species were collected during the surveys, only a single juvenile Atlantic Salmon was captured during the surveys of 2001, 2004, and 2005 in Meadow Lake and its associated tributaries. This, combined with the capture of only one adult in this watershed during the Keltic Project studies in 2001 survey in Meadow Lake, indicate the virtually non-existent status of Atlantic salmon in the Meadow Lake system. The low or non-existent salmon population in the Isaac's Harbour River, at least upstream of Meadow Lake, is likely due to the low pH of the water in the system. Meadow Lake is situated within an area of NS considered

highly sensitive to lake acidification (NSE, 1998). Acid stress would severely reduce the survival of any juvenile salmon produced in this system.

With the exception of American Eel, which spawns at sea, all fish species collected in Meadow Lake would be expected to spawn in the Meadow Lake watershed. Ninespine Stickleback likely spawns virtually anywhere in the watershed, and Yellow Perch, Golden Shiner, and Blacknose Shiner probably spawn in Meadow Lake. Brook Trout and White Sucker likely use the tributaries to Meadow Lake for spawning purposes. Meadow Lake also provides abundant nursery and feeding habitat for all constituents of the fish community.

Low pH and alkalinity levels tend to limit the salmonid fish production in Meadow Lake. On the other hand, the lake is shallow, quick to warm up, and has an extensive riparian zone. These factors promote plant production, and hardy non-salmonid species may flourish in such habitat.

Invertebrates noted around the margins of Meadow Lake included mayflies, caddisflies, planaria, leeches, beetles, water striders, and chironomids.

9.5.3 Freshwater Mussels

Freshwater mussels are bivalve molluscs which, as the name suggests, occur in freshwater environments, where they often burrow into the substrate. Two families occur in NS, the Unionidae, or River Mussels, and the Margaritiferidae, the Freshwater Pearl Mussels. Freshwater mussels complete their entire life cycle in fresh water, with larval stages (glochidia) of many species attaching themselves to specific fish species to aid in dispersal within watersheds. Adults also tend to have very specific habitat requirements. Freshwater mussels are therefore very sensitive to habitat degradation, and changes in host populations. Currently, NSDNR lists ten species of freshwater mussels as resident species in NS.

No freshwater mussel species are known to occur on the Project site. None were reported in the Keltic Project EA (AMEC, 2006), nor have any been found during recent surveys by AMEC in 2012 and 2013. None have been reported from Meadow Lake, although targeted surveys were not conducted. It is possible that some freshwater mussels may occur in the tributaries draining into Meadow Lake.

Freshwater mussel SOCC are discussed further in Section 9.7.2.2.

9.5.4 Water Quality

9.5.4.1 Project Site

In 2007, Dillon conducted water quality sampling on five locations on or near the current Project site, as part of an agreed water quality monitoring plan for the Keltic Project with NSE (Dillon, 2008a). The five locations included upstream and downstream reaches of the unnamed watercourse and Betty‘s Cove Brook, as well as Dung Cove Pond.

All samples were analyzed for general inorganic chemistry, metals and petroleum hydrocarbons and compared against the Canadian Water Quality Guidelines for the Protection of Aquatic Life (CCME, 1999) and the Atlantic PIRI Guidelines (RBCA, 2012) in place at the time:

- Petroleum hydrocarbons were below applicable guidelines in all sample and sampling events.
- pH was below the recommend range of 6.5-9 in all samples.
- Aluminum was above guidelines of 0005-0.1 mg/L (pH dependent) in all samples.
- Arsenic was above guideline of 0.005 mg/L in all samples except SW-4, which was only sampled on one occasion).
- Cadmium was above guideline of 10 µg/L (hardness dependent) in all samples except SW-1 in October 2007.
- Copper was above guideline of 0.002-0.004 mg/L (hardness dependent) in the SW-5 November sample.
- Iron was above the guidelines of 0.3 mg/L in SW-1 (October) and in both samples from SW3 and SW5.
- Zinc was above the guideline of 0.03 mg/L in SW-4 in November 2007.

Previous samples collected in 2005 from Betty's Cove Brook indicated low pH and elevated aluminum (AMEC, 2006).

Full water quality sampling results are provided in the original March 2008 Dillon report in Appendix J (Dillon, 2008a).

Some water quality data was also collected for the Keltic Project EA completed in 2006 (AMEC, 2006). A summary of the in-situ results for water samples collected from three on-site water bodies is presented in Table 9.5-3.

Table 9.5-3 In-situ Water Parameters of Red Head Ponds (Spring 2005)

Location	Temperature (°C)	Conductivity (µS/cm)*	DO (mg/L)	pH	Salinity (ppt)
Pond 4	16.59	38880.0	10.03	8.46	24.83
Pond 5	18.75	25120.0	9.34	7.43	15.32
Dung Cove Pond (Pond 6)	14.93	75.0.	8.36	6.49	0.03

Note:
* µS/cm = microseimens per centimetre.

Updated baseline water quality data will be collected on the Project site prior to any site disturbance.

9.5.4.2 Meadow Lake

Meadow Lake is relatively shallow, with a maximum depth of about 2 m. A log driving dam that impounded the water to a level similar to that proposed under the present Project used to be present near the lake outlet, but has not existed since the 1930s. Dissolved oxygen levels were within normal ranges during all surveys in 2004 and 2005. Conductivity is low because of the nature of the geology associated with this watershed. Humic substances concentrations are elevated, as are total organic carbon, colour, and aluminum, which may be present as an organic chelate. Aluminium values exceeded the CCME (1999) guideline in all samples.

Copper and lead were found present above CCME (1999) guideline values in only one water sample collected in March 2002. This result may represent an anomalous event or a sampling error. Iron and manganese are both present in varying concentrations, sometime exceeding both, the CCME aquatic habitat (1999) and drinking water guidelines (Health Canada, 2012).

The most noteworthy results from the water-quality survey in this lake are the low field-measured pH values, which ranged from 3.4 to 4.96 during the 2004 surveys (Table 9.5-4). The lab-measured pH values were slightly higher, ranging between 4.7 and 5.1. The field-measured values are considered to be more representative of lake conditions.

Table 9.5-4 In-Situ Surface Water Quality Measurements in Meadow Lake in Spring 2005

Location	Temperature (°C)	Conductivity (µS/cm)	Dissolved Oxygen (mg/L)	pH
Northeast Inlet (0603321 E 5011240 N)	13.8	26.3	11.03	4.2
Northwest Inlet (0603301 E 5011301 N)	11.7	35.3	12.25	3.4
East Branch Tributary Inlet (0604555 E 5010807 N)	14.3	33.8	9.68	4.14
Western Shore (0604228 E 5009951 N)	15.6	-	9.95	4.19
Centre of South Bay (0604284 E 5009138 N)	16.9	33.1	9.53	4.24
Outlet (0604284 E 5008371 N)	18.9	32.8	8.57	4.96

The low pH levels are likely the result of the combination of acidic precipitation and the low alkalinity of study-area waters due to the underlying bedrock geology. The significance of this situation in Meadow Lake is that Atlantic Salmon cannot spawn successfully in waters with such low pH levels. Reproduction begins to fail at a pH of 5.4 and reproduction is impossible at a pH of 4.6 or below. The low pH levels in Meadow Lake are the likely explanation for the near absence of Atlantic Salmon in the survey catches.

Other noteworthy water quality results from this lake were the highly negative Langelier Index values. Water from this lake may be considered to be very corrosive.

Updated baseline water quality data will be collected from Meadow Lake prior to any construction activities.

For an assessment of the interaction between the Project and the herein described environment, refer to Section 10.10.

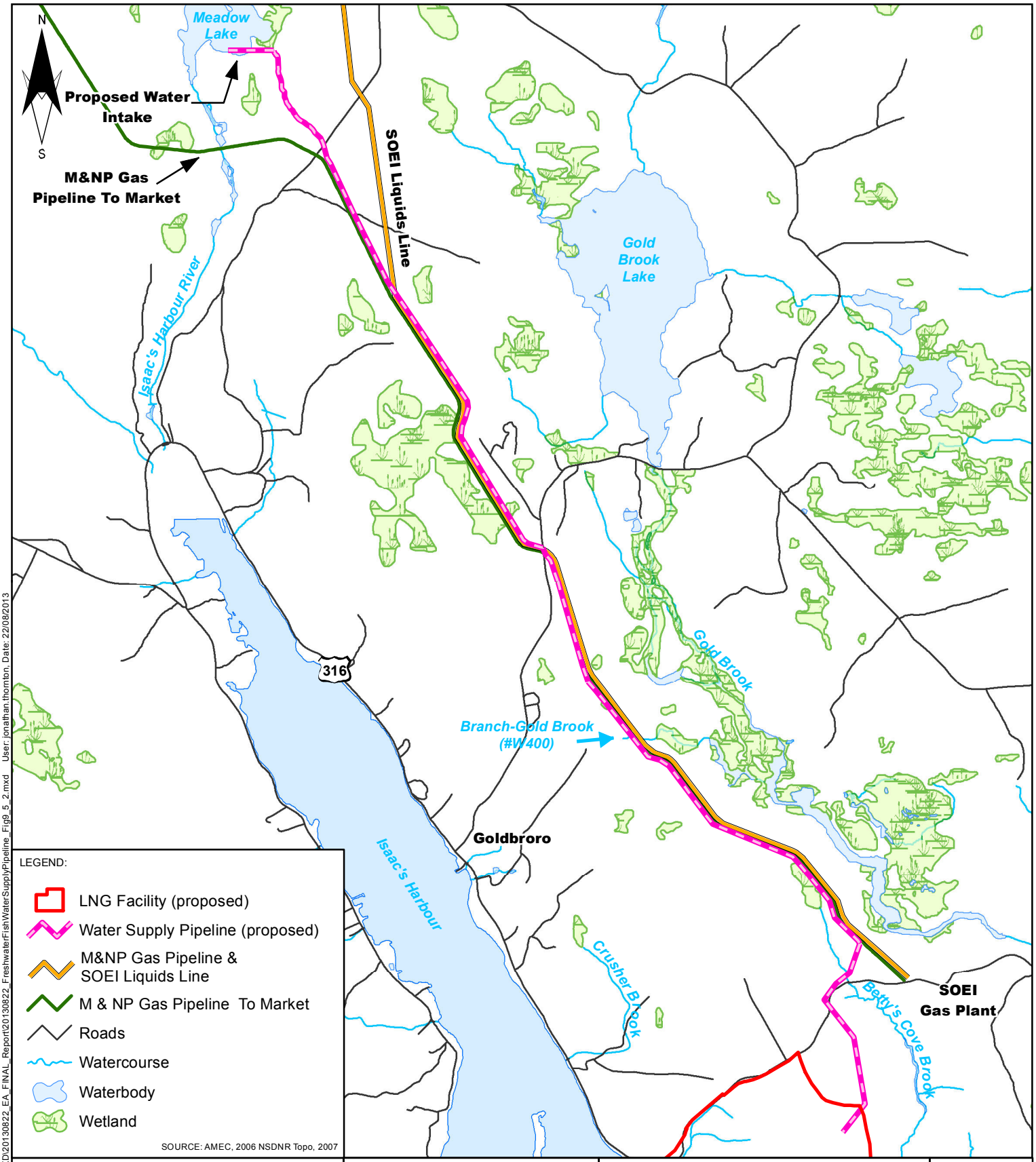
LEGEND:

- Elevation Contours (5m Intervals)
- Field Delineated Wetland
- Inferred Wetland
- Swamp
- LNG Facility (proposed)

CLIENT: Pieridae Energy (Canada) Limited	SCALE: 200 100 0 200 Metres 1:12,500	PROJECT: GOLDBORO LNG ENVIRONMENTAL ASSESSMENT	DWN BY: TM
			CHK'D BY: TM/BC
			DATE: Aug 2013
AMEC Environment and Infrastructure A Division of AMEC Americas Ltd. 50 Troop Avenue, Unit 300 Dartmouth, N.S., B3B 1Z1 (P) 902-468-2848 (F) 902-468-1314	DATUM: UTM Zone 20	TITLE: FRESHWATER FISH HABITAT AT LNG FACILITY	REV. NO:
	PROJECTION: NAD83		FIGURE NO: 9.5-1
	PROJECT NO: TV121039		

SOURCE: AMEC, 2006 / NSDNR Topo, 2007 / NSDNR Aerial Imagery, 2008

Path: G:\GIS\PROJECTS\TV121039_Phase3000\MXD\20130812_EA_FINALReport\20130814_FreshwaterHabitat_Fig9_5_1.mxd User: tanya.morehouse, Date: 15/08/2013



CLIENT: Pieridae Energy (Canada) Limited

SCALE: 500 250 0 500 Metres — 1:30,000

PROJECT: GOLDBORO LNG — ENVIRONMENTAL ASSESSMENT

DWN BY: JT

CHK'D BY: TM/GB

DATE: Aug 2013

REV. NO: N/A

FIGURE NO: 9.5-2

AMEC Environment and Infrastructure
A Division of AMEC Americas Ltd.
50 Troop Avenue, Unit 300
Dartmouth, N.S., B3B 1Z1
(P) 902-468-2848 (F) 902-468-1314

DATUM: UTM Zone 20

PROJECTION: NAD83

PROJECT NO: TV121039

TITLE: FRESHWATER FISH HABITAT ON THE WATER SUPPLY PIPELINE

Path: G:\GIS\PROJECTS\TV121039_Phase3000\MXD\20130822_EA_FINAL_Report\20130822_FreshwaterFishWaterSupplyPipeline_Fig9_5_2.mxd User: jonathan.thornton. Date: 22/08/2013

9.6 Marine Environment

9.6.1 Oceanographic Conditions

9.6.1.1 Winds

MSC50 is a hindcast of hourly wind and wave data provided by Meteorological Service of Canada (Swail *et al.,* 2006). The data cover the years 1962 to 2011 and provide hourly 1-hour average wind speed at a height of 10 m. Wind speeds and directions were extracted for node #8086 (45°6‘ N - 61°36’ W) located at the mouth Stormont Bay, between Cape Mocodome and Goose Island. Monthly wind roses (Figure 9.6-1) show predominance of winds from the northwest and west in the winter and from the southwest in the summer. The annual wind rose (Figure 9.6-2) shows prevalent winds from the northwest, west and southwest.

Extremal analysis was performed on the wind hindcast. Extreme values are presented in Table 9.6-1; the uncertainties represent the lower and upper bounds of the 95% confidence intervals on the maximum likelihood estimates of the extreme values. These are representative of conditions offshore just outside of Stormont Bay. Variations in speed and direction can be expected near shore at the site of the face of the wharf due to local topography and the presence of man-made structures. Site specific measurements and consideration of gust speed will typically be part of the front end engineering phase.

Table 9.6-1 Extreme Wind Speeds for MSC50 Node # 8086

Node	1 year Return (m/s)	10 year Return (m/s)	25 year Return (m/s)	50 year Return (m/s)	100 year Return (m/s)
8086	22.1 ± 0.2	24.5 ± 0.7	25.9 ± 0.9	26.7 ± 1.1	27.4 ± 1.2

Source: Swail *et.al*., 2006

9.6.1.2 Wave Climate

The MSC50 wave hindcast provides wave climate just outside of Stormont Bay between Cape Mocodome and Goose Island. The entire hindcast covers the years 1954 to 2011; however, prior to 1962 ice cover information available was not accurate enough to be properly accounted for in the wave generation and propagation modelling. Therefore only years 1962 to 2011 were used in this analysis. Predominant and largest offshore waves are from the south and southeast (Figure 9.6-2). Extremal analysis was conducted on the wave hindcast. Results are presented in Table 9.6-2; the uncertainties represent the lower and upper bounds of the 95% confidence intervals on the maximum likelihood estimates of the extreme values.

Table 9.6-2 Extreme Significant Wave Heights for MSC50 Node # 8086

Node	1 year Return (m)	10 year Return (m)	25 year Return (m)	50 year Return (m)	100 year Return (m)
8086	5.9 ± 0.1	7.7 ± 0.6	8.6 ± 0.7	9.2 ± 0.8	9.9 ± 1.0

Source: Swail *et.al*., 2006

As they propagate up the bay towards the site of the proposed wharf, waves are affected by refraction and shoaling that result in significant attenuation and spreading of wave energy to which the numerous islands, shoals and land heads contribute efficiently. However overall the bay remains quite exposed to the remnant wave energy as demonstrated by the predominance of large cobbled beaches and rocky shorelines dominated by coarse substrate (AMEC, 2006).

Estimates of extreme significant wave heights near the site of the wharf were derived from Waverider buoy data acquired between December 1984 and July 1985 and presented in CB&I and Royal Haskoining DHV (2013). They are reproduced in Table 9.6-3 and demonstrate the difference between the offshore wave climate and that near the wharf, although because of the relatively low data return (36%) some sever events may have been missed by the buoy (MapleLNG, 2008). Site specific measurements over a sufficiently long period will typically be part of the front end engineering phase.

Table 9.6-3 Extreme Significant Wave Heights near Wharf Site from 1984-1985 Waverider Buoy

1 year Return (m)	10 year Return (m)	25 year Return (m)	50 year Return (m)	100 year Return (m)
3.8	4.7	5.0	5.3	5.6

9.6.1.3 Currents

Tidal currents dominate the circulation in coastal inlets such as the system formed by Stormont Bay, Country Harbour and Isaac's Harbour. Tidal currents tend to be rectified, flowing back and forth parallel to the shoreline. Stronger currents are expect in the narrows channels at the entrance to Isaac's Harbour and Country Harbour with water velocities decreasing rapidly away in the wider outer Harbour. Freshwater inflow from Country Harbour River and Isaac's Harbour River contribute to an increased estuarine circulation, especially during spring freshet. Based on the tidal prism, tidal currents are expected to be around 0.1 m/s (AMEC, 2006).

Current measurements at a depth of 10 m near the site of the wharf in 18 m of water were acquired in 1984-1985 during a seven months period. Statistics indicate that currents rarely exceed 0.3 m/s (MapleLNG, 2008). The 100-year combined tidal and residual current was estimated around 0.5 m/s (CB&I and Royal Haskoning DHV, 2013). Site specific measurements over a sufficiently long period will typically be part of the front end engineering phase.

9.6.1.4 Wave Levels

The Canadian Hydrographic Services (CHS) had a tide gauge in Isaac's Harbour for two weeks in the summer of 1963. Based on this limited data, Highest Astronomical Tides, Mean Sea Level and Lowest Astronomical Tide were estimated at 1.94 m, 0.97 m and 0.00 m above CD. In the Canadian Tide and Current Tables published by the department of Fisheries and Ocean, Isaac's Harbour is a secondary port with Point Tupper as reference port. Combining water level levels given for Isaac's Harbour relative to Point Tupper with those given for Point Tupper gives Highest Astronomical Tides, Mean Sea Level and Lowest Astronomical Tide respectively at 2.1

m, 1.2 m and 0.3 m. Site specific water level measurements will be acquired over an appropriately long period for the front end engineering phase.

For an assessment of the interaction between the Project and the herein described environment, refer to Section 10.18.

9.6.2 Marine Habitat and Vegetation

In response to proposed and constructed industrial projects in recent years, several EA's and other studies have been completed over the past decade in order to assess the habitat of the Project area. These studies have led to an increased knowledge of the marine environment and a better understanding of fisheries capability. Results from these studies and other relevant marine and ecological research from elsewhere in the province, have been compiled to characterize the marine environment of Stormont Bay and surrounding areas.

The Project is located near the coastal waters of Stormont Bay, Country Harbour and Isaac's Harbour. This area is located within the Guysborough Harbours Unit, a coastal ecological zone characterized by long, narrow inlets with steep valley sides. The coastline is submerged, with parallel inlets and estuaries separated by headlands typically composed of greywacke or granitic bedrock covered with a thin layer of quartzite till. Glaciofluvial deposits of coarse sand and gravel are found in many of the river valleys, while the coastline is generally rockier with few sand beaches (NSMNH, 1996). Marine habitats were surveyed using underwater survey methods.

9.6.2.1 Substrate

Stormont Bay is predominantly covered with fine sand and silt with scattered rock shoals. The subtidal zone, extending to depths approximately 15 m below mean low water, has a predominantly sand and gravel bottom (NSMNH, 1996). The nearshore marine habitat at Red Head has a substrate of boulders, cobbles and pebbles, with finer materials such as sand and gravel in more protected bays.

The Goldboro area was historically a site of active gold mining. Evidence of this activity can still be seen in the form of abandoned mine sites and tailings dumps. Gold mine tailings tend to be high in arsenic and mercury as a result of the extraction process. Several tailings sites have been identified near the Project site both on land and in the harbour. Sediment samples taken from the proposed wharf site do not show elevated mercury or arsenic levels and the terrestrial sites appear to be well contained (AMEC, 2006). Past mining contamination of local marine sediments has been documented. A study by NSDNR for mercury and arsenic contamination levels in Isaac's Harbour found that while there is a layer within the near surface sediment with an elevated metal content, the concentrations are within acceptable limits. The sampling site nearest to Red Head shows almost no change in arsenic levels throughout the sediment column with a slight elevation of mercury near the surface of the sea bottom (AMEC, 2006).

In general the coastal plant and animal communities were more productive in rockier areas than in beach areas that had finer substrates. Along the coastline near redhead, the most productive

intertidal habitats were generally the mid to low intertidal and upper subtidal zones on partially exposed rocky shoreline (Envirosphere Consultants Limited, 2004).

9.6.2.2 Estuaries

Freshwater inflow to Stormont Bay from the Country Harbour and Isaac's Harbour watersheds gives the harbours estuarial characteristics. The entrance to these harbours is unimpeded by the thick glaciofluvial deposits (sills) found in many other inlets in the area so water flow and mixing is less restricted (NSMNH, 1996). This results in greater circulation of water and nutrients between Stormont Bay and the estuarine heads of the Harbours. The estuarine environment also receives greater saltwater inflow due to its openness to Stormont Bay.

Country Harbour River and Isaac's Harbour River watersheds in addition to smaller tributaries along the coastline, supply most of the freshwater to Stormont Bay. Freshwater inflow is highest in spring and winter, with peak flows occurring in April. In estuarial headwaters, freshwater will layer over top of the deeper saltwater column beneath. The degree of mixing and circulation that occurs depends upon a number of factors including tidal influences, freshwater inflows, storm conditions and saltwater inflow characteristics. Therefore, circulation patterns can vary seasonally and annually.

9.6.2.3 Nearshore

The Guysborough County Coastal Resources Mapping Project (Guysborough County Inshore Fisherman's Association, 2001) mapped habitat types that support specific benthic invertebrates (such as lobster and scallop) in Stormont Bay and surrounding areas. Significant variation in the marine habitat occurs at water depths of less than 20 m and up to 1 km from shore. The near-shore marine habitat at Red Head, the site of the proposed jetty trestle and marginal wharf, has a substrate of boulders, cobbles and pebbles with finer materials such as sand and gravel prevalent in more protected bays. A narrow band of coarser sediment with relatively sparse macro algae cover stretches from the shoreline seaward for approximately 50 m. Marine plants such as kelp are associated with rockier areas, while Eelgrass beds occur on sandy substrates (Figure 9.6-3). These habitat variations are similar to what predominates in nearshore coastal areas elsewhere in Stormont Bay.

9.6.2.4 Offshore

Stormont Bay is open to the ocean and is not as influenced by fresh water inflows as Country and Isaac's Harbours however, it is more susceptible to wave and ice action along its coastline (NSMNH, 1996). Stormont Bay is predominantly covered with fine sand and silt with scattered rock shoals. Water depth is significantly greater towards the central part of the bay and the ocean floor here is covered in soft, silty mud. Shallow, sandier shoals occur on either side of the entrance to Stormont Bay, the largest of these occurring near Harbour and Goose Islands and in the vicinity of Country Harbour Head.

The marine habitats of Stormont Bay and the estuarial habitats of Country Harbour and Isaac's Harbour support a variety of marine organisms. Species include algae, phytoplankton, zooplankton, marine invertebrates, and estuarial, freshwater and pelagic fishes.

9.6.2.5 Marine Flora

A benthic sampling program was conducted within the Project area in 2002 to characterize the benthic habitat along the nearshore sections of the Deep Panuke pipeline route to shore. The study identified several marine floral species typical of western North Atlantic coastlines including Bladder Wrack (*Fucus vesiculosis*), Kelp (*Laminaria* sp.) and Coral Weed (*Corallina officinalis*) (EnCana Corporation, 2002).

A shoreline survey was conducted in November 2004, and observed the presence of typical western North Atlantic intertidal communities dominated by Rockweed (*Ascophyllum nodosum*) and Bladder Wrack. Kelp and other seaweeds are generally abundant in all nearshore areas of Stormont Bay (AMEC, 2006). Seaweed density in the Red Head area is variable. To the east, seaweed abundance is moderate and is restricted to lower intertidal and upper subtidal zones. Productivity northwest of Red Head was significantly lower (Envirosphere Consultants Limited, 2004).

9.6.3 Sensitive Coastal Habitats

The shoreline of Dung Cove and Red Head is located within the Project footprint and is the proposed site of the jetty trestle and marginal wharf structures which would both extend out into Stormont Bay. There are three ponds located in the Project area on the Red Head peninsula and are separated from the ocean by barrier beaches. The largest, Dung Cove Pond, is freshwater and is fed by a watercourse descending through the Project footprint. The smaller ponds are brackish or saline.

The shoreline of Dung Cove and Red Head is predominantly cobble beach bordered by coniferous trees and various species of graminoid and ericaceous plants. The upper beach is composed of cobble with gravel and some sand. Several species of seaweeds and invertebrate shells were observed in the strandline at the high tide mark including: kelp, rockweed, bladderwrack, coralline algae, rock crab, horse mussel, periwinkle, scallop, waved whelk and green crab. The mid beach is composed of cobble, gravel and boulder with some areas of sand and fine gravel. The lower beach is composed of boulder and cobble with little sand. Rockweed and bladderwrack were observed growing on the large substrate of the lower beach and barnacles, periwinkles and sideswimmers were also present.

9.6.4 Marine Wildlife

9.6.4.1 Marine Invertebrates

Off the NS coast, the rocky subtidal zone typically extends to about 15 m below the mean low water mark and grades into sand/gravel sedimentary bottom. Coastal marine habitat in Stormont Bay can be divided into intertidal (littoral) and subtidal (sublittoral) zones. The littoral zone, which exists between high and low tide, contains habitat for invertebrates adapted to growing on rocky surfaces that are able to withstand tidal and wave action. These include a variety of species including chitons, limpets, barnacles (*Balanus* sp.), Blue Mussels (*Mytilus edulis*) and some crustaceans such as Rock Crab (*Cancer irroratus*). Rocky areas within the sublittoral zone, support mussels, Rock Crab, Lobster (*Homarus americanus*), Sea Urchin (*Strongylocentrotus droebachiensis*) and sea stars (*Asterias* sp.) among others (McLaren *et.al*.,

1996) while finer substrate supports soft shell clams and other bivalves and marine worms. Other marine organisms typical of these areas include periwinkles (*Littorina littorea, L. saxatilis and L. Obtusatus*) and amphipods such as *Hyale nilssoni* and *Gammarus* species (Envirosphere Consultants Limited, 2004).

EnCana conducted benthic sampling in 2002 within the Project area, to characterize the benthic habitat along the nearshore sections of the Deep Panuke pipeline route to shore. The study identified several benthic invertebrate species. Rocky substrate in the nearshore was dominated by barnacles, whelks, hermit crabs, sea urchins, lobsters, rock crabs, blue mussels, horse mussels (*Modiolus modiolus*), polychaete worms, bryozoans, sponges, tunicates and other invertebrates. These are all species pervasive to the western North Atlantic coastal rocky intertidal zone. The study along the nearshore environment of the pipeline corridor determined that the most common macrofauna were sea stars and bivalves (EnCana Corporation, 2002).

Lobster

Studies completed in the area have identified important Lobster habitat. In the shallower waters of eastern Stormont Bay, between Red Head (the site of the proposed wharf) and Harbour Island, there is a consistent mix of rock, boulder, kelp and sand. In the outer deeper areas (outside Country Harbour Head and past Harbour Island) Lobster habitat is more variable. The Black Ledges area, a shoal on the western entrance to Stormont Bay is considered good Lobster habitat/Urchin habitat with shoals surrounded by large sandy mud areas (AMEC, 2006).

Lobster productivity depends upon a number of density independent factors such as temperature, time of hatching, predation, wind direction and food supply. These factors have the greatest effects on larval survivability and consequently Lobster populations and area productivity. Optimal habitat for lobster changes as they grow. Smaller post-larval lobsters prefer to live in tunnels or in natural crevices and move to habitats with coarser substrates and suitable cover when and they grow larger. Juvenile lobsters prefer areas with algae, stones and large crevices but some larger lobsters have been observed on compact sand or mud bottoms consolidated by Eelgrass. All sizes of Lobster have been observed co-existing in areas with large stone size and heavy algal cover. Sand covered in Eelgrass had a low abundance of juveniles and adults, while on bare sand bottoms no resident lobsters were observed (National Oceanographic and Atmospheric Association, 1994).

Rock Crab

Rock crabs inhabit the coastal areas of the intertidal zone and subtidally to depths of up to 40 m. Rock crabs often spend winters in shallower waters on softer sand and mud substrates and then migrate to deeper waters during the spring and summer. Larvae float freely in the water column between mid-June and mid-September until they settle on the ocean floor.

Sea Urchin

Sea urchins rely upon seaweed as their primary food source with the highest concentrations of urchins located near kelp beds. In Stormont Bay, kelp has increased in areas where urchins have formerly grazed. Management measures have recently been instituted to manage this fishery in Guysborough County.

9.6.4.2 Marine Fish

Fish are the most abundant and diverse group of vertebrates in the ocean with 538 species recorded in the Canadian Atlantic region alone. The familiar commercial species of marine fish in NS make up only a small proportion of the total number of species. Numerous lesser-known, but in some cases abundant, species inhabit the different marine and estuarine habitats. The marine fish likely to be found in the waters off NS may be divided into five groups:

- estuarial and coastal;
- demersal (groundfish);
- pelagic (open ocean);
- mesopelagic (intermediate depth); and
- exotic and transient species.

Estuarine and Coastal Fish Species

Up to 20 fish species are commonly found in estuaries around the coast of NS. They include species that remain in estuaries for their entire life cycle or migrate into fresh water for short periods to spawn. Anadromous fish that pass through estuaries on their way to spawning grounds in freshwater include Gaspereau (*Alosa pseudoharengus*), Atlantic Salmon (*Salmo salar*), Atlantic Smelt (*Osmerus mordax*) and American Shad (*Alosa sapidissima*). Catadromous fish such as American Eels spend most of their lives in freshwater before passing through estuaries upon returning to the Atlantic Ocean where they spawn as adults in the open ocean. Species such as Brown Trout (*Salmo trutta*), Brook Trout and sticklebacks (*Gasterosteus* sp.) which typically live in fresh water often feed in coastal estuaries during parts of the year because of the abundance of food and favourable temperatures. The juveniles of many demersal and pelagic fishes such as Cod (*Gadus morhua*), Pollock (*Pollachius virens*) and Herring (*Clupea harengus harengus*) also feed in coastal environments (NSMNH, 1996).

Atlantic Salmon

Salmon begin to migrate up Country Harbour and Isaac's Harbour Rivers by April and spawn between late October and mid-November, burying their eggs in gravel to cobble size material. Atlantic Salmon generally hatch in the spring and emerge from the gravel by early June. Atlantic Salmon smolts migrate to the sea from mid-May to mid-June (Scott and Crossman, 1973) while adult Salmon downstream migration is variable. In some river systems populations remain overwinter but in others downstream migration takes place immediately after spawning. At sea Atlantic Salmon feed on shrimp and small fishes.

Atlantic Smelt

Smelt inhabit coastal waters of Atlantic Canada and migrate into freshwater streams and rivers to spawn in spring. There colouration varies from transparent-olive to bottle-green above with silver belly. The presence of an adipose fin distinguishes the smelt from closely related species. Smelt are important prey for many species of fish and marine mammals (Leim and Scott, 1966).

American Eel

American eels are catadromous fish, migrating out of freshwater streams and rivers to the Atlantic Ocean where they continue far offshore to spawn. Elvers migrate from the Atlantic into freshwater rivers in late spring. The colouration of the American Eels varies with habitat from black to muddy-brown above with yellowish undersides. American Eels can reach a length of almost 1 m and feed primarily at night foraging for small fishes and invertebrates (Leim and Scott, 1966).

Brook Trout

Brook Trout are native only to eastern North America and are present in most Atlantic Canadian streams and lakes. There are both resident and sea-run populations, sometimes inhabiting the same streams, with the sea-run fish reaching larger sizes than the residents. The sea-run fish will migrate out of the rivers and streams to coastal areas and estuaries in late fall to forage and then return to freshwater in the spring. Brook Trout will spawn by mid-to-late September, burying their eggs in gravel to cobble size material, and generally hatch and emerge from the gravel in late March or early April (AMEC, 2006). They are distinguished from similar species by their striking colouration, dark-green vermiculate markings and orange-red spots encircled by blue halos and the presence of white bands along the leading edge of their pectoral, pelvic and anal fins.

Demersal (groundfish) species

Groundfish occur both offshore and in coastal inlets and estuaries and live close to the bottom for much of their adult life but shift between shallow and deep waters depending on seasonal temperature changes. During winter most groundfish species move off the tops of the banks to deeper, warmer waters along the bank edges and in the adjoining basins (Scott and Scott, 1988). These include Cod, Haddock (*Melanogrammus aeglefinus*), Hake (*Urophycis and Merluccius* sp.), American Plaice (*Hippoglossoides platessoides*), Redfish (*Sebastes* sp.), and Argentine (*Argentina silus*). Other species more tolerant of colder temperatures, including Yellowtail Flounder (*Pleuronectes ferruginea*) and most skate species (Rajidae) remain on the banks during the winter. As surface waters warm in the spring, groundfish such as Cod, Haddock, Silver Hake, and American Plaice move into shallower water on the banks. Deeper water species such as Argentine, White Hake and Fedfish remain in the deeper areas along the shelf edge. In the spring, many species migrate over the Scotian Shelf on the way to summer feeding or spawning grounds. Witch Founder (*Glyptocephalus cynoglossus*), Wolfish (*Anarhichas lupus*) and Monkfish (*Lophius americanus*) appear to remain in the same general location throughout the year (Kulka and Stobo, 1981).

Atlantic Cod

The Atlantic Cod is a cold water species rarely observed in water temperatures above 10^{o}C. Its colouration can be various shades of grey, green, brown or red with numerous rounded brownish to reddish spots. The Atlantic Cod can also change colour to match the surroundings. The Atlantic Cod is a voracious feeder and feeds on crustaceans, Herring, Capelin (*Mallotus villosus*) and other small fishes. This fish was historically a very important commercial species (Leim and Scott, 1966).

Haddock

Haddock are distinguished from similar species by the presence of a black lateral line and black spot on the sides of their body. They generally range from approximately 38 to 76 cm in length and rarely exceed 4.5 kg. Haddock feed on benthic prey items such as crustaceans, molluscs and worms but brittle stars and bivalves make up the bulk of their diet (Leim and Scott, 1966).

American Plaice

The American Plaice is a flatfish with eyes on the right side of its body, a rounded caudal fin and relatively straight lateral line. It also has a large mouth and feeds on shrimp, amphipods, worms and other small benthic invertebrates. It is reddish or grayish brown on the eyed side and white on the blind side. Plaice are often found in deep water, >600 m and on a substrate consisting of fine sand or soft mud (Leim and Scott, 1966).

Yellowtail Flounder

The Yellowtail Flounder is a flatfish with eyes on the right side of its body. It has a relatively small mouth and a distinguishing feature of this flatfish is the arched lateral line. It is brownish-olive with numerous irregular rusty-reddish spots on the eyed side of its body. It is most abundant in 40 to 60 m of water on sandy or mixed sand and mud bottoms (Leim and Scott, 1966).

Pelagic Species

Pelagic fish travel mostly in large schools, feeding primarily in surface waters or middle depths. Key commercial species on the Scotian Shelf include Atlantic Herring, Atlantic Mackerel (*Scomber scombrus*), Tuna (*Thunnus* sp.), Swordfish (*Xiphias gladius*) and Porbeagle Shark (*Lamna nasus*). Herring and Mackerel show major spring and fall movements, with major concentrations of Herring overwintering in Chedabucto Bay and Mackerel move south to wintering areas along the shelf off Sable Island Bank beginning in October. Tuna and Swordfish show migration patterns related to water temperature, with fish following the Gulf Stream in spring and then moving towards the Shelf Slope in summer. Shark also move onto the Scotian Shelf as waters warm in the spring and returning south in the fall. In early fall, migratory species present on the Scotia Shelf move offshore to the south. Tuna, Swordfish and Shark leave the shelf by November (AMEC, 2006).

Atlantic Herring

The Atlantic Herring is distributed along the North American coast of the Atlantic Ocean from northern Labrador to Cape Hatteras. Studies of Atlantic Herring along the Canadian coast indicate that there are likely six or more distinct populations within Canadian waters and extensive migrations of these populations are unlikely. Atlantic Herring feed on zooplankton such as copepods and euphasiids and also consume mollusc larvae, fish eggs and the larvae of some fish species. The Atlantic Herring is an important prey item for several larger species of fish including Cod, Hake, Salmon, Tuna, sharks, etc. and are also preyed upon by marine mammals such as seals, dolphins and whales (Scott and Scott, 1988).

Atlantic Mackerel

Mackerel are highly migratory, pelagic fish species and are present in Stormont Bay year round with juveniles present throughout the year and adults in Spring and Summer. In winter adult Mackerel generally move to feeding grounds on the Scotian Shelf southwest of Sable Island (Scott and Scott, 1988). Mackerel are an important food source for many large fish and marine mammals.

Swordfish

Widely found in tropical and temperate waters of the Atlantic, Pacific and Indian oceans, swordfish commonly reach 3 m in length and weigh more than 450 kg. They are highly migratory and are present off the coast of NS in summer and early fall when water temperatures are warmest. Swordfish hunt small schooling pelagic fishes such as Herring and Mackerel and will also consume Squid (Cephalopod) (Leim and Scott, 1966).

Mesopelagic Species

Mesopelagic species, including Lanternfish (Myctophids), live on the continental slope and are unlikely to be seen in inshore waters. Many of these deepwater species migrate vertically towards the surface at night and toward the bottom by day. Data on mesopelagic species in the Project area were compiled from surveys along the Scotian Slope from 1984 to 1989 by Halliday *et al*. (1995). More than 200 species of mesopelagic fish were found. Lanternfish dominated but other fish included Lightfish (Gonostomatidae), Viperfish (Chauliodontidae), Silver Hatchetfish (Sternoptychidae), Scaled Dragonfish (Stomiidae), Sawpalate (Serrivomeridae), Snipe Eel (Nemichthyidae), Dogfish Shark (Squalidae), Longneck Eel (Derichthyidae) and Gulper (Eurypharyngidae) can be found in the deeper waters off NS.

Exotic and Transient Species

Several exotic species have been observed off the coast of NS brought by warm water currents from the Gulf Stream off the continental slope. Studies in St. Margaret's Bay and Prospect Bay yielded 31 species from warmer waters, including Flying Fish (Exocoetidae), Seahorses (*Hippocampus* sp.), and several species of shark. In addition, several cold water species of eastern origin such as Greenland Cod (*Gadus ogac*), Mailed Sculpin (*Triglops murrayii*) and Arctic Eelpout (*Lycodes reticulates*) have been recorded from cold-water areas on the banks and eastern shore (AMEC, 2006).

Transient species, typically with a southern distribution, that migrate seasonally to or through the Project area include species such as Sunfish (*Mola mola*) and Basking Sharks (*Cetorhinus maximus*). There are occasional inshore species such as Sturgeon (*Acipenser* sp.) and species from deep water such as Grenadiers (Macrouridae).

Sunfish

Ocean Sunfish have an average length of 1.8 m and can weigh 1000 kg. Adult Sunfish have an odd appearance, with a ventrally flattened body and lacking a caudal fin, and are often observed at or near the surface. They are slow moving and feed primarily on jellyfish.

Basking shark

The basking shark is the second largest fish in the world reaching lengths of approximately 10 m. The basking shark feeds exclusively on plankton swimming through the water, mouth agape, filtering out the plankton using their bristle-like gill rakers. Basking sharks are often observed at or near the surface and in areas of high plankton concentrations.

9.6.4.3 Marine Mammals

Whales and seals are found throughout the Scotian Shelf, with fewer species in inshore waters. NSMNH (1996) listed 21 species of whales, dolphins and porpoises in NS waters and six species of seals. Stormont Bay/Country Harbour is not an important area for cetaceans (NSMNH, 1996) however whales or seals may enter the area following schools of Herring or Mackerel from spring to fall.

Cetaceans

The general distribution of whales on the Scotian Shelf defines important areas of marine production that are often associated with the edges of banks, the slope of the Shelf and inlets or canyons (Sutcliffe and Brodie, 1977). The ocean dynamics associated with these bottom features result in higher levels of biological production and results in higher concentrations of marine mammals.

Mysticetes

Most baleen whales that occur in the northern hemisphere feed in higher latitudes in summer, exploiting biologically productive areas in the northwest Atlantic and the Gulf of St. Lawrence and moving south for the winter (NSMNH, 1996). Nonetheless, some individuals could be found throughout the year but in significantly lower numbers in winter than in summer. The Scotian Shelf is a region of high diversity of prey items, and baleen whales have adapted their seasonal feeding strategies as well as fat storage accordingly (Brodie, 1975). Filter-feeding baleen whales are attracted to areas with higher densities of large copepods and euphausiids that can be efficiently harvested (Brodie *et al*., 1978). The larger copepods (McLaren *et al*., 2001) and euphausiids are known to become concentrated in deeper waters of the Scotian Shelf basins and off the Shelf break through advection and vertical (including seasonal) migration.

Listed below are some of the more common baleen whales present along the Atlantic coast of NS.

Fin Whale

Adult Fin Whales (*Balaenoptera physalus*) average 18 to 20 m in length and are widely distributed in all the world's oceans but typically occur in temperate and polar regions. Named for its recognizable and easily seen crescent shaped dorsal fin, it is one of the fastest whales in the ocean having been clocked at over 35 km/h. The Fin Whale does not show its flukes during deep dives but can be easily spotted by the tall columnar blow that may reach 6 m in height (McCloskey and Kennedy, 2012).

Minke Whale

The Minke Whale (*Balaenoptera acuterostrata*) is the smallest baleen whale on the Scotian Shelf. Adults average 7 to 10 m in length and prey on small schooling fishes such as Sand Lance (Ammodytidae) and Capelin. It is widespread and seasonally abundant in the Northwest Atlantic. It has been identified in late spring and the summer months across the shelf, with a preference for water less than 200 m deep (Hooker *et al*., 1999).

Humpback Whale

Adult Humpback Whales (*Megaptera novaeangliae*) average 13 to 16 m in length and have unusually long pectoral flippers. They are often referred to as the "clowns of the sea" due to their surface displays and breaching acrobatics. The Humpback Whale will create a bubble net around a group of small schooling fish such as Mackerel or Herring to corral the fish into a tight ball to make lunge-feeding more efficient (McCloskey and Kennedy, 2012).

Odontocetes

Small toothed whales, dolphins and porpoises occur on the Scotian Shelf year round. In general, most species appear to frequent the shelf during summer and early fall, moving to the southwest as winter approaches (Kenney, 1994). Dolphins can range throughout the Scotian Shelf, over deep water on the Shelf break and into coastal inlets and harbours. The larger toothed whales i.e., Sperm (*Physeter macrocephalus*) and Northern Bottlenose Whale (*Hyperoodon* sp.) are associated with deeper waters, inlets and canyons where they feed on deepwater squid and fish.

Listed below are some of the more common toothed whales present along the Atlantic coast of NS.

Harbour Porpoise

Atlantic Harbour Porpoise (*Phocoena phocoena*) are widely distributed in cold-temperate coastal waters of the northern hemisphere. They are nearly always found in relatively shallow water, less than 125 m deep on the continental shelf (Gaskin, 1992). They often come close to shore and into estuaries or harbour in the summer in pursuit of their favoured prey of Herring, as well as Mackerel, Capelin, Hake, Pollock and Squid (Brodie, 1995). This species is further discussed in Section 9.7.3.2.

Atlantic White-sided Dolphin

White-sided Dolphins (*Lagenorhynchus acutus*) occur in temperate waters in the North Atlantic and in sub-arctic portions of the North Atlantic. They are most commonly found in groups of 30 to 70 individuals however larger groups are also observed. White-sided Dolphins feed on small pelagic fishes and Squid. Groups of Atlantic White-sided Dolphins occasionally enter Bedford Basin during summer, feeding for several weeks (EnCana Corporation, 2002).

Long-finned Pilot Whale

The Long-finned Pilot Whale (*Globicephala melas*) feeds over a wide range of the Scotian Shelf, as evidence by the status as the most abundant whale in Sable Island strandings (Lucas and Hooker, 2000). During spring and summer, this species feeds on Squid and fish along the shelf break but are often found over banks and may move across the Shelf to the nearshore by late summer (Kenney, 1994). Pilot Whales are observed in large numbers on both coasts of Cape Breton Island, following shoals of Mackerel and occasionally stranding in groups (EnCana Corporation, 2002). The Long-finned Pilot Whale often travelling in groups of several hundred is the whale most likely to occur in numbers on the Scotian Shelf throughout the year (Lucas and Hooker, 2000).

Sperm Whale

Sperm Whales are the largest of the toothed whales growing to a length of approximately 21 m with an extensive worldwide distribution. They routinely dive to depths of hundreds of metres and may occasionally dive as deep as 3000 m and primarily feed on Squid. Sperm Whales are generally distributed over large areas that have high secondary productivity and step underwater topography and are unlikely to be found in coastal areas.

Pinnipeds

Harbour Seals (*Phoca vitulina*) and Grey Seals (*Halichoerus grypus*) are routinely present on the Scotian shelf and frequently haul out on the shoreline (NSMNH, 1996). Both species prey on small pelagic fishes and may enter the Project area following schools of Herring or Mackerel.

Harbour Seals

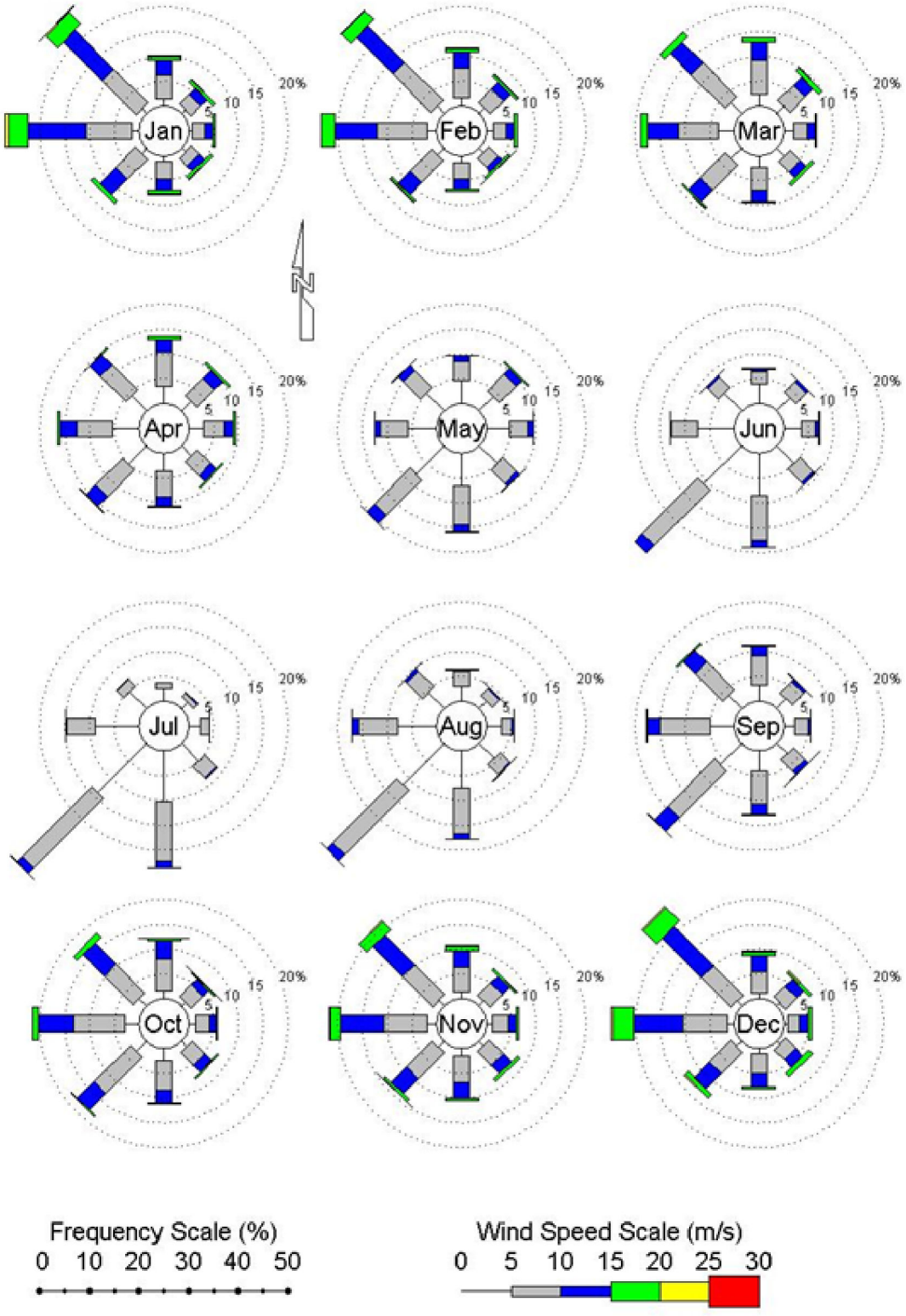
Adult Harbour Seals can grow up to 1.85 m in length and weigh close to 135 kg. They will feed on small fishes and generally stay close to coastal regions where they often haul out on rock outcroppings. Harbour seals are likely to be found in close proximity to the Project area.

Grey Seals

Adult Grey Seals can reach a length of 2.5 to 3 m and may weigh more than 270 kg. Grey Seals feed on a variety of fishes but primarily on benthic and demersal species. There is a large population of Grey Seals on Sable Island and they disperse widely after breeding in December and January. The total population of Grey Seals in Atlantic Canada is about 174,000 individuals (Hammill and Stenson, 2000).

For an assessment of the interaction between the Project and the herein described environment, refer to Section 10.11.

MSC50 #8086, 45.1N - -61.6W

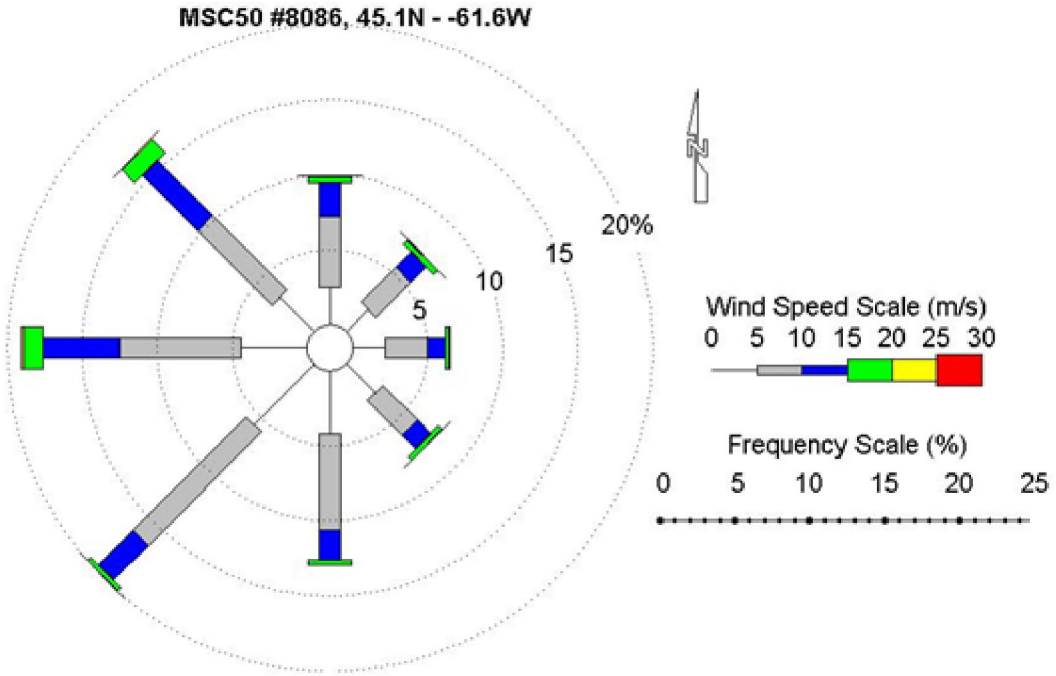


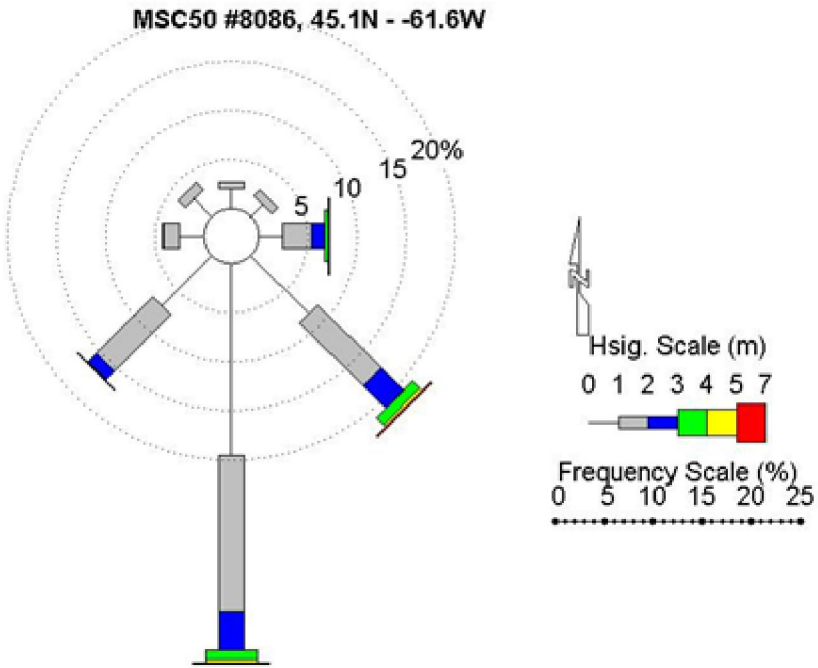
SOURCE: The MSC50 Wind and Wave Reanalysis, 2006

CLIENT: Pieridae Energy (Canada) Limited	SCALE:	PROJECT: GOLDBORO LNG ENVIRONMENTAL ASSESSMENT	DWN BY: TM CHK'D BY: GB DATE: June 2013
AMEC Environment and Infrastructure A Division of AMEC Americas Ltd. Suite 1 - 495 Prospect Street Fredericton, NB E3B 9M4 Tel. 506-458-1000 Fax 506-450-0829 www.amec.com	DATUM: PROJECTION: PROJECT NO: TV121039	TITLE: **MONTHLY WIND ROSE FOR MSC50 Node #8086**	REV. NO: FIGURE NO: 9.6-1

Path: G:\GIS\PROJECTS\TV121039_Phase3000\MXD\20130812_EA_FINALReport\20130814_MonthlyWind_Fig9_6_1.mxd User: tanya.morehouse Date: 14/08/2013

Annual Wind Rose for MSC50 node #8086





Annual Wave Rose for MSC50 node #8086

CLIENT: Pieridae Energy (Canada) Limited	SCALE:	PROJECT: ENVIRONMENTAL ASSESSMENT — GOLDBORO LNG	DWN BY: TM	DATE: June 2013
	DATUM:		CHK'D BY: GB	REV. NO:
AMEC Environment and Infrastructure A Division of AMEC Americas Ltd. Suite 1 - 495 Prospect Street Fredericton, NB E3B 9M4 Tel. 506-458-1000 Fax 506-450-0829 Web www.amec.com	PROJECTION:	TITLE: ANNUAL WIND AND WAVE ROSE FOR MSC50 Node #8086	SCALE:	FIGURE NO: 9.6-2
	PROJECT NO: TV121039			

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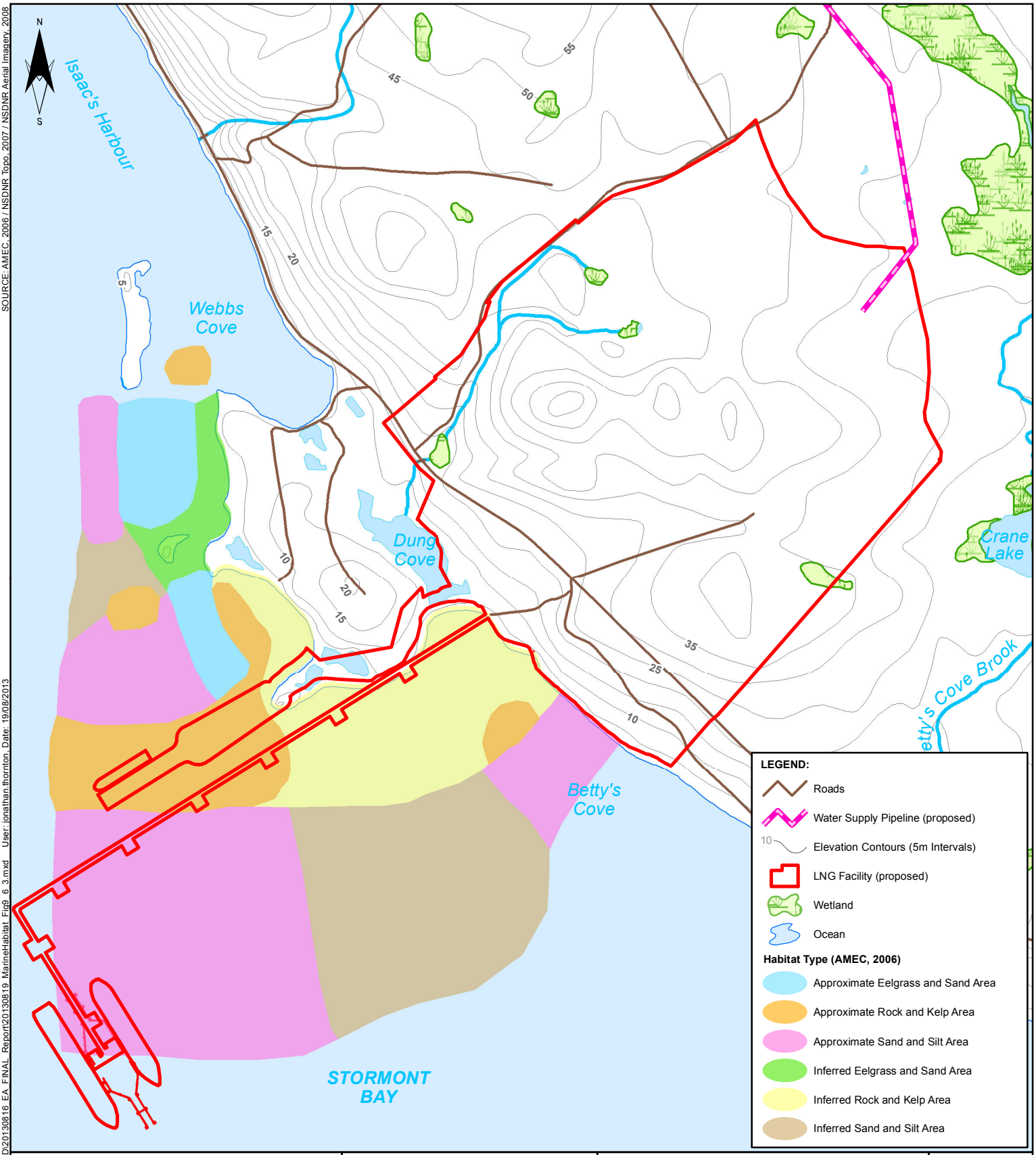
SOURCE: The MSC50 Wind and Wave Reanalysis, 2006



SOURCE: AMEC, 2006 / NSDNR Topo, 2007 / NSDNR Aerial Imagery, 2008

Path: G:\GIS\PROJECTS\TV121039_Phase3000\MXD\20130816_EA_FINAL_Report\20130819_MarineHabitat_Fig9_6_3.mxd User: jonathan.thornton, Date: 19/08/2013

CLIENT: Pieridae Energy (Canada) Limited	SCALE: 200 100 0 200 Metres 1:12,500	PROJECT: GOLDBORO LNG ENVIRONMENTAL ASSESSMENT	DWN BY: TM
			CHK'D BY: TM/BC
AMEC Environment and Infrastructure A Division of AMEC Americas Ltd. 50 Troop Avenue, Unit 300 Dartmouth, N.S., B3B 1Z1 (P) 902-468-2848 (F) 902-468-1314	DATUM: UTM Zone 20	TITLE: MARINE FISH HABITAT AT LNG FACILITY	DATE: Aug 2013
	PROJECTION: NAD83		REV. NO:
	PROJECT NO: TV121039		FIGURE NO: 9.6-3

9.7 Species at Risk (SAR)

Under the federal SARA, the COSEWIC determines whether a species is at risk. Following a period of public and stakeholder review, the Governor in Council may recommend to the Minister of Environment whether the species will be protected under SARA. SAR are those classified as Extirpated, Endangered, Threatened, or Special Concern in SARA Schedule 1. Once listed, measures for protection and recovery of the species are implemented. Under SARA (SARA section 32 and 33), prohibitions apply to species listed in Schedule 1 as Extirpated, Endangered, or Threatened, but not to species of Special Concern. Currently, there are 42 species listed under SARA (Schedule 1) for NS.

On the provincial level, species listed as Endangered, Threatened, or Vulnerable under the NSESA are also considered to be SAR. Since the amendment to the list of protected species in July 2013, there are 52 species listed under NSESA. Other organizations apply their own criteria to species thought possibly to be threatened by human activity. These include species which are designated Red (at risk) or Yellow (sensitive) by NSDNR, listed in the General Status of Wild Species in NS, as well as species ranked S1 (extremely rare), S2 (rare) or S3 (uncommon) by the ACCDC. These species are considered to be SOCC. In addition, wildlife is also protected under the NSWA, such as raptors, and enjoy a special status.

Since the completion of the Keltic Project EA (AMEC, 2006), numerous species have been added to the species listed under federal and provincial Endangered Species legislation, as well as to lists of species which are of conservation concern. SAR and SOCC can be found in numerous taxonomic groups, including lichens, vascular plants, molluscs, odonates, butterflies, fish, amphibians, reptiles, mammals, and birds. Data provided for a 100 km radius around Goldboro by ACCDC (Appendix K (K-1)) indicated the potential for presence of a number of SAR and numerous SOCC (ACCDC, 2012)(Appendices ; Appendix D-1, D-2, D-3, D-4, G and H) though few have actually been observed in the Project area (AMEC, 2006 and AMEC, 2012). Data requests to the NSMNH resulted in nine records for rare animals, and three records of rare plants in the area near the Goldboro LNG facilities (see below) (NSMNH, 2013) (Appendix K-2).

Descriptions of the ranking systems used by COSEWIC, SARA, NSESA, the NSDNR General Status Ranks of Wild Species in NS, and the ACCDC databases are provided in Appendix K-3.

Wild species listed as SAR in NS by SARA, COSEWIC, NSESA, and/or are listed in the NSDNR General Status Report as Red or Yellow are summarized by taxonomic group in a "Priority Species List" (Step 1, NSE, 2009b). In order to determine the potential for occurrence of these species in the Project area, a two step evaluation process according to NSE (2009b) including habitat modelling was carried out as described below.

Evaluation Process - Distribution

Priority species were evaluated concerning their presence in the broad geographic area of the proposed Project (Step 2, NSE, 2009b), using information on previously recorded sightings obtained from COSEWIC, NSDNR, NSMNH, ACCDC, and SigHab databases. Sources also included previously completed reports that summarized published and unpublished listings of

occurrences of rare species and distribution maps from a variety of literary sources such as the Roland's Flora of Nova Scotia (Zinck, 1998). Data received from ACCDC for a 100 km radius is provided in Appendix K-1, and data received from the NSMNH for the area of the Goldboro LNG plant in Appendix K-2.

All data was then used to compile a Short List of Priority Species that occur in the general geographical area of the Project, i.e., Eastern NS (Appendix K-4 (Tables K-4.1 and K-4.2)). Those species that did not have distribution in the area were excluded from the short list.

Evaluation Process - Habitat

The species listed in the Short List of Priority Species were then reviewed with respect to their habitat requirements (Step 3, NSE, 2009b). Those species which exist in, or frequent habitats found within the Project footprint or immediate surrounding areas, were summarized by taxonomic group as "species with potential to be present at the Project site" (see below). Subsequently, suitable habitat was scanned for indications of the presence of these Priority species during field surveys as indicated below. Results of the Priority species evaluation process are provided in the following sections.

It should be noted that it is possible that other species of concern exist within the area without previously recorded sightings. Therefore, the potential presence of other Priority species with habitat requirements met by habitat available within the Project area was considered during field surveys.

9.7.1 Terrestrial Species of Conservation Concern (SOCC)

9.7.1.1 Vascular Plant SOCC

A total of 279 species, subspecies and varieties of vascular plants are considered to be SAR in NS (i.e., listed under SARA, COSEWIC (2013) or the NSESA), or are listed as SOCC (i.e., ranked RED or Yellow in the NSDNR General Status of Wildlife in NS (NSDNR, 2013d). For definitions of the conservation rankings see Appendix K-3.

A short-list of Priority Flora Species (SARA, COSEWIC, NSESA, and NSDNR General Status of Wildlife in NS) was assembled based on known geographic distribution of Priority Species in the geographic region around the Project area, using data received from ACCDC and the NSMNH and distribution maps in Zinck (1998). The NSDNR SigHab database does not contain information on vascular plant and lichen SAR and SOCC within NS any longer (NSDNR, 2012c). The table listing the vascular plant species along with their habitat requirements is provided in Appendix K-4 (Table K-4.1).

It should be noted that Tall Beakrush (*Rhynchospora macrotsachya*) is considered as a candidate to be added to the COSEWIC list. According to the ACCDC (Appendix K-1) this is considered to be an S1 species. Habitat for this species is wet sand and peat, along the shores of ponds, lakes, streams and marshes (Crow and Hellquist, 2000). Although this habitat is present at the site, it is unlikely to find this species present since it was not observed during the initial field survey nor by ACCDC for a radius of 100 km around the Project site.

A total of 174 vascular plant Priority Species, subspecies and varieties were identified for the region, eastern NS (Step 2, NSE (2009b)) (Appendix K-4, Table K-4.1). ACCDC provided 543 records of 183 vascular plant species, subspecies and varieties considered to be at risk by NSDNR or of conservation concern by ACCDC, for a radius of 100 km around the Project site (Appendix K-1).

The NSMNH provided records of three vascular plant SOCC for the area around the Project footprint: Newfoundland Dwarf Birch (*Betula michauxii*, NSDNR Yellow), Slender Cottongrass (*Eriophorum gracile*, NSDNR Yellow), and Northern Burreed (*Sparganium hyperboreum*, NSDNR Yellow) (Appendix K-2). All plant records provided by NSMNH were also provided by ACCDC.

Flora Species of Special Status with the Potential to Occur at the Project Area

Habitat modelling was applied in order to estimate the potential for the presence of 174 short-listed vascular plants in the Project footprint or immediate surrounding areas (Step 3, NSE (2009b); see Appendix K-4, Table K-4.1). Based on information in Zinck (1998) and Hinds (2000), habitat is available for about half of the short- listed vascular plant species: 91 Priority vascular plant species contained in the Short list of Priority Species have potential to occur in the Project area based on their habitat requirements.

Due to the large number of Priority species known to occur in the region, not all plants can be discussed in detail. Habitat requirements for Priority species recorded by ACCDC within 20 km radius around the Project footprint, and Priority species listed by the NSMNH occurring around the Project area (without distance) will be discussed below, as these species are closest to the Project site and thus likely have high potential to occur in the Project area (Table 9.7-1). Habitat requirements for the remaining species, based on information in Zinck (1998) and Hinds (2000), and their potential for presence at the site, are included in Appendix K-4, Table K-4.1.

Table 9.7-1 Priority Vascular Plant Species Potentially Present on/near the Project Site

Scientific Name	Common Name	NSDNR Status	ACCDC Rank	Habitat
Betula michauxii	Newfoundland Dwarf Birch	YELLOW	S2	Peat and sphagnous bogs.
Botrychium simplex	Least Grape-Fern	YELLOW	S2S3	Lakeshores, or mossy edges of streams or waterfalls.
Carex tenuiflora	Sparse-Flowered Sedge	RED	S1	Wet woods and bogs.
Eriophorum gracile	Slender Cotton-Grass	YELLOW	S2	Wet peat and inundated shores.
Senecio pseudoarnica	Seabeach Groundsel	YELLOW	S2	Gravelly seashores.
Sparganium hyperboreum	Northern Bur-Reed	YELLOW	S1S2	Peaty pools.
Vallisneria americana[1]	Tape Grass	RED	S2	Quiet waters.

Note:
1. Tape Grass was not noted in the ACCDC request (ACCDC, 2012; Appendix K-1) but was observed on site.

While there is suitable habitat for a number of plant SOCC, few were found during the field surveys.

Flora Species of Special Status Known to Occur at the Project Area

Field surveys of a variety of habitats in the Project area were carried out in 2004 and 2005 in order to identify vascular plant SOCC and SAR with early and late phenology (AMEC, 2006). A vascular plant inventory based on those surveys amended by current (2013) conservation ranks is provided in (Appendix D-2). During the field survey only two vascular plant SOCC were found (Table 9.7-2). Both species were found during the Meadow Lake survey. In addition, Tape Grass was also found in Dung Cove Pond. Surveys of the water pipeline ROW were apparently not carried out at that time (AMEC, 2006). However, surveys were conducted for the M&NP Mainline which runs immediately adjacent to the water supply line for most of the distance.

Confirmatory vascular plant SAR surveys of the Project area (LNG facility, Meadow Lake and ROW) were carried out in June 2013. No additional vascular plant SAR/ SOCC were detected. Methods and results are provided in Appendix D-3.

Table 9.7-2 List of Flora Species of Special Status Surveyed known to occur on site

Species Name	Common Name	NSDNR Status	ACCDC Status	Habitat
Rubus flagellaris	Northern Dewberry	UNDETERMINED	S1?	Dry fields, forest openings, and the borders of thickets
Vallisneria americana	Tape Grass	RED	S2	Quiet waters

As discussed in Section 9.4.1, during the vegetation surveys for the Keltic Project EA, Variegated Scouring Rush was listed as the only rare vascular plant species detected in the Project area (AMEC, 2006). Since then this species has been downgraded and is now ranked Green (Secure) by NSDNR (NSDNR, 2013d), but it is still of limited conservation concern for ACCDC (ranked S3). During habitat surveys of the LNG site in September 2012, hundreds of Variegated Scouring Rush shoots were found in Wetland 3 (Section 9.4.1.1; Appendix D-1).

Also, please note that that Northern Commandra, which is given a Yellow status in NS, (Pronych and Wilson, 1993) is purported to be in the general area, but was not observed during the study (AMEC, 2006). ACCDC has records for Northern Commandra for a distance of about 51 km from the Goldboro LNG site (ACCDC, 2012; Appendix K-1).

9.7.1.2 Lichen (Non-vascular Plant) SOCC

A total of 31 species of lichens are considered to be SARA (i.e., listed under SARA, COSEWIC (2013) or the NSESA), or listed as SOCC (i.e., ranked Red or Yellow in the NSDNR General Status of Wildlife in NS (NSDNR, 2013d)). For definitions of the conservation rankings see Appendix K-3. It should be noted that *Sticta limbata* and *Pannaria lurida* (NSDNR Red) are in Group 1- high priority candidates in COSEWIC's Candidate species list (COSEWIC, 2013).

A short-list of Priority Species was assembled based on known occurrences of Priority Species in the geographic region, using data received from ACCDC and the NSMNH and professional knowledge (Step 2, NSE, 2009b), Lichens are not listed in the NSDNR SigHab database (NSDNR, 2012c). The table listing the 29 lichen species with potential to occur in eastern NS, along with their habitat requirements is provided in Appendix K-4 (Table K-4.1). Two Priority species, *Leptogium dactylinum* and *Solorina saccata* are not known to occur in eastern NS and are not included in the table. While *Sclerophora peronella* is unlikely to occur in the Project area because its known distribution is limited to Cape Breton Highlands National Park, it was retained in the short-list using a precautionary principle, though this is outside of the 100 km radius applied by ACCDC.

ACCDC provided 59 records for 10 species of lichens considered to be at risk by NSDNR, NSESA, SARA or COSEWIC, or of conservation concern by ACCDC, for a radius of 100 km around the Project site (ACCDC, 2012, Appendix K-1). The NSMNH does not have records for rare lichens in the Project area (NSMNH, 2013; Appendix K-2).

Lichen Species of Special Status with the Potential to Occur in the Project footprint

Of the 29 lichen Priority Species identified for the region (Step 2), all but one has the potential to occur on site (Step 3, NSE, 2009b) based on their habitat requirements. Frosted Glass Whiskers (*Sclerophora peronella*) grows on exposed heartwood of Red Maple trees in mature/old growth forest in Cape Breton and therefore is unlikely to occur in the Project area. The lichen Priority species encompass ground-dwelling (terricolous), rock-dwelling (saxicolous) and tree-dwelling (arboreal) lichens, with one species occurring in freshwater.

In addition to the species contained in the Priority species list, NSDNR General Status lists 15 species of lichens as ”undetermined”, (NSDNR, 2013d). These species have the potential to be ranked as Priority Species once sufficient data are available to allow for the assignment of ranks. A comparison with the rankings in the General Status of Species in Canada (NGSWG, 2013) for NS (updated in 2010), indicates that five of these species may potentially be ranked “Red” or “Yellow” by NSDNR. The remaining 10 species will likely be considered to be Secure: *Psoroma hypnorum, Massalongia carnosa and Nephroma resupinatum* are ranked “Maybe at risk”, and *Collema leptaleum and Peltigera collina* are ranked “Sensitive” (NGSWG, 2013). These species could potentially be present in the Project area. The General Status of Species in Canada lists one species as “at risk” in NS (*Erioderma pedicellatum*, Boreal Felt Lichen (BLF)), 27 species “May Be at Risk” and 37 species as “Sensitive” (NGSWG, 2013). It should be noted that only 27 of these species are currently a Priority species in the sense of NSE (2009b).

Of the 28 remaining lichen Priority Species, two species, BFL (SARA, COSEWIC and NSESA Endangered, NSDNR Red, ACCDC S1S2, NGSWG At Risk) and Blue Felt lichen (*Degelia plumbea*, COSEWIC Special Concern, NSESA Vulnerable, NSDNR Yellow, ACCDC S2; NGSWG Secure) are considered most likely to occur in the general area, because ACCDC has records of 37 observation in 8 km distance and ten observation in 7 km distance, respectively (ACCDC, 2012, Appendix K-1).

Boreal Felt Lichen (BFL)

This lichen grows on bark of mature Balsam Fir trees in cool, humid habitat. Wet coniferous forests, usually in or near wetlands, on north to east facing slopes near the coast are preferred (Cameron and Neily, 2008). NSE Protect Areas Branch has prepared predictive maps indicating polygons of potential BFL habitat in NS based on a heuristic model (NSE, 2008). The maps indicate that there is no potential BFL habitat within the footprint of the LNG facility. However, there are several large and small polygons of potential BFL habitat within a 5 km radius of the Project site (Figure 9.7-1). One polygon of high suitability (Category 1) habitat is located about 500 m northeast of the LNG facility and more than 250 m east of the water pipeline near the SOEI gas plant. There is no potential BFL habitat at the south end of Meadow Lake, but two polygons of Category 2 (medium) and two polygons of Category 3 (low suitability) habitat are located near the water pipeline ROW where it runs parallel to the M&NP gas pipeline (Figure 9.7-2).

Lichen Species of Special Status Known to Occur at the Site

There are no known occurrences of rare lichen species, including BFL, in the Project footprint.

A lichen survey of the LNG facility and wharf site was carried out in September 2012 targeting all lichen SAR or SOCC in all potential habitats. In addition, indicator species and any cyanolichens were of interest and were included in the surveys, as their habitat requirements are similar to the habitat requirements of the Priority species as indicated in Appendix K-4. Survey methods and photos are provided in Appendix D-1. No rare lichen species were found in the LNG facility footprint, though numerous thalli of lungworts (*Lobaria pulmonaria* and *Lobaria scrobiculata*) occurred on some hardwood trees. Much of the observed forest habitat is likely not conducive to the presence of rare lichen species due to the disturbance history (Appendix D-1).

In addition to looking for BFL directly, the available habitat was evaluated concerning suitability as habitat for the BFL. While Balsam Fir, the dominant forest trees species, is generally a suitable host species for BFL, the microclimatic conditions required by this species apparently was not met at the LNG facility. Wet forests on north to east facing slopes were not encountered. The southern edge of Wetland 1 is located at the bottom of a low slope, but forests dried up quickly with distance from this and other wetland, and no BFL was found (Appendix D-1). A section of the margin of the above mentioned polygon of potential BFL habitat of intermediate suitability (Category 2) located near the eastern corner of the LNG facility (Figure 9.7.1) appeared to have been cleared for the SOEI pipeline ROW.

Previously, a lichen survey was conducted as part of the MapleLNG Project monitoring program in 2007 (Jacques Whitford, 2007b). Surveys were concentrated in areas determined to have a high potential for BFL on and around the MapleLNG site (including adjacent Keltic property). These surveys also included the above mentioned polygon of Category 2 BFL habitat located nearest to the LNG facility (i.e., approximately 150 m east of the eastern corner of the current LNG facility). These surveys did not include habitat near the Meadow Lake shoreline, and covered only sections of the water pipeline ROW, since the surveys focused on BFL habitat.

Neither BFL species, nor suitable habitat was identified. In addition, an investigation of these stands failed to identify any indicator cyanolichen species or the liverwort, *Frullania tamarisci*. The report concluded that no further lichen monitoring was warranted due to the lack of habitat at the property.

Supplementary confirmatory rare lichen surveys were carried out in the ROW and near Meadow Lake in June 2013. No lichen Priority species were detected (Appendix D-3).

9.7.1.3 Bird SOCC

A total of 33 species of birds are at risk in NS under SARA, COSEWIC, NSESA, or listed as SOCC ranked Red or Yellow in the NSDNR General Status of Wildlife in NS (NSDNR, 2013d). All of these were included in the initial Fauna Priority Species List. For definitions of the conservation rankings see Appendix K-3. In addition, all raptors are protected under the NSWA. While a number of the Priority species have not been recorded in eastern NS, there is potential for many of the Priority species to be found in the Project area based on available habitat, either as breeding birds or during migration. A list of bird species that have potential to occur in the Project area based on habitat requirements and distribution is provided in Table 9.7-3.

Table 9.7-3 Priority Avian Species at Potentially Present within the Project Area

Scientific Name	Common Name	COSEWIC	NS General Status	*NS Endangered Species Act*
Asio flammeus	Short-eared Owl	Special Concern	Yellow	--
Bucephala islandica princeps (Eastern pop.)	Barrow's Goldeneye	Special Concern	Yellow	--
Calidris maritima	Purple Sandpiper	--	Yellow	--
Chordeiles minor	Common Nighthawk	Threatened	Yellow	Threatened
Contopus cooperi	Olive-sided Flycatcher	Threatened	Yellow	Threatened
Euphagus carolinus	Rusty Blackbird	Endangered	Yellow	Endangered
Gavia immer	Common Loon	Not At Risk	Yellow	--
Hirundo rustica	Barn Swallow	Endangered	Yellow	Endangered
Histrionicus histrionicus pop. 1	Harlequin Duck	Endangered	Yellow	Endangered
Parus hudsonicus (syn. Poecile hudsonicus)	Boreal Chickadee	--	Yellow	--
Passerculus sandwichensis ssp. principes	Ipswich Sparrow (Savannah Sparrow)	Special Concern	Yellow	--
Perisoreus canadensis	Gray Jay	--	Yellow	--
Pooecetes gramineus	Vesper Sparrow	--	Yellow	--
Sialia sialis	Eastern Bluebird	Not At Risk	Yellow	--
Sterna dougallii	Roseate Tern	Endangered	Red	Endangered
Sterna hirundo	Common Tern	Not At Risk	Yellow	--
Sterna paradisaea	Arctic Tern	--	Yellow	--
Wilsonia canadensis	Canada Warbler	Threatened	Yellow	--

Although habitat may be available to these species, many have no suitable breeding or nesting habitat within the Project area; nonetheless, individuals may potentially migrate through or over-winter in the area.

Records of bird SAR and SOCC in the Project area were obtained from field surveys conducted in 2004, 2005, 2008, and 2013 and from existing databases. Data were obtained from the Maritimes Breeding Bird Atlas, and the NatureCounts database was consulted for additional information sightings on rare and colonial species. The NSMNH provided information on records of Priority species within the Project footprint and surrounding area in a letter dated 30 April 2013, and ACCDC results for Priority species within a 100 km buffer around the Project area were obtained on 14 September 2012. Records of wintering waterfowl and seabird colonies were obtained from CWS.

All Priority species that were recorded in the general Project area are shown in Table 9.7-4, along with a description of nesting habitat and potential for breeding within the Project area. Based on available habitat, these species are likely to be seen within the Project area at some time during the year. Appropriate nesting habitat is not available for terns, which typically nest on offshore islands, but Common and Arctic Terns have been observed foraging offshore; telemetry studies on foraging Roseate Terns (Bird Studies Canada, 2009) indicated that they seldom occur in the Project area, but they were observed during field surveys for the Keltic Project and it is possible that they may occur. Purple Sandpipers breed in the Arctic, but may be seen during the winter months feeding on rocky beaches. Harlequin Ducks require fast-flowing rivers for breeding, and have not been reported to breed as far south as the Maritimes; however, they may feed offshore in the winter months. Potential breeding habitat exists in the Project area for the Rusty Blackbird, Eastern Bluebird, Ipswich Sparrow and Vesper Sparrow. Evidence of breeding in the Project area was recorded for the Short-eared Owl, Common Nighthawk, Olive-sided Flycatcher, Common Loon, Barn Swallow, Boreal Chickadee, Grey Jay and Canada Warbler.

Table 9.7-4 Priority Avian Species Recorded in the General Project Area, Including Nesting Habitat Preferences and Potential for Occurrence on Project Site

Scientific Name	Common Name	Habitat	Potential Nesting Habitat in Project Area	Recorded During
Asio flammeus	Short-eared Owl	Nests are slight depression in the ground, or cups of dried weeds or flattened grasses. Often hidden under low shrubs, reeds, and grasses near water. Prefers extensive stretches of relatively open habitat such as marshland or deep grass fields.	Yes	AMEC Field surveys; MBBA data; ACCDC report
Calidris maritima	Purple Sandpiper	Coastal environments in Arctic.	No	ACBC; ACCDC
Chordeiles minor	Common Nighthawk	Prefer clearings and barren outcrop areas in forested land, wastelands.	Yes	Field Survey; ACCDC; MBBA
Contopus cooperi	Olive-sided Flycatcher	Along forest edges and openings with tall snags for foraging and singing. Nests generally well out toward tip of horizontal branch in coniferous tree.	Yes	AMEC Field Survey*; ACCDC; MBBA

Scientific Name	Common Name	Habitat	Potential Nesting Habitat in Project Area	Recorded During
Euphagus carolinus	Rusty Blackbird	Frequents cool habitats in spruce bogs, swamps, and damp alder swales.	Yes	ACCDC
Gavia immer	Common Loon	Prefers lakes larger than 24 ha with clear water, an abundance of small fish, numerous small islands, and an irregular shoreline. Ground-nesting; prefers to nest on islands.	Yes	Field Survey*; ACCDC; ACBC; MBBA
Hirundo rustica	Barn Swallow	Open areas (fields, meadows) for foraging. Mud nest fastened to a vertical wall or ledge underneath an overhang.	Yes	Field Survey; ACCDC; MBBA
Histrionicus histrionicus pop. 1	Harlequin Duck	Nests built on ground on islands or banks of fast-flowing streams. Favour marine environments, but move inland to breed. In winter, occurs along headlands where surf breaks against rocks. Feed close to rocky shorelines or skerries.	No	ACBC; ACCDC
Parus hudsonicus (syn. Poecile hudsonicus)	Boreal Chickadee	Coniferous areas, bogs, swamps.	Yes	Field Survey*; ACCDC; ACBC; MBBA
Passerculus sandwichensis ssp. principes	Ipswich Sparrow (Savannah Sparrow)	Nests of grass and vegetation built on hollows scratched in ground under shelter of shrub, small tree or tussock of grass. Nest in heath-dominated terrain in dense grass on coastal dunes and upper beaches. Prefer outer dune beaches with good grass.	Unlikely	ACCDC
Perisoreus canadensis	Gray Jay	Favours coniferous forests.	Yes	Field Survey*; ACBC; ACCDC
Pooecetes gramineus	Vesper Sparrow	Short grass or low shrubs, such as pastures, blueberry fields, and clearings.	Yes	ACCDC
Sialia sialis	Eastern Bluebird	Clear cut areas amid forests.	Yes	ACCDC
Sterna dougallii	Roseate Tern	Nest on small offshore islands and inlets.	No, but nesting on Country Island	Field Surveys; ACCDC; CWS
Sterna hirundo	Common Tern	Coastal areas and lakes in Southwest NS.	Unlikely	Field Survey*; ACBC; ACCDC
Sterna paradisaea	Arctic Tern	Islands facing the open sea.	Unlikely	Field Survey; ACBC; ACCDC
Wilsonia canadensis	Canada Warbler	Wet, swampy places in woods of mixed growth.	Yes	Field Survey; MBBA; ACCDC

Notes:
MBBA = 2nd Maritime Breeding Bird Atlas (2006 - 2010)
ACBC = Audubon Christmas Bird Count for Sheet Harbour (National Audubon Society, 2013).
CWS = Personal communications with CWS staff (2013) including: R. Gautreau, A. Hicks, S. Wilhelm, K. Potter.
* Field Survey July 2013

Landbird Species of Special Status (Including Raptors and Passerines) Occurring in the Project Area

Breeding evidence has been recorded in the Project area for the Short-eared Owl, Common Nighthawk, Olive-sided Flycatcher, Barn Swallow, Boreal Chickadee, Grey Jay and Canada Warbler (AMEC, 2006; Appendix D (AMEC Survey 2013), and ACCDC, 2012). Potential breeding habitat exists in the Project area for an additional five landbird species of special status that were not directly observed: the Northern Goshawk, Rusty Blackbird, Eastern Bluebird, Ipswich Sparrow and Vesper Sparrow (Table 9.7-4). During the Keltic Project surveys, a pair of Short-eared Owls was observed in low shrub habitat, and a pair of Grey Jays was seen in immature mixed forest. Boreal Chickadees were seen in mature conifer forest, as well as mature and immature mixed forest. During the July 2013 field surveys, targeted surveys that incorporated playback of vocalizations in areas of suitable habitat for certain species was used to detect SAR in the Project area. Just one federally-listed avian SAR, the Olive-sided Flycatcher, was detected along the pipeline route near Goldbrook Road without the use of playback. Boreal Chickadee and Gray Jay were both observed in the Project area (Appendix D-4).

Owls and raptors are protected under the NSWA. In addition to the Northern Goshawk and Short-eared Owl, breeding evidence was reported for a number of owl and diurnal raptor species during field surveys for the Keltic Project and/or in the MBBA square in which the Project area is situated: Long-eared Owl, Boreal Owl, Bald Eagle, Osprey, Broad-winged Hawk and Merlin. Of these, only the Osprey has been confirmed as breeding in the Project area; the rest are considered possibly or probably breeding. During the April 2013 survey effort, an adult Osprey was observed occupying a nest near the Sable plant site.

Other species of special status that were observed flying over the Project area during the field surveys with no breeding evidence include American Kestrel, Red-tailed Hawk, Sharp-shinned Hawk and Northern Harrier (Appendix H, Table H-4). Suitable breeding habitat exists in the Project area for all of these species.

Shorebird Species of Special Status Occurring in the Project Area

One shorebird SOCC, the Purple Sandpiper, has been reported by both ACCDC and in the ACBC in nearby Sheet Harbour. Purple Sandpipers breed in the Arctic; however, in the winter months, this species feeds on invertebrates along rocky shorelines throughout the province, and may be found on the coastline at Red Head.

Waterfowl and Seabird Species of Special Status Occurring in the Project Area

One waterbird SOCC, the Common Loon, has potential to breed in freshwater lakes and ponds in the Project area. During the surveys for the Keltic Project and the April and July 2013 field program, Common Loons were observed in open water, in both freshwater and marine environments.

Common Tern, Arctic Tern and Roseate Tern all breed on coastal islands, including Country Island, a major colony located within 10 km of the Project area. All three species have been observed in the marine waters off the site during surveys for the Keltic Project in 2004 and 2005. Roseate Tern is a SAR listed by both SARA and NSESA. Between 18 and 53 pairs of Roseate Terns per year have been reported nesting on Country Island since surveys at this colony began in 1996 (Rock and Shervill, 2012). While they do not breed in the immediate Project area, there is potential for Roseate Terns to forage in the area. A Roseate Tern Foraging Survey was conducted, and results are depicted in Figure 9.7-3 (AMEC, 2006). Roseate Tern follow-up surveys conducted in 2008 (Bird Studies Canada, 2009) indicate little or no presence at the Project site, and generally confirmed previous radio-telemetry studies.

No species of special status as listed by SARA, COSEWIC, NSESA or NSDNR were identified during the CWS winter waterfowl surveys. However, it is possible that some of the unidentified goldeneye that were reported are Barrow's Goldeneye, which winter in small numbers off the coast of NS. The Common and Barrow's Goldeneye are very similar in appearance, and mixed flocks of the two species are known to occur.

The landbird species of special status potentially occurring at Meadow Lake are largely the same species listed for the LNG site, although Barn Swallow, Eastern Bluebird and Ipswich Sparrow are considered unlikely based on available habitat. None were observed in July 2013 (Appendix D-4).

Common Loon is the only waterbird species considered to have potential to nest at Meadow Lake, and in fact, they were observed breeding during surveys for the Keltic Project. Terns may occasionally forage in the lake, but are not likely to breed there. No suitable feeding habitat for the Purple Sandpiper or Barrow's Goldeneye occurs at Meadow Lake.

9.7.1.4 Mammal SOCC

A total of 11 terrestrial mammalian SAR, are listed by SARA, COSEWIC, NSESA, and NSDNR in NS, of which four have potential to occur at the Project site based on known distributions and habitat preferences. (Appendix K-4). ACCDC (2012) had records for four mammal species occurring within 100 km of the Project area: Canadian Lynx, Eastern Cougar, Moose, and Little Brown Bat (Appendix K-1).

In NS, a breeding population of Canadian Lynx is found only in Cape Breton. Therefore, Canadian Lynx is considered highly unlikely to occur in the Project area, and is not included in the assessment of habitat requirements. While there have been many reports of Eastern Cougar in NS in several decades, there has been no conclusive evidence of this species, and NSDNR lists it as Undetermined. This species is also considered unlikely to occur in the Project area.

The NSMNH does not have any records of mammal species of concern in the general Project area (NSMNH, 2013). Data provided by ACCDC (2012) showed no records of mammal SAR or SOCC occurring within a 10 km radius of the Project area, , but records did exist for within a 100 km radius.

Although not reported by ACCDC or the NSMNH for the area, based on its habitat preferences and reported range in the province, the Fisher (*Martes pennanti*, NSDNR Yellow) is also considered possible to occur in the region. Fishers occur in mixed and coniferous forests, typically in proximity to watercourses (Banfield, 1977). Their diet consists primarily of small mammals, and they are one of the few natural predators of porcupines. No sign of Fisher was observed during surveys for the Keltic Project or in the April 2013 survey effort, although because there is suitable Fisher habitat within the Project area, it is considered possible.

Mammal SOCC occurring in the Meadow Lake area are expected to be similar to those known or expected on the main Project site. One known exception is the Little Brown Myotis, which tends to forage over water (Broders *et al*., 2004) and so may utilize habitats around Meadow Lake for feeding purposes more so than the main Project site. Moose may also utilize the wetland habitats around Meadow Lake and may occur more frequently in this area than on the main Project site.

The mammal species of concern potentially occurring on the Project site, Meadow Lake, and the pipeline route, are discussed in the following subsections.

Moose

As only very low numbers of Moose occur in Eastern mainland NS, many of the Moose sightings recorded within the 100 km radius are likely from the large Cape Breton population (Parker, 2003). Only the mainland population of Moose is listed as Endangered by NSESA. Nonetheless, this species was retained in the shortlist and is subjected to the review of habitat requirements.

Moose inhabit second-growth forest, openings, swamps, lakes and wetlands (NatureServe, 2013), and suitable Moose habitat occurs within the Project area. Field surveys for mainland Moose conducted in late April of 2013 showed some use of the survey area by Moose, with tracks and scat observed in a few scattered locations to the west and northeast of the Project area (Figure 9.7-4). Therefore, this species is considered to have potential for presence within the Project site.

Surveys were conducted by AMEC personnel, accompanied by a First Nations hunter experienced in tracking Moose and other wildlife, in late April of 2013 to detect the endangered mainland population of Moose. A total distance of 9.6 km was surveyed on foot over two days, with the survey effort focussed primarily on areas of suitable Moose habitat. Figure 9.7-4 shows the transects that were surveyed. As well, any observed evidence of Moose presence was recorded during additional field surveys for potential bat hibernacula (below). Moose scat was observed in a cleared area west of the Project area, and a single fairly recent Moose track was observed on the shoulder of the Sable site road. Older Moose track and likely Moose browse was found to the northeast of the Project area (Figure 9.7-4). Abundant deer, Porcupine and Snowshoe Hare sign were observed throughout the survey area. Moose are reported to concentrate in the bogs just south of Ocean Lake (pers. comm., NSDNR, cited in AMEC, 2006), although no sign of Moose, tracks, or droppings was observed during surveys from the air

during summer and winter, and at ground level during summer for the Keltic Project (AMEC, 2006). A single Moose was reported by a local resident to have been seen near the mouth of New Harbour River during the late fall of 2004.

Fisher (*Martes pennanti*)

Fishers are listed as Yellow by NSDNR. Although not reported by ACCDC for the area, a small numbers of fishers were captured by fur harvesters in Guysborough County in 2011-2012. Fishers, though not abundant, are widespread in the province and occur in mixed and coniferous forests, typically in proximity to watercourses (Banfield, 1974). Their diet consists primarily of small mammals, and they are one of the few natural predators of porcupines.

No sign of fisher was observed during surveys for the Keltic Project or in the April 2013 survey effort. However, because there is suitable fisher habitat and abundant food (including porcupine) within the Project area, its presence is considered possible.

Bats

There are two bat species at risk potentially occurring in the Project area, the Little Brown Bat (*Myotis lucifugus*) and the Northern Long-eared Bat (*Myotis septontrionalis*). Both *Myotis* species have also recently been listed as Endangered under the NSESA. They are now ranked Endangered by COSEWIC and may soon be listed under SARA (Elderkin, M., pers. comm., April 2013). These species are discussed in detail in the following paragraphs. Other bat species may occasionally utilize habitats on and near the Project site, but are not expected to occur regularly. Note that while the 2006 Keltic Project EA document (AMEC, 2006) states that habitat for Red Bats (*Lasiurus borealis*) and Hoary Bats (*Lasiurus cinereus*) occurs on the Project site, this is likely very marginal, as these species are considered to be at, or likely beyond, the northern edge of their range in NS (Broders *et al.*, 2004).

The colonial hibernation behaviour of many bat species results in a high level of vulnerability during the winter months. While bats may arouse naturally and move around within their hibernaculum (Tuttle, 1991), unintentional arousals during hibernation (such as being disturbed by humans entering their hibernaculum) can cause bats to rapidly deplete their stored fat reserves, eventually leading to starvation (Thomas, 1995). A small number of visits to a winter hibernaculum of colonial species can have serious effects on the bat population utilizing that hibernaculum. Though often considered to be simply “flying mice”, bats are much longer-lived (up to 35 years) and have much lower reproductive rates (a single offspring per year or so for many species) than mice. This long lifespan and low fecundity results in even small population impacts having long-term repercussions for bat populations.

A dramatic example of this vulnerability is the current white-nose syndrome (WNS) situation in northeastern North America. This recently discovered condition is caused by a fungus, *Geomyces destructans*, which thrives in cold cave conditions and therefore affects bats during hibernation (Blehert, 2012; Lorch *et al.*, 2011). The condition, named for a distinctive fungal growth around the muzzles and on the wings of affected bats, causes them to wake more frequently during hibernation and deplete their fuel and/or water stores (Reeder *et al*., 2012, Cryan *et al.*, 2010). WNS was first identified in a cave in New York, US, in February 2006

(Blehert *et al.*, 2008), and has since spread to five provinces (Ontario, Quebec, NS, NB, and PEI) and 21 states as of March 25, 2013. It has contributed to the deaths of over 5.5 million bats in the northeastern US (US Fish & Wildlife Service, 2012), and has decimated populations in NB (Canadian Broadcasting Company (CBC) News, 2012).

Little Brown Bat

The Little Brown Bat is a small species which is probably the most common bat species in North America, ranging from Alaska to California (Barbour and Davis, 1969). While individuals migrate from summering to wintering areas, they are generally not considered long-distance migrants. They are considered the most abundant and widespread bat species in NS (Scott and Hebda, 2004; Broders *et al.,* 2004). This species has been shown to be seriously affected by WNS in other parts of its range and may be at risk of rapid extirpation in the Northeast US within 20 years, due to WNS mortality (Frick *et al.,* 2010). Of all the bat species affected by WNS in northeastern North America, the Little Brown Bat has experienced the greatest losses (Frick *et al.,* 2010). Due to the WNS threat, the ACCDC has recently changed this species' status from S4 (apparently secure with many occurrences, but of longer-term concern) to S1, meaning this species is extremely rare and may be especially vulnerable to extirpation. The Little Brown Bat was one of three bat species recently listed as Endangered in Canada by COSEWIC, under a rare emergency listing spurred on by the WNS issue (COSEWIC, 2012b). In July 2013 it was also listed as Endangered under the NSESA.

Throughout their range, Little Brown Bats are usually abundant in forested areas, and are often associated with human settlement. In summer, reproductive females may form nursery colonies containing hundreds, sometimes thousands of individuals in buildings, attics, and other man-made structures. Females generally give birth to single young. Males and non-reproductive females roost alone or in smaller groups and may be found in buildings, caves, trees, under rocks, behind shutters, in crevices, and under tree bark (Barbour and Davis, 1969; Fenton and Barclay, 1980).

In late summer, Little Brown Bats may travel hundreds of kilometres to swarm around caves and abandoned mines (Fenton and Barclay, 1980). Their hibernation sites tend to be extremely humid (>90%) and to maintain temperatures above-freezing (i.e., 1-5°C) (Fenton and Barclay, 1980). In NS, this species is known to hibernate in several caves or abandoned mine openings (AMOs) (Moseley, 2007a). Tuttle (1991) has reported that this species may arouse at intervals during hibernation to move about in response to temperature fluctuations. This behaviour has been observed among hibernating bats in a cave in Hants County, NS (Hebda, 2006 cited in Moseley, 2007a). Little Brown Bats have also been observed to use underground sites as summer roosts in NS (Moseley 2007b).

Northern Long-eared Bat

The Northern Long-eared Bat is a small non-migratory species which is widely distributed across North America, with a range from Newfoundland and the eastern US to coastal British Columbia (Barbour and Davis, 1969). Formerly listed as S2 (considered rare in the province) by ACCDC, they have recently been relisted as S1 (extremely rare and may be especially vulnerable to extirpation) due to WNS. It has been considered uncommon in NS, but is one of

three bat species considered to have significant populations in NS (Broders *et al.,* 2004). NSDNR lists them as Yellow, meaning they are sensitive to human or natural impacts. In the case of Northern Long-eared Bats, this is due to their vulnerability at winter hibernacula, when large numbers congregate to hibernate. This species has been shown to be affected by WNS in other parts of its range (Frick *et al.,* 2010.). The Northern Long-eared Bat was recently listed as Endangered in Canada due to WNS (COSEWIC, 2012c). In July 2013 it was also listed as Endangered under the NSESA.

The Northern Long-eared Bat is considered a forest-interior species (Broders *et al*., 2006; Caceres and Barclay, 2000; Henderson and Broders, 2008; Sasse and Pekins, 1996; Jung *et al*., 1999) and occurs in both hardwood and softwood forests (Foster and Kurta, 1999). Northern Long-eared Bats are known to forage under the forest canopy (Laval *et al.,* 1977; Broders *et al.,* 2006) often near vernal pools and forest streams (Brooks and Ford, 2005). They roost preferentially in deciduous trees (Sasse and Pekins, 1996; Menzel *et al.,* 2002; Carter and Feldhamer, 2005).

The Northern Long-eared Bat swarms around mines and caves in the fall, and hibernates in many of these same spaces, although not in large numbers. Northern Long-eared Bats are said to prefer cooler hibernation temperatures than Little Brown Bats (van Zyll de Jong, 1985). In NS, they are known to hibernate at most caves used by Little Brown Bats (Scott and Hebda 2004), where they often squeeze into small crevices within the cave. They often hibernate solitarily or in small clusters. They may be overlooked in hibernation caves due to their physical similarity to little brown bats and their tendency to squeeze into small crevices. Recent harp trapping studies at several hibernacula in NS have shown that this species often makes up a substantial proportion of bats trapped (Garroway, 2004). It is currently felt that this species may be more common than previously believed, perhaps in part because the Northern Long-eared Bat has lower intensity echolocation calls and is thus not recorded as well as the Little Brown Bat (Broders *et al.*, 2004; Miller and Treat, 1993).

Bat Habitat and Bat Presence on and Near the Project Site

The Project site provides much forested and wetland area which may be used as roosting and foraging habitat by Northern Long-eared and Little Brown Bats. As a result of the extensive underground mining history of the area, the Project site and adjacent lands include numerous AMOs, some of which may provide conditions suitable for bat hibernation and or roosting. A review of the Nova Scotia AMO Database (NSDNR, 2013e) indicates that over 30 AMOs are known to occur on the Project site itself, with another 60 openings within 1 km of the site boundaries (Figure 9.1-5). None of these mine openings correspond to caves which are known bat hibernacula (summarized by Moseley, 2007a and 2007b). The original depths of some of these openings were much greater than the current depths, but according to the records, the majority have been filled or sealed for public safety (NSDNR, 2013e). Many are also apparently flooded.

To obtain a better understanding of bats frequenting the area and the potential for bat hibernacula on or near the site AMEC conducted two surveys:

- AMO inventory and physical characterization; and
- Acoustic bat survey of AMOs.

AMO Inventory and Physical Characterization

A preliminary survey of the mine openings on and around the site was conducted in April 2013 (Appendix D-5). Discussions with Don McAlpine of the NB Museum, as well as previous consultation with Dr. Hugh Broders of Saint Mary's University (both well-respected bat experts), published literature, and the knowledge of the study team were utilized to determine factors possibly indicating suitability of a given opening as a bat hibernaculum.

In NB, bat caves supporting the greatest numbers of bats typically have little temperature variation, winter dark zone temperatures averaging 4 to 5° C, and minimum dark zone temperatures dropping to no less than 3.1° C (Vanderwolf *et al*., 2012). The dark zone is the area within the cave into which no light penetrates. Such caves typically have long (> 140 m) passages, lack running water, and have single entrances (Vanderwolf *et al*., 2012). Moseley (2007a) found that caves used for hibernation by bats in NS tend to have less constant temperatures in the dark zone due to relatively short passage length, presence of running water or air flow associated with multiple entrances. The cave supporting the largest known hibernating bat population in NS is over 365 m long, while other significant (50 to 100 individuals) and small (10 to 50 individuals) bat caves are in the 70 to 300 m range (Moseley, 2007b). Minor bat caves (10 individuals) range from 26 to 75 m in passage length (Moseley, 2007b).

A total of 75 known AMO locations within approximately 500 m of the Project site were visited by a pair of AMEC biologists in April 2013 (Appendix D-5). Each opening was characterized in terms of suitability as bat hibernacula. A general description of each mine opening was recorded, including data on approximate width, depth, water level, surrounding vegetation, general habitat of area, evidence of use by animals, elevation, and any other general comments. Each AMO was also photographed. All known mine openings within 500 m of the Project site are plotted on Figure 9.1-5. Note that the seven AMOs listed in the AMO database (NSDNR, 2013e) on Hurricane Island were not visited due to the low potential of these openings serving as suitable bat hibernacula, as well as logistical constraints. The AMEC biologist did not enter any of the openings, excepting those which were simply shallow surface depressions, to minimize potential transfer of WNS and for general health and safety reasons.

Several of the mapped AMO locations were found to represent more than one opening, resulting in a total of 88 AMOs actually visited. These were described in conjunction with the associated known mapped mine openings. In addition, during the course of this survey, 26 previously unmapped AMOs were also discovered on the site. The above-listed procedure was used to document new mine openings, and coordinates of all new AMOs were recorded with GPS. In total, 114 AMOs within 500 m of the Project site were assessed. All are shown on Figure 9.7-5, though identifying details have been deleted.

The survey results demonstrated that none of the AMOs on the Project site currently provide suitable bat hibernating habitat (Appendix D-5). All appear to have been backfilled in accordance with NS government safety requirements, and many are now just shallow surface depressions. Few were more than 4 m deep, and of those that were, most were flooded. Several appear to be shallow surface trenches. Waste rock and cobbles occurred around many openings. Evidence of wildlife, particularly porcupine, deer and hare, was common. No evidence of raccoon visitation to any mine openings was noted (which has been noted in NB at WNS-affected caves (McAlpine *et al.,* 2011)).

Two AMOs within 1 km of the site did appear to be potentially suitable as bat hibernacula, due to their reported depths (> 20 m). Data collected on these two AMOs will be provided to NSDNR. The AMEC survey conducted in September 2013 found that one of these AMOs was closer to 27 m deep, while the second one was approximate/y 21 m deep.

Acoustic Bat Survey of AMOs

Following the physical indentification and characterization survey of the AMOs in the area, targeted bat monitoring was then conducted in the vicinity of the two off-site AMOs considered to have potential as bat hibernacula. The objective was to determine the presence of bats as well as possible swarming activity of bats in and around the AMOs which would provide some indication of use as roosting and possibly as hibernation sites. The survey methodology is described in the following paragraphs.

Two Anabat SD2 acoustic bat detectors were deployed in the field, one at each of the two AMOs of interest. Specifics on the locations will be provided to NSDNR. The detectors recorded ultrasonic acoustic signals from August 27 to September 16, 2013 Each Anabat SD2 detector was deployed, along with its power supply, on the ground in a waterproof housing fitted with a microphone tube, which allowed sampling of a section of the sky approximately 45 degrees from horizontal. The Anabat SD2s were positioned to sample the sky directly above the entrance to the two abandoned mine openings. The Anabat SD2 units were programmed to record all ultrasonic sounds between 7:00 o'clock pm and 7:00 o'clock am. The waterproof housing was covered in brush to minimize visibility and potential vandalism, and was also tied to a nearby tree to avoid accidental loss into the mine opening (Appendix D-6, Photo D6-1) during regular maintenance events. The Anabat SD2 units were intended to provide information on bats flying in the general area, above the mine opening.

In addition to the Anabat SD2 units, two Anabat Roost Loggers were also deployed, one at each of the same two AMOs. These units are acoustic monitors with low-sensitive microphones which are intended for monitoring bats at and around caves, mines and other roost areas. The Anabat Roost Logger units were situated close to the mouth of each AMO opening, with the microphone facing horizontally across the entrance. Each unit was secured to the base of a tree at the opening, and was also tied to minimize the chance of accidental loss into the opening (Appendix D-6, Photo D6-2). The Anabat Roost Loggers units were programmed to record all ultrasonic sounds throughout the day, and also recorded ground-level temperature at five-minute intervals. The Roost Loggers were intended to provide data on bats entering or exiting the mine openings.

Survey Results

Preliminary Anabat SD2 survey results confirmed the presence of *Myotis* species bats in the general area of both AMOs. Bats generally appeared for the night at around 8:30 pm (dusk). Confirmed or suspected *Myotis* calls were detected on every night, though activity levels were low to moderate (0 to 49 accoustic events/calls per night per AMO), suggesting that the number of bats foraging in the area is relatively small. The generally low activity also suggests that, for the duration of the survey, bats were not swarming near either of the AMOs.

While it is difficult to consistently distinguish reliably between *M. lucifugus* and *M. septentrionalis* using Anabat SD2 data, calls were recorded which match the recognized signal for each species, and therefore it is likely that both endangered *Myotis* species do in fact occur in the area.

The Anabat Roost Logger detected very low numbers of *Myotis* calls near the entrance to the AMOs, further supporting the idea that bats were not using the AMOs at this time for roosting or swarming activities. Of the few Myotis-type calls that were recorded by the Roost Loggers, few if any occurred at dusk, suggesting that these calls did not represent bats emerging from the AMOs. Rather, they were scattered throughout the night-time hours. It is suggested that these calls, which do not match up time-wise with calls from the Anabat SD2 units, may represent calls of low-flying *Myotis* bats which were not detected by the skyward-pointing Anabat SD2 units. They often occur during periods of bat activity in the area, as observed by the Anabat SD2 unit.

Many of the calls recorded appear to be *Myotis* calls, but are of generally higher frequency than is typically recorded. This is most likely due to the fact that the AMO sites are in areas of high 'clutter', ie, the canopy is not as open as it usually is for typical bat surveys (which are often conducted at forest edges). With the increased amount of physical obstacles (ie, tree branches, leaves) in the area potentially interfering with their sonar, bats may be producing slightly different echolocation calls to compensate.

A summary of the Anabat SD2 and Roost Logger acoustic and temperature data is provided in Appendix D-6, along with some photos of the deployed equipment. Two nights with large amounts of records with extraneous noise ('junk records'), August 29 and September 13, correspond to nights of heavy rainfall in the area. Several calls which appear to be from bat species other than *Myotis* were also recorded. These will be forwarded to bat experts for further identification, if possible.

While Anabat SD2 and Roost Loggers do not provide population estimates of bats in an area, they do provide information on activity levels, which allow prediction of abundance. Levels detected in this study are rather low, suggesting that bat population in the area is relatively small.

9.7.1.5 Herpetile SOCC

Four species of reptiles at risk are listed by SARA, COSEWIC, NSESA and/or NSDNR in NS. There are currently no species of amphibian at risk listed by SARA, COSEWIC, NSESA and/or

NSDNR in NS. Of the four herpetile Priority species in NS, only the Wood Turtle and Snapping Turtle (*Chelydra serpentina*) have potential to occur in the Project area, and are included in the Shortlist of Priority Fauna Species (Appendix K-4). The other two species, Blanding's Turtle (*Emydoidea blandingii*) and Northern Ribbonsnake (*Thamnophis sauritus septentrionalis*), are restricted to southwestern NS, in the general area of Kejimkujik National Park in Queens and Lunenburg Counties (Gilhen, 1984; NSDNR, 2013f) and are not expected to occur on the Project site.

NSMNH (2013) does not list any terrestrial reptile or amphibian species of concern as occurring with the general area of the Project site, though it does state that marine turtles may occur in nearby marine environments. Marine turtle SAR are discussed further in Section 9.7.3.3).

Wood Turtle

According to data provided by ACCDC (2012), the Wood Turtle (NSDNR Yellow, COSEWIC and SARA Threatened, NSDNR Threatened, ACCDC S3) has been recorded within 100 km of the Project area (Appendix K-1). The largest known wood turtle population in NS occurs in the St. Mary's River (MacGregor and Elderkin, 2003), which is approximately 25 km west of the Project area.

For most of the year, Wood Turtles live along permanent streams, but in summer months they roam widely over a large variety of terrestrial habitats adjacent to streams, including deciduous forest, fields, woodland bogs and marshy pastures. For nesting, Wood Turtles require fairly moist but well-drained, unshaded, vegetation-free sites with loose substrate, such as sandy or gravely stream banks or sand-gravel bars in streams (MacGregor and Elderkin, 2003; NatureServe, 2013). They also use such banks for basking and will utilize clearings created by humans for basking or breeding (NatureServe, 2013). They prefer hard-bottomed streams and rivers composed of sand or gravel, and avoid streams with clay or mucky substrate; clear rivers and streams of medium size (between 2 m and 30 m wide) are considered ideal (MacGregor and Elderkin, 2003).

The banks of all streams found within the Project area are vegetated, and therefore do not meet the species' nesting habitat requirements. Wood Turtles are not likely to overwinter in the small, fairly shallow streams in the Project area. Although there is potential foraging habitat during summer months, Wood Turtles are highly unlikely to nest within the proposed site.

Snapping Turtle

According to data provided by ACCDC (2012), the snapping turtle (COSEWIC Special Concern, NSESA Vulnerable) has been recorded within 100 km of the Project area (Appendix K-1). Snapping Turtles utilize a wide variety of aquatic habitats, preferring those with a soft muddy or sandy bottom. They are highly aquatic, seldom emerging from the water even to bask, and they are able to tolerate brackish water. Nest sites are often far from water, and may include banks, lawns, gardens, road embankments, or even Muskrat burrows. Snapping Turtles are omnivorous, feeding on invertebrates and plants as well as fish, frogs, and other small vertebrates. They hibernate all winter on the bottom of lakes and rivers. Foraging habitat is marginal for Snapping Turtles on the Project site, though suitable nesting habitat may occur.

As stated in Section 9.4.3.3, the habitat in Meadow Lake is unlikely to support Wood Turtles; however, Snapping Turtles are possible in the lake.

9.7.1.6 Odonate SOCC

The Odonata, or dragonflies and damselflies, are large predatory insects which complete their larval development in aquatic environments before emerging as flying adults. All rely on aquatic habitats for reproduction, and some have very specific habitat requirements. Currently, there are 16 species of odonates listed as Red or Yellow in the General Status of Wildlife in Nova Scotia Report (NSDNR, 2009). No odonate species are listed under SARA, COSEWIC or the NSESA. The distribution of odonates in NS has not received much study until the last few decades, and Guysborough County is the least studied county in NS (Brunelle, P., pers. comm., 2010).

A review of the known geographic distributions of these species indicates that 15 species of Odonata of conservation concern have potential to occur in eastern NS, and so are included in the Shortlist of Priority Fauna Species (Appendix K-4). Of these, seven are considered to have potential to occur on the Project site, based on known habitat preferences (Appendix G). These are outlined in Table 9.7-5.

According to ACCDC (2012) 11 odonate SOCC are known to occur within a 100 km radius around the Project area (Appendix K-1). However, only two of these are listed by NSDNR: Harlequin Darner (*Gomphaeshna furcillata*, ACCDC S1, NSDNR Yellow), and Brook Snaketail (*Ophiogomphus aspersus*, ACCDC S1, NSDNR Red).

Table 9.7-5 Odonate Priority Species with Potential to occur on the Goldboro LNG Facility and ROW

Common Name	Scientific Name	NSDNR RANK	Habitat Preferences
Taiga Bluet	*Coenagrion resolutum*	RED	Sedge marshes and fens and well-vegetated pond and lake edges, at large lakes in sedge beds. Often in stands of water horsetail *Equisetum hiemale.*
Little Bluet	*Enallagma minisculum*	YELLOW	Ponds, shallow gravel-bottomed margins of mesotrophic lakes, where there are sparse emergent plants; occasionally larger heavily vegetated ponds.
Prince Baskettail	*Epitheca princeps*	YELLOW	Rivers, streams and lakes. Only active wave-washed shores of lakes, and slow running streams and rivers.
Harlequin Darner	*Gomphaeschna furcillata*	YELLOW	Swamps or bogs.
Clamp tipped Emerald	*Somatochlora tenebrosa*	YELLOW	The breeding habitat is typically small forested streams.
Williamson's Emerald	*Somatochlora williamsoni*	RED	Usually found at slow streams and lakes, and sometimes bog lakes. It seems to prefer shaded habitats.
Ebony Boghaunter	*Williamsonia fletcheri*	RED	Lentic environments, such as bogs and fens, also found sometimes in saturated sphagnum.

Two Significant Habitat areas for odonates are listed by NSDNR within 20 km of the Project site (NSDNR, 2012c). These are for Northern Bluet (*Enallagma cyathigerum* (syn. *Enallagma annexum*), NSDNR Undetermined, ACCDC S5) and Sphagnum Sprite (*Nehalennia gracilis*, NSDNR Undetermined, ACCDC S4). These species are known to occur approximately 4 km from the Project site, across the Bay to the southwest. As there are very few odonate experts in NS, odonate distribution and populations within the province are not as well documented as for other more-easily identified groups, and therefore many odonate species (currently 24) are listed as Undetermined by NSDNR due to a lack of distribution and population data.

The NSMNH does not have any records of odonate species of concern in the general Project area (NSNMH, 2013).

Based on habitat requirements (Appendix K-4), potential breeding habitat exists for most Odonate Priority Species short-listed, as well as the ACCDC SOCC (Appendix K-1). The Project area contains several types of aquatic habitats which are potential breeding sites for odonates such as streams, bogs, ponds, and marshes.

None of the Priority Species have been detected on the site to date. See Section 9.4.3.2 for a description of the Odonate surveys conducted on the Project site to date. Odonate surveys were conducted by Mr. Paul Brunelle, a well-known expert of Odonata of the Maritimes. He conducted his initial survey in September 2012, and conducted two follow-up surveys in early July and Early August 2013, respectively,, in order to accurately characterize the odonate fauna of the site. A single survey is insufficient to assess the odonate fauna of a site, as different species have different emergence and flying periods and all are not present at the same time. Mr. Brunelle's initial report (based on the September 2012 survey) is provided in Appendix G. . His surveys have resulted in a total of 40 odonate species being detected on the main LNG facility, along the Pipeline ROW, and at Meadow Lake. Mr. Brunelle detected a single Yellow-

listed species, Little Bluet (*Enallagma minisculum*) as well as two Undetermined species (Mantled Baskettail, *Epitheca semiaquea*, and Swamp Spreadwing, *Lestes vigilax*) at Meadow Lake. A third Undetermined species, Sweetflag Spreadwing (Lestes forcipatus) was detected on the main LNG site, away from wetland habitat.

Meadow Lake provides breeding habitat for Odonate species which prefer larger freshwater bodies than those found on the main Project site.

9.7.1.7 Lepidoptera SOCC

Nine butterfly species are listed as 'at risk' in NS by SARA, COSEWIC, NSESA, and NSDNR (NSDNR, 2013d). Only three of the Priority species have known occurrences within 100 km of the Project area (ACCDC, 2012). A fourth species, the Jutta Arctic (*Oeneis jutta*), had not been recorded in mainland NS prior to initiation of the ongoing MBA project, but was reported in Guysborough County in 2011 (MBA, 2013). Hoary Comma (*Polygonia gracilis*) and Monarch were each only recorded only once, each approximately 80 km from the Project site, and according to the MBA, Hoary Comma has only been reported in northern NB (MBA 2013). Northern Cloudywing (*Thorybes pylades*) was recorded on a single occasion in 1955, and has more recently been recorded in Guysborough and Antigonish Counties (MBA, 2013). Therefore, Monarch, Northern Cloudywing and Jutta Arctic are included in the short list of Priority Species (Appendix K-4, Table K-4.2). While the single ACCDC record for Monarch was far from the Project site, this species has was observed by AMEC personnel in the LNG facility footprint in 2012, and is therefore retained on the shortlist.

A review of habitat requirements for the butterfly species includes the consideration of larval food-plants. Butterflies depend on plants as a food source for the juvenile stage, the caterpillar. Many species are very specialized on one or a few plant species. Adults are mobile and are expected to be able to search for nectar producing plants in larger, though somewhat limited areas, thus avoiding areas unsuitable due to Project activities. However, presence or absence of larval food-plants ultimately determines the potential for presence of these species in the Project area, as well as the possibility of negative impacts caused by Project activities.

During the breeding season, Monarch butterflies (NSDNR Yellow, SARA and COSEWIC Special Concern) utilize habitats such as meadows, weedy fields and watercourses, where milkweed, the larval food plant, is present. Monarchs can occur almost anywhere in NS during spring migration, and in the breeding season near the food plants. Monarchs are common to abundant during the fall migration, notably along the Atlantic coast; however, these fall migrants are thought to originate from outside the province. Small numbers are resident. During the field surveys, no milkweed plants were found. Therefore, breeding Monarchs are unlikely to be present on the Project site.

Jutta Arctic, though relatively widespread in NB, is uncommon in NS (NSDNR Red). As it has recently been reported in Guysborough County, particular effort was made during the April 2013 surveys to detect this early-flying species in its preferred wetland habitat; however, none were seen. This species is typically observed around margins of bogs and fens. Host plants include a variety of sedges, including *Carex* spp. and Tussock Cotton Grass. As suitable habitat and

host plants occur in the Project area, breeding Jutta Arctic's individuals may be present in wetlands on the Project site.

Northern Cloudywing (NSDNR Yellow) utilizes a variety of open forest and meadow habitats where it is frequently observed visiting flowers. This species is highly colonial, and may be locally common. Although there are currently only three records for the province, all are from Guysborough and Antigonish Counties. Suitable habitat exists and at least one of the host plant species, Beach Pea, has been found in the Project area; therefore, it is possible that Northern Cloudywing may breed in the Project area. An effort was made to detect this species during early July field surveys by AMEC in 2013; however , none were observed..

As on the LNG facility site, the Monarch Butterfly is considered to potentially occur on or around Meadow Lake, but is unlikely to breed. There is potential for Jutta Arctic and Northern Cloudywing to breed around Meadow Lake, if suitable host plants are present. Milkweed plants which are larval food plants for the Monarch Butterfly, were not found during surveys anywhere in the Project footprint (Appendix D-1, D-2, D-3).

9.7.1.8 Other Terrestrial Invertebrate SOCC

The Macropis Cuckoo Bee (*Epeoloides pilosulus*) is listed as Endangered by COSEWIC and SARA, and was listed under the NSESA as Endangered in July 2013. This rare bee species reproduces within the nests of Macropis bees, and so is found only where Macropis species and their food plants (*Lysimachia* spp.) occur. *Lysimachia* species require moist habitats, while the host bee requires sunny sandy slopes for nesting sites. ACCDC ranks this species as S1. Found only once in NS in the last 40 years, and only three times in North America since the 1950s, the Macropis Cuckoo Bee is not expected to occur on the Project site, and so is not considered further in this document.

9.7.2 Freshwater Species of Conservation Concern (SOCC)

9.7.2.1 Freshwater Fish SOCC

A total of 10 species, representing 17 populations, of freshwater and/or anadramous fish species/populations are listed as SAR/SOCC by NSDNR, NSESA, SARA, and COSEWIC. Note that different populations of a species are often treated separately due to differing environments and threats, a good example being the various Salmon populations in NS. A review of the known geographic distributions of these freshwater fish species and populations of concern in NS indicates that 8 species of freshwater or anadromous fish of conservation concern have potential to occur in eastern NS, and so are included in the Shortlist of Priority Fauna Species (Appendix K-4). (Note that fish species which spend portions of their life histories in both fresh and salt water will be discussed in both of these sections, and impacts to either one of these environments can have impacts on these species). Of these species and/or populations listed in NS, seven have potential to occur in the region encompassing the Project site. These are outlined in Table 9.7-6.

Table 9.7-6 Freshwater Fish SOCC in Nova Scotia, along with their Potential to occur within Project footprint

Common Name	Scientific name	NSDNR Status/ NSESA Status	COSEWIC/ SARA Status	Potential in Region	Potential in Freshwater Habitats on Project Site
Atlantic Salmon (NS Southern Upland Population)	*Salmo salar*	RED	Endangered / No status	YES	Unlikely*
Atlantic Sturgeon	*Acipenser oxyrhynchus*	RED	Threatened /No status	YES	Unlikely*
Gaspereau (Alewife)	*Alosa pseudoharengus*	YELLOW	No status	YES	Unlikely
Brook Trout (Char)	*Salvelinus fontinalis*	YELLOW	No status	YES	Confirmed
Pearl Dace	*Margariscus margarita*	YELLOW	No status	YES	Unlikely
Brook Stickleback	*Culaea inconstans*	YELLOW	No status	YES	Unlikely
American Eel	*Anguilla rostrata*	GREEN	Threatened / No status	YES	Confirmed
Striped Bass	*Morone saxatilis, Southern Gulf of St. Lawrence population*	RED	Threatened	Yes	No

Note:
*See discussion in Marine Fish SAR section

Based on habitat preferences and known distributions, only two of these species are expected to occur on the Project site, and both are already known to occur on the Project site. Brook Trout and American Eel are known to occur on the Project site, in the unnamed watercourse on the western edge of the property, Dung Cove Pond, Meadow Lake and in the nearby Betty's Cove Brook.

Atlantic Salmon historically occurred in significant numbers in the Isaac's Harbour system, and have been captured in very small numbers in Meadow Lake as well as Isaac's Harbour River in recent years.

American Eel

American Eel is an elongated snakelike fish which exhibits a life history pattern opposite to that of anadromous fish. It spawns in the marine environment, in the Sargasso Sea, and the larvae drift or swim to continental shelves, from where they migrate upstream into freshwater systems, often occurring in very small streams. These larvae may spend up to two decades maturing in freshwater streams, ponds, and lakes, before migrating back to the Sargasso Sea for their single spawning event. Eels are very significant to the Mi'kmaq people of NS, and continue to be fished today. Eels have recently been uplisted to Threatened by COSEWIC (COSEWIC, 2012a) due to population decreases in Ontario and Quebec. (Note that unlike some other fish species, such as Atlantic Salmon, the American Eel is treated as a single population due to its single spawning location). They are still listed as Green (secure) by NSDNR and are currently abundant in NS.

Brook Trout

Brook Trout are members of the Salmonidae family which rely on cool clear streams to survive. Some are anadramous, foraging in the sea for several months of the year before returning to

freshwater streams to spawn in the fall. They remain abundant in NS, but are Yellow-Listed by NSDNR, due to their sensitivity to habitat degradation and acidification.

None of the remaining species have been reported from fish surveys conducted on the Project site as part of the 2006 AMEC report or as part of the Terms and Conditions survey conducted in 2008 for the MapleLNG Project (Dillon, 2008c). Pearl Dace (*Margariscus nachtriebi*) and Brook Stickleback (*Culaea inconstans*) generally inhabit spring-fed streams or cold streams and, as there are no known springs or cold streams on the Project site, these species are not expected to occur.

There is no suitable freshwater habitat for the rest of the species in Table 9.7-6 on the main Project site. The streams on the LNG facility site are all likely too small to support spawning Gaspereau, Atlantic Sturgeon, or Atlantic Salmon. However, all three of these species have a marine phase of their life cycle, during which they may forage within the marine portion of the Project footprint. This is discussed further in Section 9.7.3 Marine SOCC.

Freshwater SOCC occurring in the Meadow Lake area are expected to be similar to those known or expected on the main Project site. One known exception is the documented occurrence of Atlantic salmon in Isaac's Harbour River, a known migration route for Atlantic Salmon, which drains into Meadow Lake.

Atlantic Salmon

Historically, a population of Atlantic Salmon was supported by this watershed, and spawned in tributaries along Isaac's Harbour River and Meadow Lake. A single juvenile salmon was captured in this river in 2004 as part of the Keltic/Maple LNG Project's Meadow Lake surveys (AMEC, 2008a). Atlantic Salmon are known to occur in the general area, and adults have been captured in nearby lakes. An adult Atlantic Salmon was captured in 2001 in the Meadow Lake system, and a single juvenile was caught in 2004 in Isaac's Harbour River. The waters of Meadow Lake are shallow and warm, with low pH, and constitute very poor salmon habitat. This environment is considered too acidic to permit successful reproduction of salmon. The ACCDC reports 52 recent records of Atlantic Salmon within 100 km of the Project site, the closest being approximately 4 km away (ACCDC, 2012).

Atlantic Sturgeon

A group of four to five (presumably) juvenile Atlantic Sturgeon, all in the 1 m size range, has been observed in recent years in the nearby New Harbour River by an AMEC biologist (Cameron-MacMillan, M., pers. comm., 2013). As adults and juveniles of this species are known to occur in shallow waters of the Scotian Shelf (COSEWIC, 2011a), it is not too surprising, although the ACCDC request does not report any records of this species being reported within 100 km of the Project site (ACCDC, 2012). Atlantic Sturgeon need a river with access to the sea, an estuary with relatively warm brackish water, and a coastal shelf region (Dadswell, 2006). Atlantic Sturgeon is not expected to use any freshwater habitat within the entire Project footprint, as they require large rivers as habitat. See further discussion of Atlantic Sturgeon in Section 9.7.3 Marine Fish SAR.

Striped Bass

The ACCDC report also lists one report of Striped Bass (*Morone saxatilis*) occurring within 100 km of the site; however, this record is likely of the Gulf of St. Lawrence population. Striped Bass is not expected to occur in the vicinity of the Project site.

9.7.2.2 Freshwater Mussels

Currently, five species of freshwater mussels are considered to be SAR or SOCC in NS by SARA, COSEWIC, NSESA, and/or NSDNR (NSDNR, 2013d).

Four of the five Priority species are included in the Shortlist of Priority Fauna Species based on known occurrences (Appendix K-4) and are listed in Table 9.7-7. The fifth species, the Yellow Lampmussel, occurs in only a single NS location, in the Sydney River system. Therefore, this species is not expected to be present within the Project area, and is not included in the habitat evaluation.

Table 9.7-7 Freshwater Mussels SOCC Occurring in Nova Scotia

Common Name	Scientific Name	NSDNR Status	NSESA	COSEWIC Status	SARA Status	ACCDC
Squawfoot	*Strophitus undulatus*	RED	No status	No status	No schedule	S1
Delicate Lamp Mussel (Tidewater Mucket)	*Leptodea ochracea (formerly Lampsilis ochracea)*	RED	No status	No status	No schedule	S1
Yellow Lamp Mussel	*Lampsilis cariosa*	RED	Threatened	Special Concern (2004)	Schedule 1, Special Concern	S1
Brook Floater (Swollen Wedge Mussel)	*Alasmidonta varicosa*	YELLOW	Threatened	Special Concern	Schedule 1	S1S1
Triangle Floater	*Alasmidonta undulata*	YELLOW	No status	No status	No schedule	S2S3

ACCDC (2012) listed species of concern within a 100 km radius from the Project area and reported records of the remaining three species. ACCDC (2012) has no records of the three Priority mussel species within a 10 km radius of the proposed Project footprint, nor does the NSMNH (2013). Distribution maps show that the Triangle Floater, Brook Floater and Delicate Lamp Mussel have occurrences in Guysborough County (Clarke, 1981). However, Martel *et al.* (2010) in their summary of the known distributions of freshwater mussels species within Atlantic Maritime Ecozone, stated that only a single SOCC, the triangle floater, is known to occur in the river system encompassing the Goldboro site.

The Triangle Floater (NSDNR Yellow) occurs throughout NS (Cordeiro, 2011), and tends to prefer small streams with a steady flow of water, rather than riffles or rough water. It occasionally is found in lakes, ponds and canals. In terms of substrate, it prefers a mixture of coarser of finer gravel with sand and mud, or in between large stones (Clarke, 1981). This species relies on fish hosts to aid in dispersal during the larval development stage, so only aquatic habitats with fish present have potential to contain this species. It is possible that this species could occur in the unnamed watercourse on the LNG facility site, or, possibly Dung Cove Pond, both of which support fish populations. However, the fish host species known to be utilized by the Triangle Floater (Common Shiner (*Luxilus cornutus*), Blacknose Dace

(*Rhinichthys atratulus*), Longnose Dace (*Rhinichthys cataractae*), White Sucker (*Catostomus commersonii*), Pumpkinseed (*Lepomis gibbosus*), Fallfish (*Semotilus corporalis*), Slimy Sculpin (*Cottus cognatus*), and White Perch (*Morone americana*) have not been documented to occur in either of these waterbodies. No mussel shells were noted during field surveys in 2012 and 2013 by AMEC staff, nor was this species discussed in the 2006 Keltic Project EA document (AMEC, 2006). Dillon's 2008 assessment on benthic invertebrates and fish on the site also did not mention any freshwater mussel species (Dillon, 2008c). Therefore the potential occurrence of Triangle Floater within the proposed Project area is very low.

9.7.2.3 Other Freshwater SOCC

The Squat Duskysnail (*Lyogyrus granum*) is a small, poorly known freshwater species of snail which was listed as Data Deficient by COSEWIC in 2003. It has a subnational rank of S2, having been reported only eleven times in NS. ACCDC did not report any records of this species within 100 km of the Project site, and so it is not considered further in this document.

9.7.3 Marine Species of Conservation Concern (SOCC)

A review of the COSEWIC database and the SAR Public Registry listings for NS and the Atlantic Ocean found a total of 33 marine SAR or SOCC (2 reptiles, 22 fish, 8 mammals) which are known to occur in the northwestern Atlantic Ocean off eastern NS (Appendix K-3). This includes species which are fully marine, such as whales, as well as species which rely on marine habitats for only a portion of their life cycle, such as anadramous fishes. Marine birds are not included within this section, see Section 9.7.1.3 for a discussion of these species. The habitat preferences of these species were compared with the known habitats occurring within the planned Goldboro Marine Terminal footprint to determine the likelihood of their occurrence. Of the 30 SAR or SOCC occurring in this region, 11 are known to occur or have potential to occur within the area encompassing the Project site. These species are discussed in detail in the following subsections.

9.7.3.1 Marine Fish SOCC

A review of the COSEWIC database and the SAR Public Registry listings for NS and the Atlantic Ocean found a total of 22 marine or diadromous fish SOCC which are known to occur in the northwestern Atlantic Ocean off eastern NS (Full list provided in Appendix K-4). Distribution ranges and habitat preferences of these species were compared to the site location and the habitat types known to occur in Stormont Bay to determine species with potential to occur in the area of the Project site. The species considered to have potential to occur in the region encompassing the Project site are outlined in Table 9.7-8. Note that a few species occur in both freshwater and marine environments, and so, for the sake of completeness, are discussed in both the Freshwater and Marine SAR sections.

A total of nine fish SAR or SOCC which utilize marine habitats are deemed to have potential to occur within the Project footprint. A brief description of the habitat and life history of each of these fish species, along with its current designation under COSEWIC and/or SARA is provided below.

Table 9.7-8 Marine Fish Species of Concern Occurring in Northwestern Atlantic Ocean off Nova Scotia.

Common Name	Scientific Name	COSEWIC Status/SARA Status	Potential in Site Waters
American Eel	*Anguilla rostrata*	Threatened/No Status	CONFIRMED
Atlantic Cod	*Gadus morhua*	Endangered/No Status	LIKELY
Atlantic Bluefin Tuna	*Thunnus thynnus*	Endangered/No Status	LIKELY
American Plaice	*Hippoglossoides platessoides*	Threatened/No Status	POSSIBLE
Atlantic Salmon	*Salmo salar*	Endangered/No Status	POSSIBLE
Atlantic Sturgeon	*Acipenser oxyrinchus*	Threatened/No Status	POSSIBLE
Porbeagle	*Lamna nasus*	Endangered/No Status	POSSIBLE
Spiny Dogfish	*Squalus acanthias*	Special Concern/No Status	POSSIBLE
Winter Skate	*Leucoraja ocellata*	Threatened/No Status	POSSIBLE

American Eel

The American Eel spawns and hatches in the marine environment, but grows to maturity in freshwater. Juvenile eels are known to occur in the unnamed tributary on the Project site, Dung Cove Pond, and in the nearby Betty's Cove Brook. Adults and early larval stages therefore also utilize the marine portion of the Project footprint as they migrate to and from these streams. Eelgrass beds, which occur within the Project footprint, provide important cover to American Eels, especially during daylight hours. While Eels are still relatively abundant in eastern Canada, population decreases in Ontario and Quebec have led to COSEWIC recently listing the American Eel as a Threatened species (COSEWIC, 2012a). Eels continue to be a significant species to Mi'kmaq people in eastern Canada.

As an anadromous species, American Eel is also discussed in Section 9.6, and in Section 9.7.2.

Atlantic Cod

The Atlantic Cod is a marine fish species which has historically been extremely important as a commercial species in eastern Canada, but is now at very low levels and only limited fishing is permitted. The Southern Population, which encompasses the Project site, is now listed by COSEWIC as Endangered (COSEWIC, 2010a). Knowledge of the habitat requirements of Atlantic Cod is rather poor, and it has been suggested that habitat requirements change with age (COSEWIC, 2010a). Cod are known to occur in inshore waters along the Guysborough coast, and it is reasonable to presume that Atlantic Cod may forage within the Project footprint, though no habitat critical to this species is present.

Atlantic Bluefin Tuna

Atlantic Bluefin Tuna is a large predatory fish species which spawns in the Gulf of Mexico. Adults and large juveniles move northward to forage on smaller schooling fish species in warm Canadian waters in the summer and fall (COSEWIC, 2011b). Despite large population decreases, Atlantic Bluefin Tuna are still fished commercially off Guysborough County (see Section 9.8.2), and it is likely that adults may occasionally forage within the Project footprint, though no critical habitat is present. Atlantic Bluefin Tuna do not breed in Canadian waters.

American Plaice

American Plaice are a species of flounder which burrow in sediments to escape predators and ambush prey. Juvenile American plaice prefer depths of 100 to 200 m, but adults are less particular regarding habitat and could potentially occur within the Project footprint. The Maritime population was designated as Threatened by COSEWIC in 2009 (COSEWIC, 2009). Abundance of mature individuals has declined about 67% on the Scotian Shelf within the last few generations. It is reasonable to assume that adult American Plaice may occasionally forage within the Project footprint, which does not contain any critical habitat.

Atlantic Salmon

Atlantic salmon prefer rivers or streams that are generally clear, cool and well-oxygenated for reproduction and the first few years of rearing, but undertakes lengthy feeding migrations in the North Atlantic Ocean as older juveniles and adults. The Southern NS Upland population, which encompasses the Goldboro site, breeds in rivers from north-eastern mainland NS, along the Atlantic coast and into the Bay of Fundy. Atlantic Salmon have historically supported important fisheries in eastern Canada; however, most populations are now listed as Endangered by COSEWIC (2010b). The number of mature individuals has declined over the past few generations by about 61%. In addition, recent surveys have only found juvenile Salmon in 20 of 51 known historic spawning rivers in NS (COSEWIC, 2010b). Human influences, such as dam construction, pollution and logging, have eliminated and/or degraded freshwater spawning and foraging habitats. Acidification of freshwater habitats brought about by acidic precipitation is another ongoing threat to this species' survival.

It is likely that adult Atlantic Salmon may occasionally forage within the marine portion of the Project footprint, though no critical habitat is present.

As an anadromous spices, Atlantic Salmon is also discussed Section 9.6 and in Section 9.7.2.

Atlantic Sturgeon

Atlantic Sturgeon are large, slow-growing armoured fish which live and mature in the sea, but spawn in freshwater, where some juvenile rearing also occurs. They occur in rivers, estuaries, nearshore marine environments and shelf regions to at least 50 m depth along the Atlantic Coast of North America (COSEWIC, 2011a). They are listed as Threatened by COSEWIC. Breeding populations are known from the St Lawrence and Saint John Rivers, and possible in other rivers flowing into the Bay of Fundy and the Gulf of St Lawrence. Adults spend most of their time at sea, but generally remain close to shore (COSEWIC, 2011a).

While Atlantic Sturgeon was not listed in the 2012 ACCDC screening conducted for the Goldboro Project, reliable sightings of a small group (4-5) of juvenile Atlantic Sturgeon in New Harbour River were noted in 2009 by a qualified AMEC biologist (Cameron-MacMillan, M., pers. comm. 2013). These records have recently been reported to ACCDC. The watercourse and ponds on the Project site (including Meadow Lake) are unsuitable for Atlantic Sturgeon, but it is possible that adults may occasionally forage in the marine portion of the footprint. No critical habitat is present.

Porbeagle

The Porbeagle is a large cold-temperate coastal and oceanic shark which tends to be more common on continental shelves, but is occasionally found close inshore (Scott and Scott, 1988 and Compagno, 2001). It feeds on wide variety of species, especially bony fishes and Squid (Joyce *et al.,* 2002). Porbeagle abundance has declined greatly since Canada began fishing them in the 1990s. This species was listed by COSEWIC as Endangered in 2004 (COSEWIC, 2004). It is possible that Porbeagles may occasionally forage within the Project footprint. No critical habitat is present.

Spiny Dogfish

The Spiny Dogfish *(Squalus acanthias)* is a small shark which occurs world-wide on the continental shelf, from the intertidal to the shelf slope, in temperate and boreal waters. While still relatively abundant in Canadian waters, this species' low fecundity, long generation time, and vulnerability to overfishing in nearby US waters, have led to it being listed as a species of Special Concern by COSEWIC (2010c). Habitat within the marine footprint of the Project is likely suitable foraging habitat for Spiny Dogfish. No critical habitat is present.

Winter Skate

Winter Skate *(Leucoraja ocellata)* is a bottom-dwelling skate species, which is usually found on sand and gravel. The Project site falls within the region home to the Eastern Scotian Shelf population of this species, which is subject to a small directed fishery. Very little is known about the biology of Winter Skate; however, this species' delayed age at maturity, large size at birth, long generation time, low fecundity, and consequently slow population growth rate have led to COSEWIC listing this species as Threatened (COSEWIC, 2005). Winter Skate are also at risk of bycatch in fisheries for other groundfish species and/or scallops. Habitat within the marine footprint of the Project is likely marginal foraging habitat for winter skate. No critical habitat is present.

9.7.3.2 Marine Mammal SOCC

A review of the COSEWIC database and the SAR Public Registry listings for NS and the Atlantic Ocean found a total of eight marine mammal SAR of SOCC which are known to occur in the northwestern Atlantic Ocean off eastern NS , of which seven may occur in the Project area based on distribution (Table 9.7-9 below, or Appendix K-4).

Habitat preferences of these species were compared to the site location and the habitat types known to occur in Stormont Bay to determine species with potential to occur in the area of the Project site. A single species, Harbour Porpoise, is considered to have potential to occur in Project site waters. This species is discussed in the following paragraphs.

Table 9.7-9 Marine Mammal Species of Concern occurring in the Northwestern Atlantic Ocean off Nova Scotia

Common Name Population	Species Name	COSEWIC Status /SARA Status	Potential in Site Waters
Blue Whale Atlantic	*Balaenoptera musculus*	Endangered / Endangered	Unlikely
Fin Whale Atlantic	*Balaenoptera physalus*	Special Concern / Special Concern	Unlikely
Harbour Porpoise Northwest Atlantic	*Phocoena phocoena*	Special Concern / Threatened (Schedule 2)	Possible
Killer Whale Northwest Atlantic	*Orcinus orca*	Special Concern / No Status	Unlikely
North Atlantic Right Whale	*Eubalaena glacialis*	Endangered / Endangered	Unlikely
Northern Bottlenose Whale Scotian Shelf	*Hyperoodon ampullatus*	Endangered / Endangered	Unlikely
Sowerby's Beaked Whale	*Mesoplodon bidens*	Special Concern / Special Concern	Unlikely

Harbour Porpoise

The Harbour Porpoise (*Phocoena phocoena*) is one of the smallest marine mammals, reaching a maximum of about 1.9 m in length and 76 kg. They occur primarily on continental shelves, and eat mostly small schooling fish (such as Herring, Capelin, Sprat, and Silver Hake), but also Squid (Waring *et al.*, 2009). They are often spotted in harbours and bays. While currently abundant, this species is considered a species of Special Concern in Canada (COSEWIC, 2006). The Harbour Porpoise is also protected under the *Marine Mammal Regulations* of the *Fisheries Act*, which prohibits harvest. A major source of mortality for Harbour Porpoises is by-catch from fishing gear (especially gillnets) (COSEWIC, 2006).

The marine footprint of the Project contains suitable foraging habitat for Harbour Porpoises, however this is not considered critical habitat.

9.7.3.3 Marine Reptile SOCC

A review of the COSEWIC database and the Specie at Risk Public Registry listings for NS and the Atlantic Ocean found a total of two marine reptile SAR or SOCC which are known to occur in the northwestern Atlantic Ocean off eastern NS. Distribution ranges and habitat preferences of these species were compared to the site location and the habitat types known to occur in Stormont Bay to determine species with potential to occur in the area of the Project site. A single species, the Atlantic Leatherback (*Dermochelys coriacea coriacea*), is considered to have potential to occur in Project site waters (Appendix K-4). A second marine turtle species, the Atlantic Loggerhead (*Caretta caretta*), is also listed by COSEWIC (2010d) as Endangered, but

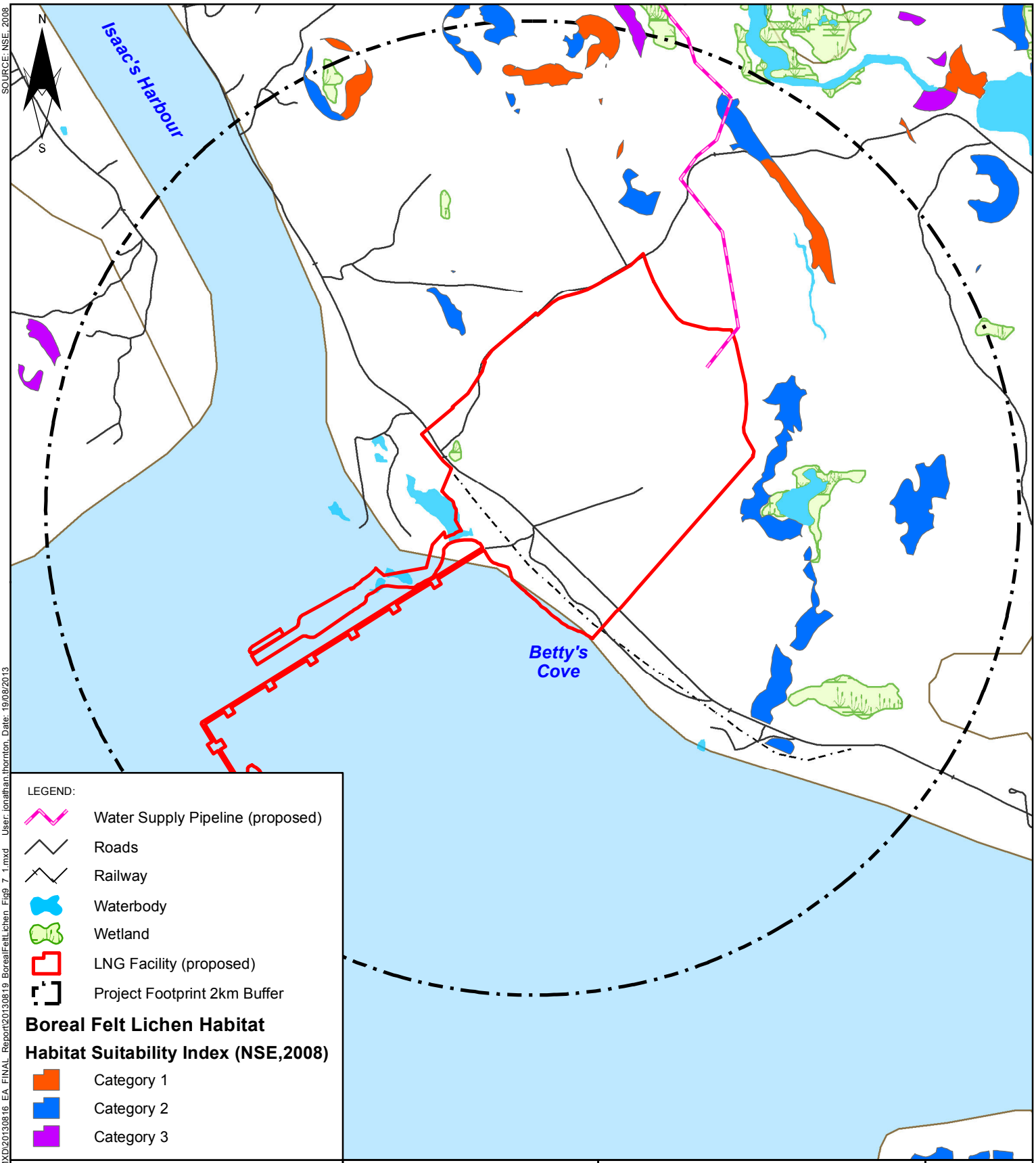
this species only occurs as juveniles far offshore, and is not expected to occur on or near the Project site.

Atlantic Leatherback

Atlantic Leatherbacks (*Dermochelys coriacea coriacea*) are large, slow-growing, long-lived migratory sea turtle species which come ashore only to lay eggs. They breed in tropical or subtropical waters and move to temperate waters in search of food (chiefly jellyfish) at other times of the year. While they do not breed in Canada, adult leatherbacks are a regular part of the Nova Scotian marine fauna in the summer and fall (James *et al*., 2006 and Witzell, 1999). Leatherbacks in Atlantic Canada occur in both offshore and coastal waters. The Atlantic Leatherback Turtle is listed by COSEWIC as Endangered (COSEWIC, 2012d). Globally, this species is estimated to have declined by more than 70%. In the Atlantic, this species continues to be impacted by fisheries bycatch, coastal and offshore resource development, marine pollution, poaching of eggs, changes to nesting beaches and climate change (COSEWIC, 2012d). Canadian waters provide an important foraging area for these turtles, however, entanglement in longline and fixed fishing gear remains a significant threat to Atlantic Leatherbacks in Canadian waters (COSEWIC, 2012d).

It is possible that adult Atlantic Leatherbacks may forage within or near the marine portion of the Project footprint. No critical habitat for Atlantic leatherbacks is present.

For an assessment of the interaction between the Project and the herein described environment, refer to Section 10.12.



LEGEND:

- Water Supply Pipeline (proposed)
- Roads
- Railway
- Waterbody
- Wetland
- LNG Facility (proposed)
- Project Footprint 2km Buffer

Boreal Felt Lichen Habitat

Habitat Suitability Index (NSE,2008)

- Category 1
- Category 2
- Category 3

CLIENT: Pieridae Energy (Canada) Limited

SCALE: 400 200 0 400 Metres 1:21,000

PROJECT: GOLDBORO LNG
ENVIRONMENTAL ASSESSMENT

DWN BY: TM

CHK'D BY: MS

DATE: Aug 2013

REV. NO:

FIGURE NO: 9.7-1

AMEC Environment and Infrastructure
A Division of AMEC Americas Ltd.
50 Troop Avenue, Unit 300
Dartmouth, N.S., B3B 1Z1
(P) 902-468-2848 (F) 902-468-1314

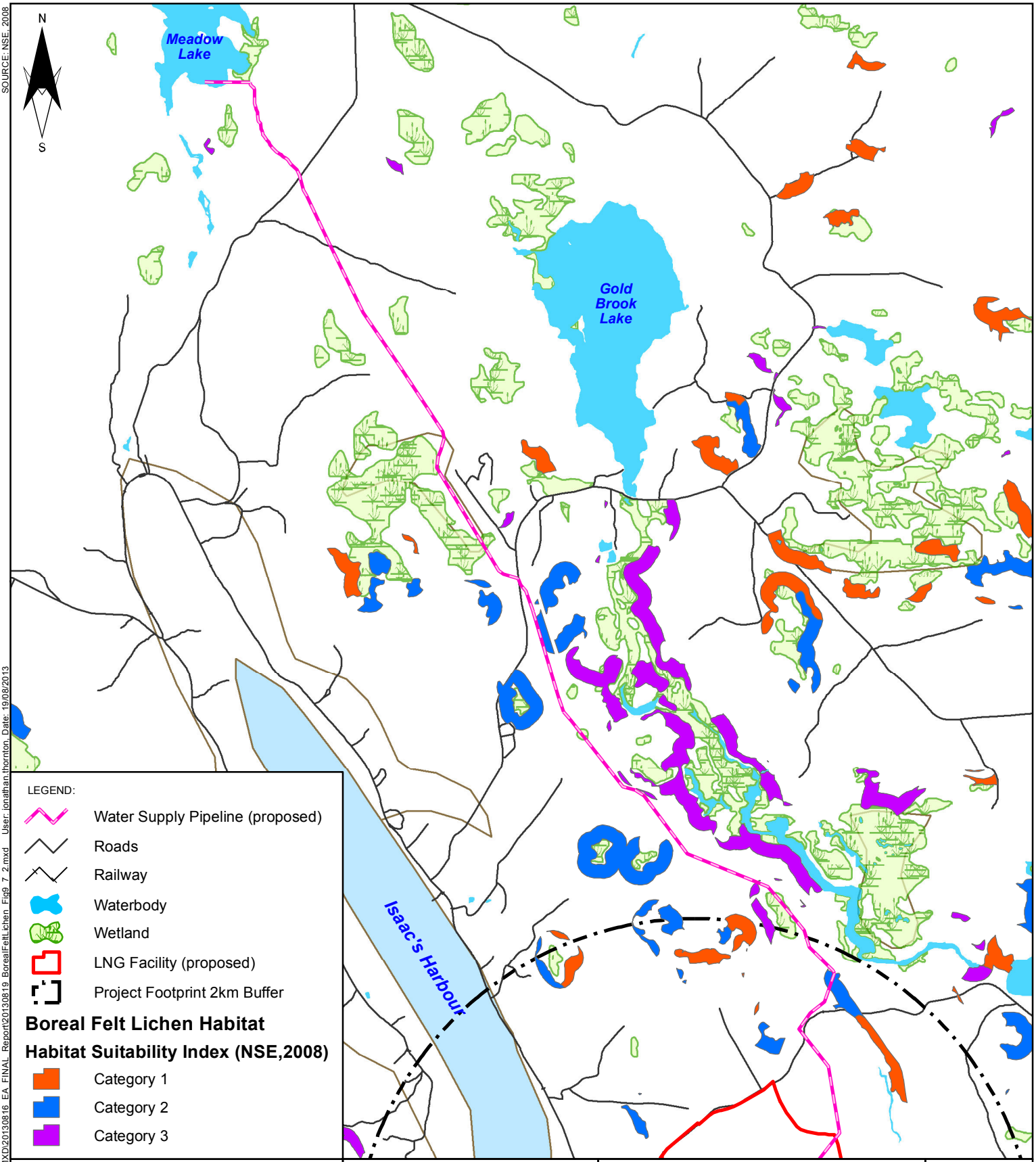
DATUM: UTM Zone 20

PROJECTION: NAD83

PROJECT NO: TV121039

TITLE: **BOREAL FELT LICHEN HABITAT MODELING AT LNG FACILITY**

SOURCE: NSE, 2008
Path: G:\GIS\PROJECTS\TV121039_Phase3000\MXD\20130816_EA_FINAL_Report\20130819_BorealFeltLichen_Fig9_7_1.mxd User: jonathan.thornton, Date: 19/08/2013



SOURCE: NSE, 2008

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CLIENT:
Pieridae Energy (Canada) Limited

SCALE:
500 250 0 500
Metres
1:30,000

PROJECT:
GOLDBORO LNG
ENVIRONMENTAL ASSESSMENT

DWN BY: TM
CHK'D BY: MS
DATE: Aug 2013
REV. NO:
FIGURE NO: 9.7-2

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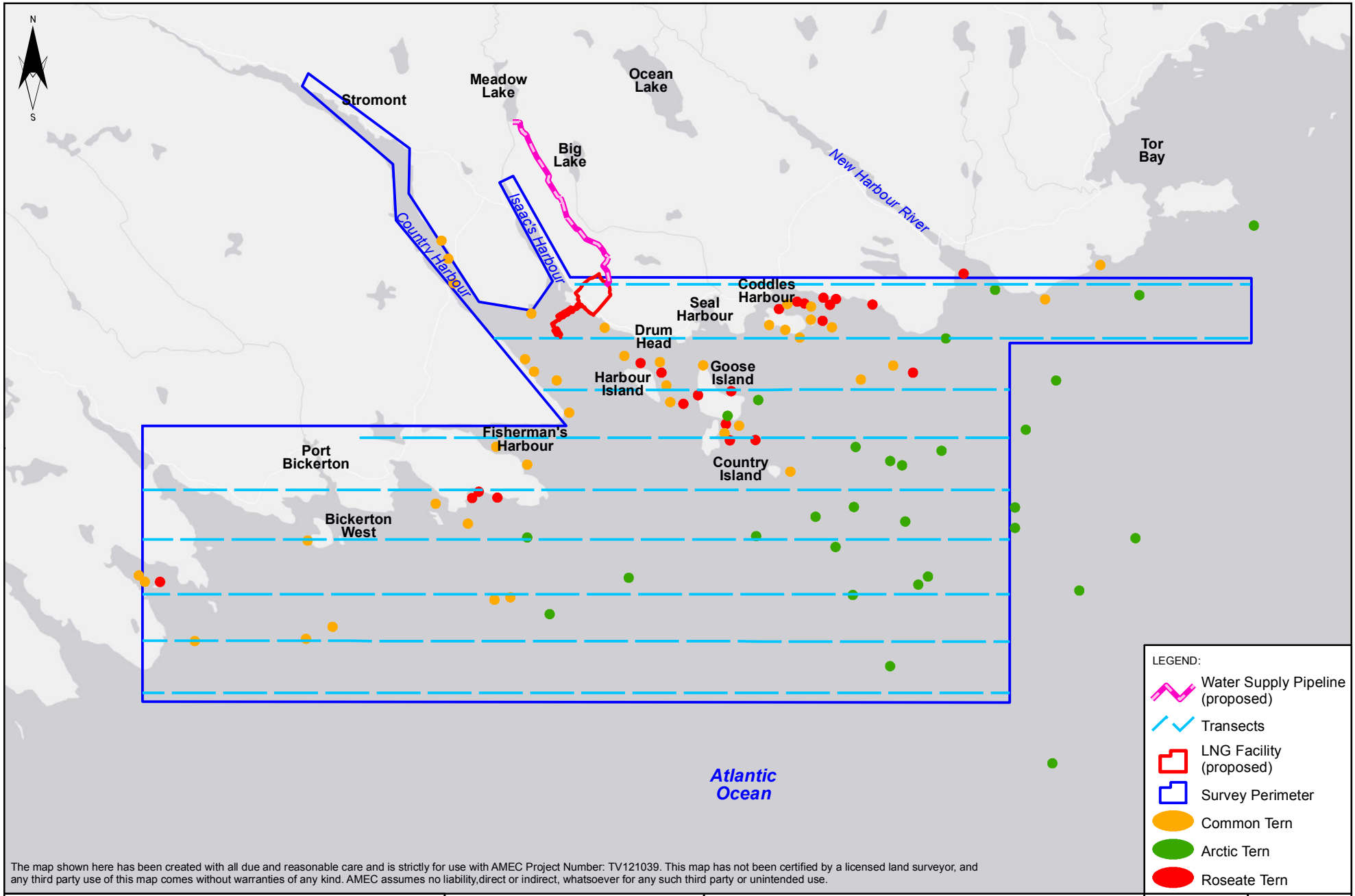
(P) 902-468-2848 (F) 902-468-1314

DATUM: UTM Zone 20
PROJECTION: NAD83
PROJECT NO: TV121039

TITLE:
BOREAL FELT LICHEN HABITAT MODELING ALONG WATER SUPPLY PIPELINE



The map shown here has been created with all due and reasonable care and is strictly for use with AMEC Project Number: TV121039. This map has not been certified by a licensed land surveyor, and any third party use of this map comes without warranties of any kind. AMEC assumes no liability,direct or indirect, whatsoever for any such third party or unintended use.

CLIENT: Pieridae Energy (Canada) Limited	3,000 1,500 0 3,000 Metres	PROJECT: ENVIRONMENTAL ASSESSMENT	DWN BY: TM	DATE: June 2013
	DATUM: NAD83		CHK'D BY: GB	REV. NO:
AMEC Environment and Infrastructure A Division of AMEC Americas Ltd. 50 Troop Avenue, Unit 300 Dartmouth, N.S., B3B 1Z1 (P) 902-468-2848 (F) 902-468-1314	PROJECTION: UTM ZONE 20 North	TITLE: 2003 - 2004 ROSEATE TERN FORAGING SURVEY RESULTS	SCALE: 1 : 200,000	FIGURE NO: 9.7-3
	PROJECT NO: TV121039			

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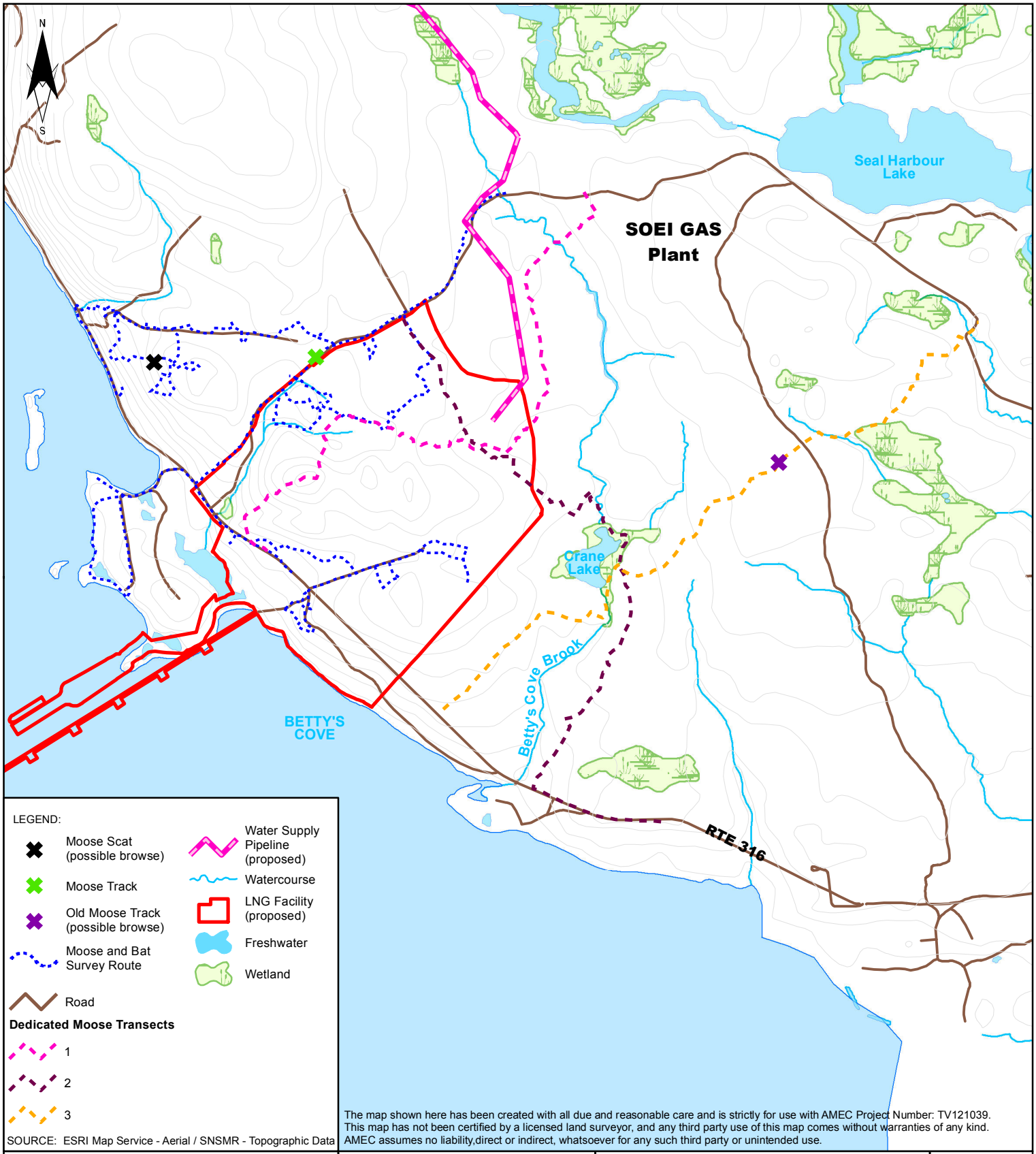
SOURCE: AMEC, 2006 / ESRI Map Service - Grey Topographic Canvas



LEGEND:

- Moose Scat (possible browse)
- Moose Track
- Old Moose Track (possible browse)
- Moose and Bat Survey Route
- Road

Dedicated Moose Transects

- 1
- 2
- 3

- Water Supply Pipeline (proposed)
- Watercourse
- LNG Facility (proposed)
- Freshwater
- Wetland

SOURCE: ESRI Map Service - Aerial / SNSMR - Topographic Data

CLIENT: Pieridae Energy (Canada) Limited

SCALE: 200 100 0 200 400 Metres — 1:20,000

PROJECT: GOLDBORO LNG — ENVIRONMENTAL ASSESSMENT

DWN BY: TM

CHK'D BY: MC/BC

DATE: Aug 2013

REV. NO:

FIGURE NO: 9.7-4

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(P) 902-468-2848 (F) 902-468-1314

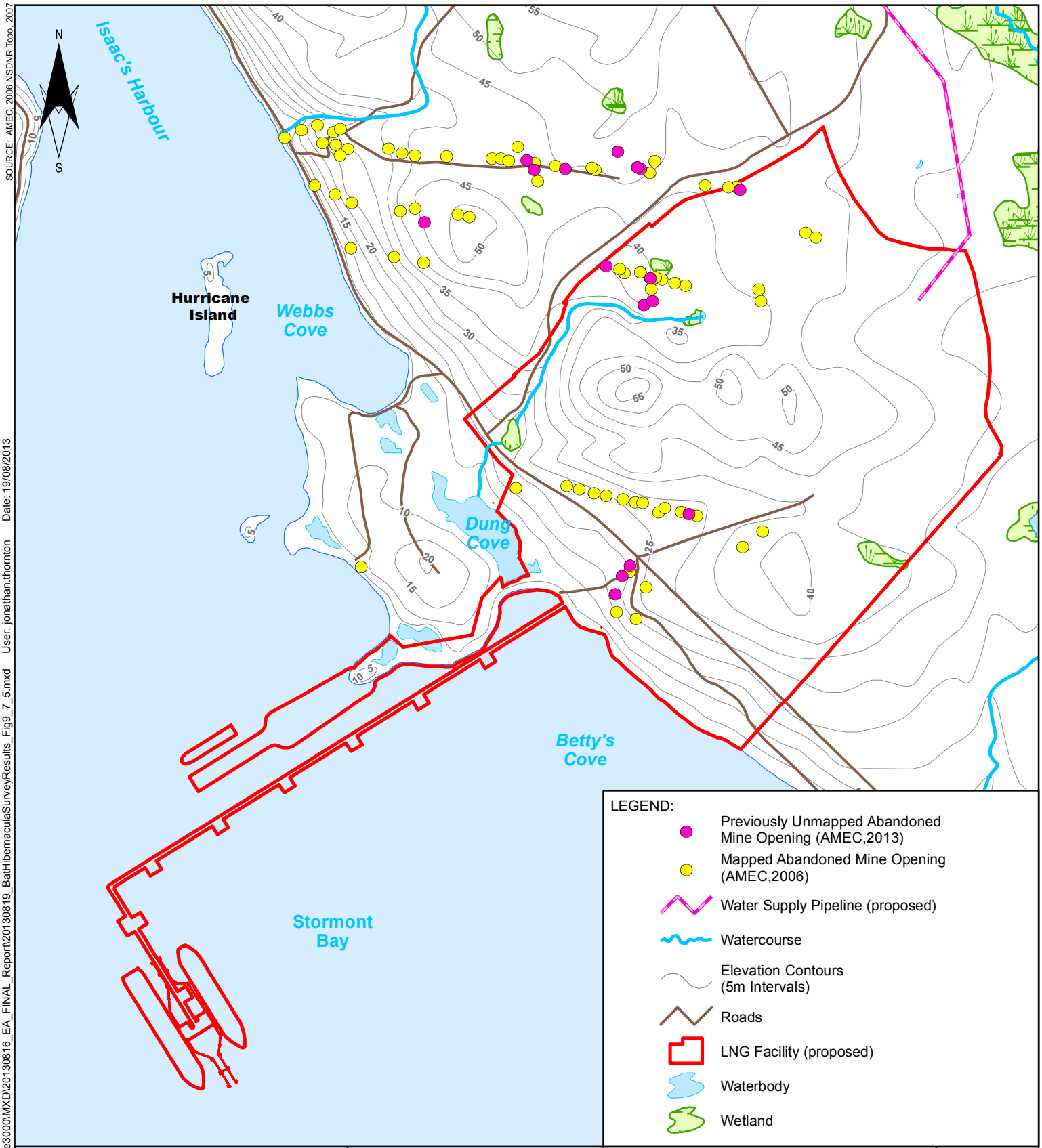
DATUM: NAD 83

PROJECTION: UTM Zone 20 North

PROJECT NO: TV121039

TITLE: **MOOSE SURVEY RESULTS (AMEC 2013)**

Path: G:\GIS\PROJECTS\TV121039_Phase3000\MXD\20130822_EA_FINAL_Report\20130822_MooseBatSurveyRte_Fig9_7_4.mxd User: jonathan.thornton Date: 22/08/2013



SOURCE: AMEC, 2006 NSDNR Topo, 2007

Date: 19/08/2013 User: jonathan.thornton Path: G:\GIS\PROJECTS\TV121039_Phase3000\MXD\20130816_EA_FINAL_Report\20130819_BatHibernaculaSurveyResults_Fig9_7_5.mxd

CLIENT: Pieridae Energy (Canada) Limited	SCALE: 200 100 0 200 Metres 1:13,000	PROJECT: GOLDBORO LNG ENVIRONMENTAL ASSESSMENT	DWN BY: TM
			CHK'D BY: TM/BC
			DATE: Aug 2013
AMEC Environment and Infrastructure A Division of AMEC Americas Ltd. 50 Troop Avenue, Unit 300 Dartmouth, N.S., B3B 1Z1 (P) 902-468-2848 (F) 902-468-1314	DATUM: UTM Zone 20	TITLE: POTENTIAL BAT HIBERNACULA SURVEY RESULTS	REV. NO: N/A
	PROJECTION: NAD83		FIGURE NO: 9.7.5
	PROJECT NO: TV121039.		

9.8 Agriculture, Aquaculture and Forestry Resources

9.8.1 Agriculture

Agriculture is an important industry to NS. The number of farms in NS remained relatively constant from the 2001 to 2011 with the number of farms of all sizes decreasing by less than 0.5% from 3,923 to 3,905 during that period (Statistics Canada, CANSIM table 004-0005). The data from Table 9.8-1 was consolidated based on information available on the Nova Scotia Federation of Agriculture (NSFA) website. Roughly 8.6% of the farms in NS are in Antigonish and Guysborough counties, the majority of which are in Antigonish County.

Table 9.8-1 Total Number of Farms in Guysborough and Antigonish and Counties

Location	2006	2011	% Change
Guysborough	90	99	10%
Antigonish	226	235	4%
Nova Scotia	3795	3905	2.9%

Source: NSFA, 2013

Agriculture operations in Guysborough and Antigonish counties are summarized in Table 9.8-2. It is important to note that agriculture operations have not been identified in, at, or near the Project site.

Table 9.8-2 Farms Classified By Industry (North American Industry Classification System), 2011

Sector	Guysborough	Antigonish
Total farms	99	235
Nursery and tree production	61	42
Fruit & tree-nut farming	26	46
Beef cattle ranching & farming, inc feedlots	3	40
Hay farming	2	27
Dairy cattle and milk production	2	34
Sheep farming	2	4
Fur-bearing animal and rabbit production	1	1
Horse and other equine production	1	9
Apiculture	1	0
Livestock combination farming	0	12
All other miscellaneous crop farming	0	4
Chicken egg production	0	4
Floriculture production	0	4
Other vegetables (e.g., potatoes) & melon farming	0	3
Goat farming	0	2
Other food crops grown under cover	0	1
Broiler and other meat-type Chicken production	0	1
Hog and pig farming	0	1

Source: Nova Scotia Department of Agriculture (NSDA), 2011, AMEC Interpretation

For an assessment of the interaction between the Project and the herein described environment, refer to Section 10.14.3.

9.8.2 Fishery, Aquaculture and Marine Harvesting

Recreational fisheries include gaspereau (alewives) which begin migration in early spring and are followed by smelt, eel, trout, and Atlantic salmon. Blueback Herring is similar to Alewife and the two are often fished together sometimes being referred to collectively as gaspereau (AMEC, 2006).

Stormont Bay supports several local fisheries including: herring and mackerel and lobster (Figures 9.8-1 and 9.8-2). Although the productivity of the Lobster Fishing Area that encompasses the proposed marine terminal is relatively low compared to other areas, lobster is the dominant species of concern (AMEC, 2006). Blue Mussel is also an important aquaculture species grown by Country Harbour Sea Farms in Country Harbour (Figure 9.8-1). The aquaculture industry generally relies on harvesting of seed spat (larvae) from Country Harbour and Stormont Bay in the summer.

9.8.2.1 Commercial Fisheries

Commercial fisheries are an important sector of the Nova Scotian economy, particularly for rural communities where employment opportunities may be limited. The fisheries within the province are regulated by DFO and are confined to specific NAFO fishing areas throughout the province. Goldboro is located within NAFO area 4W, which encompasses the eastern shore of NS from Halifax north to Fourchu in Cape Breton.

There are a total of 13 ports within the Project area:

- Bickerton West;
- Coddles Harbour;
- Country Harbour;
- Drum Head;
- Fisherman's Harbour;
- Isaac's Harbour;
- New Harbour;
- Port Bickerton;
- Port Hilford;
- Seal Cove;
- Sonora;
- Stormont; and
- Wine Harbour.

In addition, within the Project area there are three main harbour authorities which are responsible for port and wharf management:

- Harbour Authority of Port Bickerton;
- Harbour Authority of Drum Head; and
- Harbour Authority of New Harbour.

There are over 200 registered fishing vessels ranging from 18 to 64.9 feet in Guysborough County, the majority of which are less than 34.9 feet in length.

Several species of groundfish, pelagic fishes and invertebrates are fished within NAFO area 4W including: Cod, Haddock, Redfish, Halibut, Flounder, Pollock, Hake, Herring, Mackerel, Tuna, Swordfish, Argentine, Shark, Scallops, Lobster, Shrimp, Crab and others. Fishing seasons, fishing gear and catch quota regulations are established by DFO and may vary from year to year. In 2010 the highest landings of all the fisheries for area 4W was Herring and Silver Hake where 9,871 and 8,094 t were caught respectively. Redfish, Swordfish, Pollock and Halibut also had significant landings. The groundfish are predominantly fished with an otter trawl or stern trawl, however longlines are also used. Pelagic fisheries use an array of gear including otter and stern trawls, purse seines, gill or drift nets, longlines, harpoons and angling (DFO, 2013).

Snow Crab, Lobster and Shrimp were the three invertebrate fisheries with the highest landings in 2010 with 5,676 t, 3,880 t and 2,827 t respectively. Snow Crab and Lobster are fished using traps whereas Shrimp are more often fished using a shrimp trawl (DFO, 2013).

Lobster and Rock Crab are currently fished in Stormont Bay and surrounding areas. Lobster in the area is managed under Lobster Fishery area 31B, one of three Lobster Fishery Areas covering the Eastern Shore. Stormont Bay supports a small rock crab fishery with a limited number of licenses. Generally Rock Crab is managed as a by-catch associated with Lobster (AMEC, 2006).

9.8.2.2 First Nations Fisheries

There are a several commercial licences held by First Nation communities that can be and have been used in the Project area. These include elver, lobster, shrimp, mackerel, gaspereau, and groundfish. The Waycobah First Nation has used its elver licence in the area in recent years (O'Leary, E., pers. comm., 2013). Furthermore, the Paq'tnkek First Nation has an urchin lease in close proximity to the Project site, and has harvested urchins in the open urchin zone area adjacent to the Project site (Milley, C., pers. comm., 2013). While many of these licences have been inactive over recent years due to resource abundance and/or market condition, the trend in resource abundance can result in renewed harvesting activity.

9.8.2.3 Recreational Fisheries

People may fish for Mackerel or other pelagic fishes from shore within Stormont Bay however there is limited information on recreational fishing. It is unlikely that other recreational fishing occurs within the area.

9.8.2.4 Aquaculture

There are six aquaculture leases within Country Harbour and are the closest aquaculture sites to the proposed Project location. The leases for these sites are held by Atlantic Aqua Farms Partnership, the nearest of which is approximately 5 km from the Project location (Figure 9.8-2). The licensed species for these leases are Blue Mussel and Sea Scallop (*Placopecten magellanicus*).

Shellfish farming in Country Harbour is done by suspension cultivation from longlines, whereby cultures are hung at intervals along a line which is anchored at each end. Buoys and concrete blocks are tied along the line to provide mooring and regulate the overall height of the longline in the water column. Growers will sink the longlines below the ice during winter months to avoid losing valuable cultures and gear. Most operations use a boat with a power operated winch to lift, tend, clean and harvest the lines. Aquaculture operations in Guysborough County are relatively small scale and employment varies seasonally with a small core staff of less than five people (AMEC, 2006). Cultivation of finfish has been considered and attempted in some areas, but none are currently produced within Stormont Bay.

For an assessment of the interaction between the Project and the herein described environment, refer to Section 10.13.4.

9.8.3 Forestry Resources

Approximately 70% of the 400,840 ha of the land in Guysborough County is forested (Guysborough County Regional Development Authority, 2013). A little more than half of the timber produced in the County is softwood, while the remainder is mixed wood and hardwood.

In total, the northeastern region of NS (which includes Guysborough and Antigonish Counties) produces roughly 50% of the province's pulpwood, 41% of its lumber, and 74% of its whole tree chips. There are about 250-300 full-time forest-related jobs in the area, such as harvesting, trucking, road building, and silvaculture work. Guysborough supplies about 30% of the wood received by NS's pulp and paper mills, or around 625 000 m^3 per year (Guysborough County Regional Development Authority, 2013).

The proposed Goldboro LNG site is located in a forested area; however, it is considered non-merchantable. Presence of steeper terrain and wetland areas also make some of the land base non-operational. A timber evaluation conducted by Scott and Stewart Forestry Consultants Ltd. (2003) of Goldboro Industrial Park in 2003 indicated that the majority of the forest stand is immature, and has not reached commercial size (i.e., small diameter stems and low merchantable volume). In a 2003 letter to Strait Engineering Ltd, they reported:

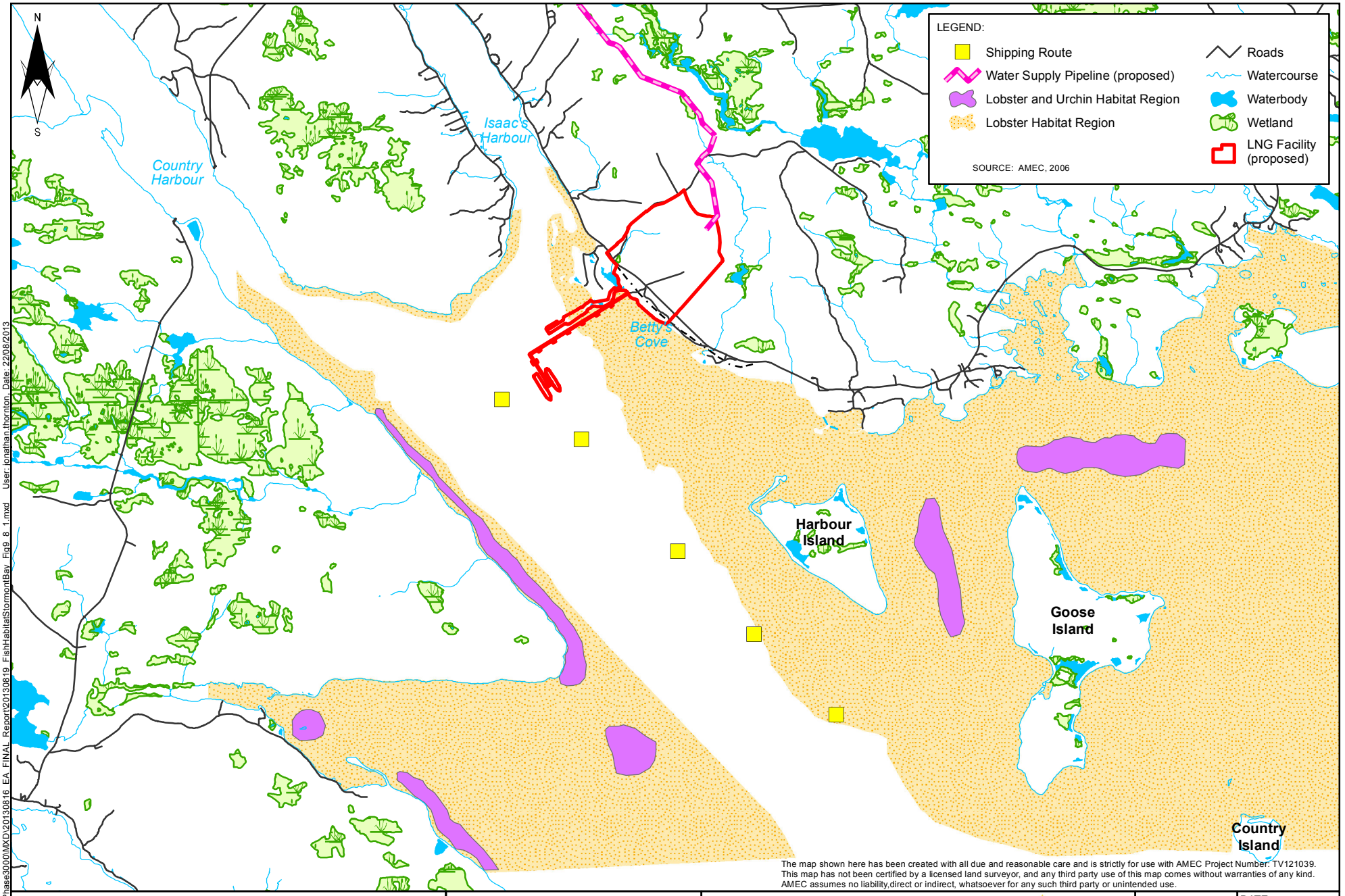
"We assessed a total of 170.4 ha. The assessed area can be broken into two categories:

- *Category 1 – ~80% of assessed area (135.8 ha) has no merchantable volume. There are merchantable trees and patches of merchantable trees scattered throughout these areas. The volume on these stands may reach 30 m^3 per ha, but are considered unmerchantable in the context of traditional forest harvesting practices.*

- *Category 2 – ~20% of the assessed area (34.6 ha) is made up of stands that have enough trees growing in them to be considered merchantable. It should be noted that the stands are not of high quality due to the small size of most of the trees and the scattered nature of the larger trees..."* (Scott and Stewart Forestry Consultants Ltd., 2003).

A high level assessment of the vegetation of the Project area was included in MapleLNG's 2008 Permit to Construct application. In that report the site was described as being cut, recut or actively cut resulting in an area of "coniferous stands, clear cuts, and shrubland". The areas that were still forested at that time consisted of mostly balsam fir with black spruce, white birch, red maple, and mountain ash. The stands were described as young with 75% of stems less than 20 cm dbh. Previously clear-cut areas are now dominated by speckled alder, white birch, and heath shrubs. The plant area contains significant amounts of slash and litter (MapleLNG, 2008).

For an assessment of the interaction between the Project and the herein described environment, refer to Section 10.14.4.



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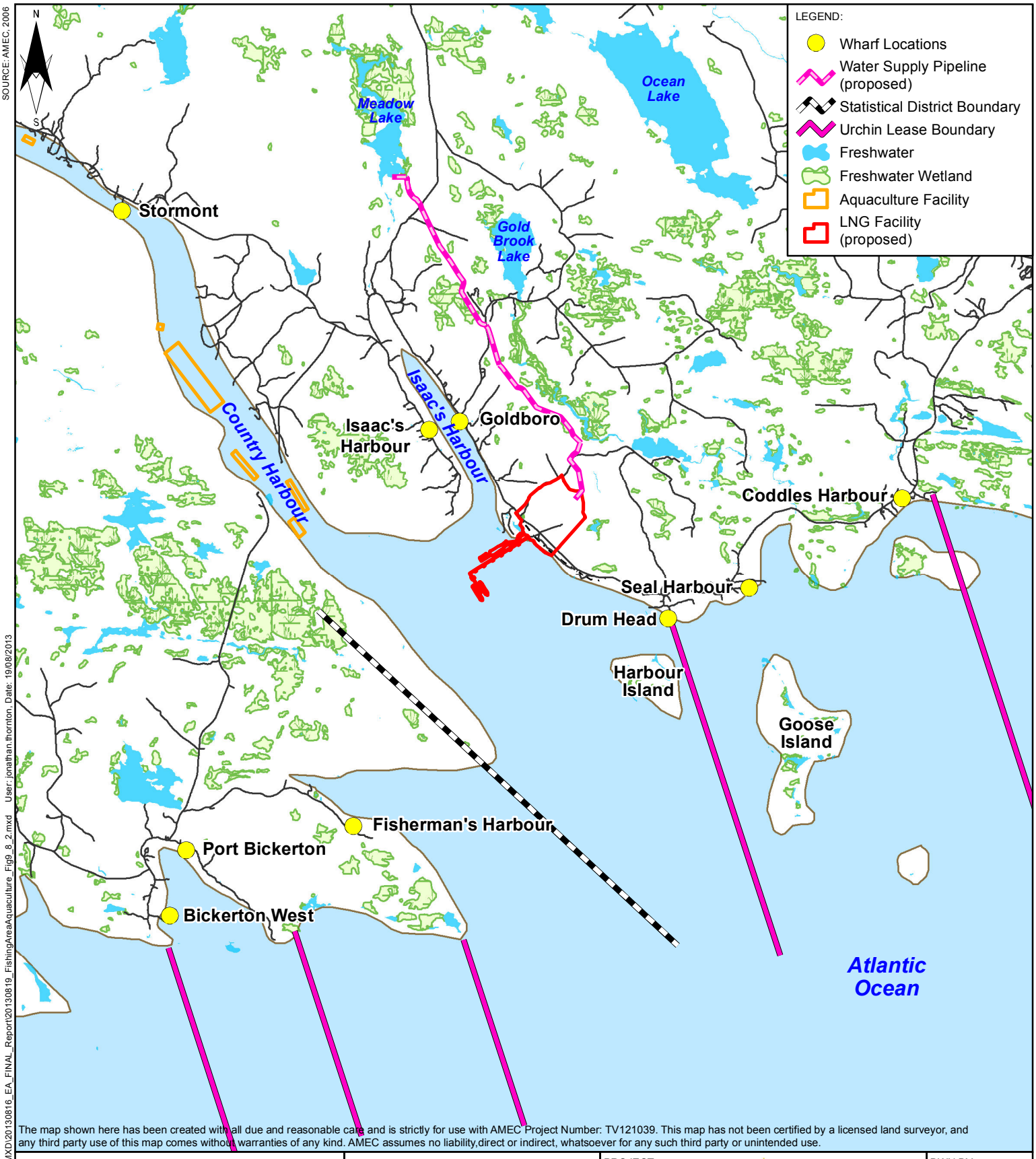
CLIENT: Pieridae Energy (Canada) Limited	0 500 1,000 2,000 Metres	PROJECT: ENVIRONMENTAL ASSESSMENT GOLDBORO LNG	DWN BY: JT	DATE: Aug 2013
	DATUM: UTM Zone 20		CHK'D BY: TM/GB	REV. NO: N/A
AMEC Environment and Infrastructure A Division of AMEC Americas Ltd. 50 Troop Avenue, Unit 300 Dartmouth, N.S., B3B 1Z1 (P) 902-468-2848 (F) 902-468-1314 amec	PROJECTION: NAD83	TITLE: FISH HABITAT IN STORMONT BAY AND ADJACENT AREAS	SCALE: 1:60,000	FIGURE NO: 9.8-1
	PROJECT NO: TV121039			



SOURCE: AMEC, 2006

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CLIENT: Pieridae Energy (Canada) Limited

SCALE: 2,000 1,000 0 2,000 Metres 1:100,000

PROJECT: GOLDBORO LNG
ENVIRONMENTAL ASSESSMENT

DWN BY: JT

CHK'D BY: TM/GB

DATE: Aug 2013

REV. NO: N/A

FIGURE NO: 9.8-2

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A Division of AMEC Americas Ltd.
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Dartmouth, N.S., B3B 1Z1
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DATUM: UTM Zone 20

PROJECTION: NAD83

PROJECT NO: TV121039

TITLE: FISHING AREAS AND AQUACULTURE NEAR COUNTRY HARBOUR