APPENDIX J

Benthic Habitat Studies

Benthic Habitat Study (CBCL 2016a)
Eelgrass Delineation (Stantec 2023)

BENTHIC HABITAT SURVEY

March 2016

ISO 9001
Registered Company

CBCL LIMITED
Consulting Engineers

151214.07

A subsidiary company of Liquefied Natural Gas Limited

Contents

Appendices

Acronyms

Bear Head LNG	Bear Head LNG Corporation Inc.
CRA	Commercial, Recreational and Aboriginal
DFO	Fisheries and Oceans Canada
HADD	Harmful Alteration Disruption or Destruction
LNG	Liquefied Natural Gas
ROV	Remotely Operated Vehicle
UBHS	Underwater Benthic Habitat Survey

CHAPTER 1 INTRODUCTION

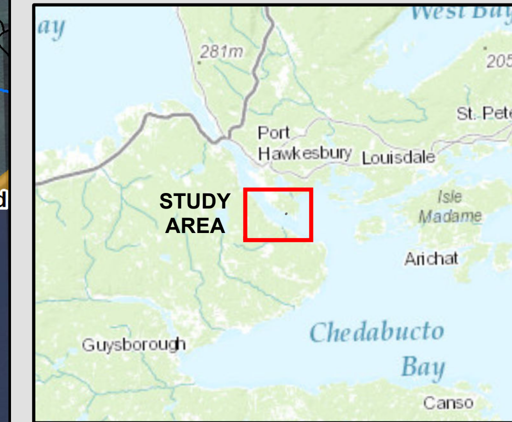
1.1 Project Background

Bear Head LNG Corporation Inc. (Bear Head LNG) is planning to build a permanent material offloading wharf with tug mooring within the western portion of their water lot on the northern shore of the Canso Strait in the Point Tupper Industrial Park in Richmond County (Figure 1.1). CBCL Limited was engaged by Bear Head LNG to conduct an underwater benthic habitat survey of the western portion of the water lot and to prepare the documentation necessary to support a “Request for Review” to Fisheries and Oceans Canada (DFO). The underwater survey of benthic habitat consisted of four transects filmed by scuba divers and 10 spot checks filmed by a submersible ROV (remotely operated vehicle).

1.2 Proposed New Marine Facility

The proposed new marine facility is to the west of the proposed liquefied natural gas (LNG) export pier. The proposed structure includes a piled wharf located in front of the shoreline and approximately parallel to the shoreline (Appendix A). The piled wharf structure consists of two segments: a material offloading wharf and a tug mooring (Figure 1.2: A). An infilled approach connects the shoreline to the back of the material offloading wharf. This armourstone sides of this approach are estimated to be 2:1 slopes. Three breasting dolphins and two mooring dolphins run perpendicular to the material offloading structure to accommodate the stern first berthing of the barge.

The material offloading wharf is approximately 50 m long by 24 m wide with an estimated 78 - 610 mm diameter piles that cover approximately 8 m^2 of the seabed surface area (see Figure 1.2: A). Many of these piles are located within the infill area. The tug mooring is approximately 116 m long by 15 m wide with an estimated 60 - 610 mm diameter piles that cover approximately 17 m^2 of the seabed surface (see Figure 1.2: A). The infilled approach has a footprint of approximately 5,700 m^2 on the seabed surface. Each breasting dolphin is estimated to have eight 1,200 mm diameter steel piles with a footprint area of 9 m^2. Each mooring dolphin is estimated to have four 1,200 mm diameter steel piles with a footprint area of 5 m^2. The total footprint of the infill area and piles is estimated to be 5,778 m^2. No dredging is planned as part of this construction.



Legend

- Property Line
- Roads and Trails
- Lakes
- Lake Boundary
- Freshwater Wetlands
- Marine wetlands
- Rivers and Streams

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1955-2015

Bear Head LNG Benthic Habitat Survey

FIGURE 1:1
PROJECT LOCATION

Drawn: KS/MD	Date: 19/11/2015
Checked: CM	CBCL Project Number: 151214.07
Approved: CB	Scale @ 11"x17" 1:25,000
Sheet: of	

Service Layer Credits: Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey,

0 250 500 750 1,000 1,250 Meters

Coordinate System: NAD 1983 CSRS UTM Zone 20N
Units: Meter

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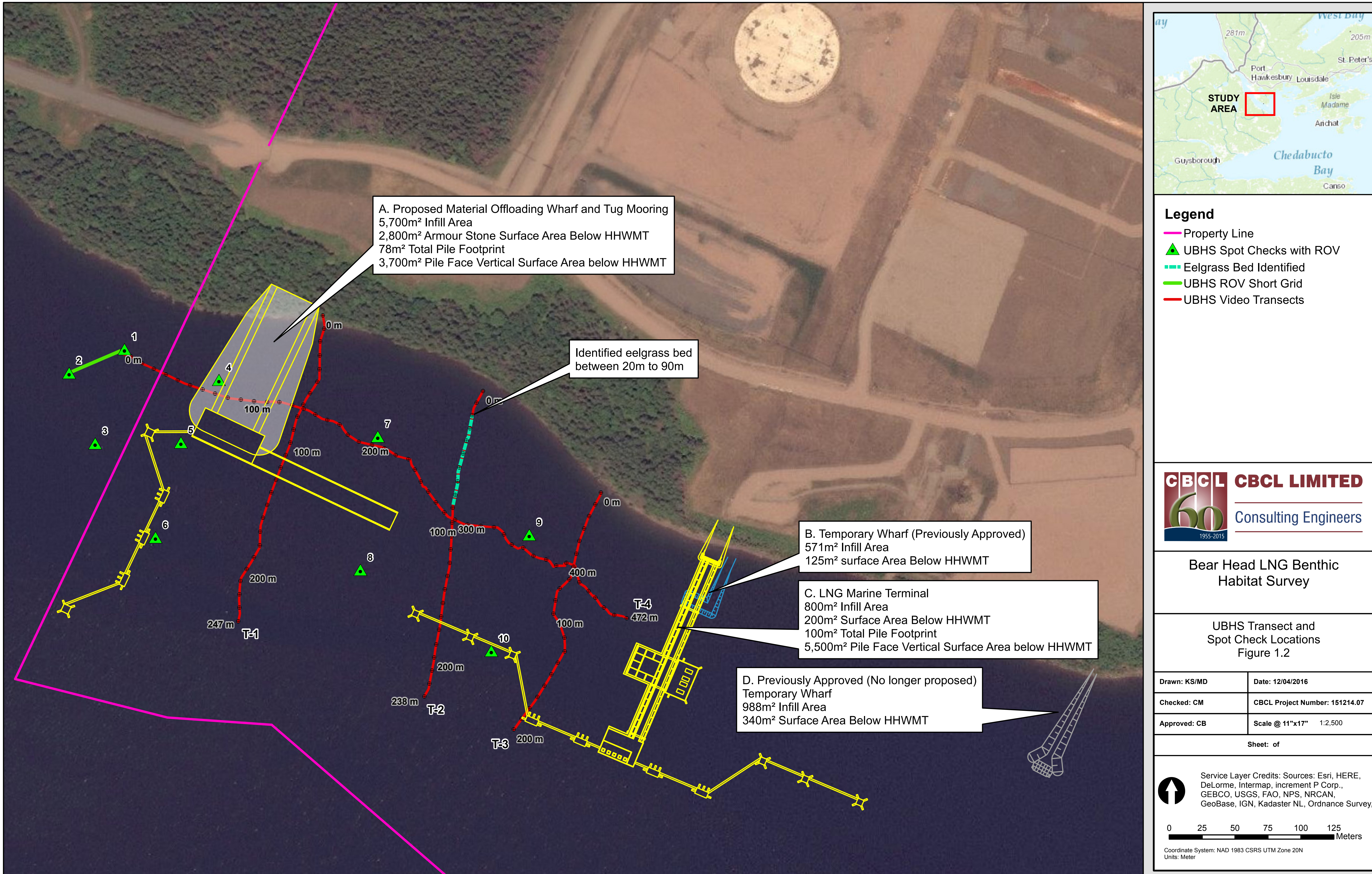

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1.2.1 Previously Proposed Temporary Facilities

The original application to Fisheries and Oceans Canada (DFO) was for the LNG Pier (Figure 1.2: C) and two temporary structures: the same temporary wharf structure proposed for this project (see Figure 1.2: B) and a second which is no longer required (Figure 1.2: D). The latter structure was planned to the east of the LNG Pier and included an infill approach to a steel sheet pile structure. This infill was estimated to have 2:1 side slopes with armour stone coverage. The infill area was approximately 62 m long by 5 m wide. The proposed material offloading wharf and tug mooring (Figure 1.2: A) will replace the functional requirements of structure D as referenced on Figure 1.2.

The second temporary structure, i.e., Figure 1.2: B, which is still required, involves infill near the shore at the location of the permanent LNG Pier (Figure 1.2). The infill area is approximately 50 m long by 6 m wide with approximate 2:1 side slopes with armour stone coverage. This structure is required to support equipment during the construction of the nearshore portion of the LNG Pier where the water depths are too shallow to allow safe access by barge-mounted equipment.

1.2.2 Comparative Footprint Areas

The previously proposed temporary infill structure (D) to the east of the LNG Pier had an approximate footprint of 988 m^2 (Appendix A). This structure is being replaced by the new permanent material offloading wharf and tug mooring (A) which has a footprint of 5,728m^2 (Appendix A).

The temporary structure at the LNG Pier that is still required has an approximate footprint of 571 m^2 (B).

1.2.3 Regulatory History

On April 12 2006, Bear Head obtained a Section 35(2) *Fisheries Act* Authorization from the DFO to construct a Marine LNG Terminal including the installation of two temporary structures to be used during construction (DFO File # 05-G7-1000) (see Figure 1.2: B, C and D). The *Fisheries Act* Authorization approved the temporary Harmful Alteration Disruption or Destruction (HADD) of 1,560 m^2 of fish habitat as detailed in the *Fisheries Act* Authorization Application submitted to DFO dated March 3, 2006. The conditions of approval included the completion of the habitat compensation project as detailed in the March 3, 2006 application. Subsequent correspondence with DFO extended the Valid Authorization Period of this approval. The latest *Fisheries Act* Authorization correspondence from DFO, dated August 29, 2014, states that DFO is satisfied that Bear Head LNG has completed their habitat compensation plan and that DFO will extend the fish habitat credit on an annual basis.

1.3 Scope of Report

This report presents the results of four underwater benthic habitat video transects and 10 drop camera spot checks. The underwater benthic habitat videos were conducted to characterize benthic substrates, macroflora and macrofauna. A review of commercial, recreational and aboriginal (CRA) fisheries that could occur within the project study area, or within the proximity of the study area, was also conducted. A comprehensive functional assessment of the observed benthic habitats that could support the identified CRA fisheries was performed.

1.4 Project Location

The survey transects and the spot check locations were completed within the western portion of the Bear Head LNG water lot located in the Point Tupper Industrial Park on the northern shore of the Strait of Canso (see Figures 1.1 and 1.2).

CHAPTER 2 METHODOLOGY

The survey methodology implemented for this project was developed to characterize the benthic habitat and its functionality in relation to CRA fisheries within the western portion of the Bear Head water lot. The following section details the survey methodology utilized.

2.1 Fisheries Habitat Survey Plan

The survey was conducted on October 15th and October 16th, 2015 by CBCL Limited personnel and a sub-contracted dive team (Atlantic Sub-Sea Construction and Contracting). The CBCL Limited observer on site ensured that the correct survey locations were videoed using a handheld GPS unit (Garmin 76CSx) and recorded any deviations from the proposed survey design (Table 2.1). The location of the linear transects and the drop camera spot checks and depicted on Figure 1.2.

Table 2.1: Geographical coordinates for the proposed and surveyed transect start and end points (Datum: WGS 1984)

Transect	*Surveyed Start Point*		*Surveyed End Point*	
	LAT	*LONG*	*LAT*	*LONG*
T1	45.554376	61.308052	45.556453	61.307167
T2	45.555915	61.305625	45.553838	61.306259
T3	45.5536	61.305397	45.555205	61.304501
T4	45.554343	61.304273	45.556247	61.309122

2.2 Underwater Video Transects

Four (4) linear transects were delineated using a weighted and anchored line with every 10 m segment tagged (Figure 1.2). Three (3) linear transects ran approximately perpendicular to the shoreline from the upper intertidal zone to the divers 'no decompression limit', or to the limit at which the divers could safely stay underwater without having to decompress on ascension from the bottom (~21 m in depth). This resulted in two transects 245 m in length and one transect 200 m in length. The fourth transect ran approximately parallel to the shoreline from the western limit of the Bear Head water lot through the location of the proposed segmented wharf structure to the proposed location of the LNG Pier approximately to 450 m eastward. The dive team recorded video approximately 1 m above the surface of the sea floor. At each 10 m interval, the diver panned in a

360 degree arc from left to right to capture adjacent habitat types and substrate uniformity. Transects were conducted at water depths of between 0 to 21 m.

2.3 Underwater Video Spot Checks

Video spot checks were completed in ten (10) locations (Table 2.2). Six (6) of these locations were to the west of Transect 1, two (2) were located between Transects 1 and 2, and the remaining two (2) were located between Transects 2 and 3 (Figure 1.2). A video of the sea floor was taken at the selected location by completing a 360° video pan of the surrounding area. Due to the mobility of the ROV utilized for the spot checks, the video pan included a short circular survey at each spot check location. The ROV was also utilized for a short grid survey between SC1 and SC2 to increase the resolution of the habitat survey in that portion of the Bear Head water lot to the west of Transect 1. Spot checks were conducted at water depths between 7 to 17 m.

Table 2.2: Geographical coordinates for the proposed and surveyed transect start and end points (Datum: WGS 1984)

Spot Checks	*Proposed Spot Check Locations*	
	LAT	*LONG*
SC1	45.556253	-61.309103
SC2	45.556099	-61.309645
SC3	45.555614	-61.309407
SC4	45.55603	-61.308191
SC5	45.555608	-61.308573
SC6	45.554964	-61.30884
SC7	45.555621	-61.306658
SC8	45.554713	-61.306854
SC9	45.554928	-61.305205
SC10	45.554141	-61.305598

2.4 Habitat Classification and Function

Habitats were identified and categorized based on substrate type, flora and fauna. Substrate types were approximated visually using the following Wentworth scale (Wentworth, 1922):

- Boulder: > 256 mm;
- Cobble: 64-256 mm;
- Gravel: 2-64 mm; and
- Fines: < 2 mm.

Marine macroflora and macrofauna species abundance was assessed based on a semi-quantitative scale and on the professional judgement of the CBCL Limited biologists. The classifications included:

- Abundant (A): Numerous (not quantifiable) observations;
- Common (C): Frequent (not quantifiable) observations;
- Occasional (O): Intermittent (quantifiable) observations; and
- Uncommon (U): Infrequent (quantifiable) observations.

Habitat suitability and functionality for each habitat type identified was determined for the following lifecycles of identified or potential CRA fisheries: spawning, rearing, overwintering, adult foraging, cover and migration. Using professional judgement and information gleaned from a thorough literature review of the habitat requirements of each species, an evaluation of poor, poor-moderate, moderate, moderate-good or good was provided for each lifecycle.

CHAPTER 3 CRA FISHERIES ASSESSMENT

3.1 CRA Fisheries Assessment Approach

Approximately 538 species of fish reside in the Atlantic Ocean (Breeze *et al*., 2002). In order to narrow down a list of the most important and common CRA fish and prey species within the Study Area, a summary of CRA fisheries within, or in proximity to, the Bear Head site was derived from the following sources:

- Bear Head Environmental Assessment (SNC Lavalin, 2015);
- Personal communications with the DFO (Gentile, Paul. *Pers. Comm*. 2015);
- A thorough desktop review, including a literature search (e.g., Canada-Nova Scotia Strait of Canso Environment Committee, 1975); and
- Positive identification of species in the underwater benthic habitat videos.

A list of all species selected for the CRA fisheries assessment and the fish habitat functional assessment (see Chapter 5) is provided in Table 3.1.

Table 3.1: List of CRA Fish Species Selected

Common Name	***Scientific Name***	***Reason Selected***
American Oysters	*Crassostrea virginica*	• Recreational Fishery • Commercial Fishery
Sea Scallops	*Placopecten magellanicus*	• Observed in Study Area • Commercial and Recreational Fishery
Sand Shrimp	*Crangon Septemspinosa*	• Prey Species to CRA • Observed in Study Area
Green Sea Urchin	*Strongylocentrotus droebachiensis*	• Potentially Observed in Study Area • Commercial Fishery
Bar/Soft Shell Clams	*Spisula solidissima/ Mya Arenaria*	• Observed in Study Area • Recreational Fishery
Hermit Crabs	*Pagarus sp.*	• Observed in Study Area • Prey Species to CRA
Lobster	*Homarus americanus*	• Observed in Study Area • Commercial and Aboriginal Fishery
Blue Mussel	*Mytilus edulis*	• Shell Debris Observed in Study Area

Common Name	Scientific Name	Reason Selected
		• Recreational Fishery
Rock Crab	*Cancer irroratus*	• Observed in Study Area • Commercial Fishery
Snow Crab	*Chionoecetes opilio*	• Commercial Fishery • Aboriginal Fishery
Bluefin Tuna	*Thunnus thynnus*	• Commercial Fishery
American Plaice	*Hippoglossoides platessoides*	• Commercial Fishery
White Hake	*Urophycis tenuis*	• Observed in Study Area • Commercial Fishery
American Eel	*Anguilla rostrata*	• Potential Aboriginal Fishery • Commercial Fishery
Atlantic Salmon	*Salmo salar*	• Potential Aboriginal Fishery • Commercial and Recreational Fishery
Brook Trout	*Salvelinus fontinalis*	• Potential Aboriginal Fishery • Recreational Fishery
Cod	*Gadus morhua*	• Commercial and Recreational Fishery
Mummichog	*Fundulus heteroclitus*	• Important prey species
Sandlances	*Ammodytes americanus*	• Observed in Study Area • Important Prey Species
Atlantic Herring	*Clupea harengus*	• Potentially Observed in Study Area • Commercial Fishery
Threespine Stickleback	*Gasterosteus aculeatus*	• Important prey species
Northern Shrimp	*Pandalus borealis*	• Potentially Observed in Study Area • Important Prey Species • Commercial Fishery
Winter Flounder	*Pseudopleuronectes americanus*	• Observed in Study Area • Commercial and Recreational Fishery
Mackerel	*Scomber scombrus*	• Commercial Fishery • Recreational Fishery
Cunner	*Tautogolabrus adspersus*	• Observed in Study Area • Recreational Fishery • Prey Species

3.2 Commercial Fisheries

Over 25 species of fin fish and shell fish have the potential to be commercially fished in the Strait of Canso region (Canada-Nova Scotia Strait of Canso Environment Committee, 1975; SNC Lavalin, 2015). Due to the large volume of commercial species potentially fished near the Bear Head water lot, only species that were observed in the underwater video and species identified to be the most valuable were included in this assessment (Table 3.1). The commercial fish species which were observed in the underwater video include:

- White hake;
- Lobster;
- Rock crab;
- Atlantic herring (Potentially);
- Winter flounder;
- Northern shrimp (Potentially);
- Sea scallops; and
- Green sea urchin (Potentially).

Habitat for the species listed above occurs within the Bear Head water lot. Habitat functional assessments for these species are provided in Chapter 5.

3.3 Recreational Fisheries

Recreational fisheries identified near the Bear Head water lot include:

- American oyster;
- Bar/soft shell clams;
- Cod;
- Mackerel;
- Cunner;
- Blue mussel;
- Atlantic salmon;
- Brook trout;
- Sea scallops; and
- Winter flounder.

The following recreational fish were observed in the underwater video:

- Bar/soft shell clam siphons;
- Cunner;
- Blue mussel shell debris; and
- Winter flounder.

Habitat for the species listed above occurs within the Bear Head water lot. Habitat functional assessments for these species are provided in Chapter 5.

3.4 Aboriginal Fisheries

An aboriginal fishery for American lobster takes place in the greater Strait of Canso/Chebucto Bay area (Gentile, Paul, pers. comm., 2015). Other potential species taken by the aboriginal fishery in the area include: Atlantic salmon, snow crab, American eel and brook trout. American lobster were identified in the underwater video. Habitat functional assessments for these species are provided in Chapter 5.

3.5 Fish that Suppport CRA Fisheries

Six species have been identified through desktop research and observations of the underwater benthic habitat videos as prey species of the above noted CRA fisheries. Shrimp (suspected *Pandalus borealis or P. montagui),* sand lances *(Ammodytes sp.),* cunner (*Tautogolabrus adspersus*) and hermit crabs *(Paguroidea family)* were identified in the survey. The common mummichog *(Fundulus heteroclitus)* and threespine stickleback *(Gasterosteus aculeatus)* were identified using the Bear Head Environmental Assessment (2015) and the Canada-Nova Scotia Strait of Canso Environment Committee (1975).

3.5.1 Shrimp

Shrimp were identified during the benthic habitat video review. The commercial shrimp fishery in eastern Canada occurs between the Gulf of St. Lawrence off the Scotian Shelf, Northwestern Newfoundland and Labrador and the Davis Strait (DFO, 2014). Shrimp are an integral link in the food chain and are a key prey species for groundfish such as cod and halibut, which are both CRA fisheries (DFO, 2014).

3.5.2 Sandlance

Sandlances (or sand eels) were identified during the benthic habitat video review. They are commonly found in water depths less than 90 m with sand or light-gravel substrates. They are known for their sand burrowing behaviour between periods of feeding activities. The sandlance is an important prey species for cod, salmon, haddock (*Melanogrammus aeglefinus*), silver hake (*Merluccius bilinearis*) and yellowtail flounder (*Pleuronectes ferruginea*) (Auster and Stewart, 1986). Sandlance were observed during the underwater video survey.

3.5.3 Hermit Crab

Hermit crabs were identified during the benthic habitat video review. They are not considered to be a commercial, recreational or aboriginal fishery, but are an important food source for CRA fish such as skates, cod, and hake. They prefer sandy habitat types and are found in shallow subtidal zones (Christian, 2010). Hermit crab were observed during the underwater video survey.

3.5.4 Mummichogs

Mummichogs are common in tidal waters and salt marsh, along the shores of harbours and in brackish waters in streams and estuaries. Mummichogs are an important prey food for CRA fisheries such as American eels (*Anguilla rostrate*) and crabs (Abraham, 1985). Although not observed during the underwater video survey, this species is suspected to occur in the water lot (SNC Lavalin, 2015).

3.5.5 Threespine Stickleback

Threespine sticklebacks can be found in marine, brackish and coastal freshwater environments. They are abundant and are slow swimmers, making them easy prey for predatory fish species such as salmonids (i.e., Atlantic salmon, brook trout) (Evans et al., 2002). Although not observed during the underwater video survey, this species is suspected to occur in the water lot (SNC Lavalin, 2015).

3.5.6 Cunner

Cunner are a common species along the shoreline and prefer to reside in rocky reefs, eelgrass beds, rocky outcrops, gravel and kelp (Auster, 1989). Cunner would suffice as a food source for larger predatory fish species. Cunner were observed during the underwater video survey.

CHAPTER 4 VIDEO TRANSECT INTERPRETATION

4.1 Transects

The survey included three transect lines running perpendicular to the shoreline and one transect running parallel to the shoreline following the 6 m (20 ft) depth contour line. The substrates of the three perpendicular transects were initially dominated by coarse materials in the intertidal and low subtidal zone, such as cobble gravel and small boulders, before transitioning to substrates dominated by fine materials comprised of sand, silt, mud and organic detritus. The fourth transect was dominated alternatingly by coarse and fine materials. The substrate composition of each of the four transects was affected by depth and distance from the shoreline (see transect interpretations in Appendix B).

Macrofloral species identified during the interpretation of the video transect surveys consisted of *Fucus sp*., *Ascophyllum nodosum*, *Chorda filum*, *Laminaria sp*., *Desmarestia sp*., *Agarum cribrosum*, *Chondrus crispus*, *Polysiphonia sp*., *Corallina officinalis, Lithothamnium sp.* and *Zostera marina.* Photographs of some of the species observed are provided in Appendix C.

Macrofauna positively identified during the interpretation of the transects include American lobster (*Homarus americanus*), rock crab (*Cancer irroratus*), green crab (*Carcinus maenas*), hermit crab (*Pagurus sp.*), rock barnacle (*Balanus sp.*), periwinkle (*Littorina sp*.), sea scallop (*Placopecten magellanicus*), sea star (*Asterias sp*.), plumose anemone (*Metridium senile*), northern cerianthid (*Cerianthus borealis*), sand shrimp (*Crangon sp.*), lugworm (*Arenicola sp*.), sandlance (*Ammodytes americanus*), sculpin (*Myoxocephalus sp.*), cunner (*Tautogolabrus adspersus*) and winter flounder (*Pseudopleuronectes americanus*). Other macrofauna that was observed, but could not be identified, is included in the summary of each transect and included in Appendix B. Photographs of some of the species observed are provided in Appendix C.

A summary of the findings of each transect can be found in Sections 4.1.1 to 4.1.4. Section 4.2 contains an overview of the ten spot checks. A breakdown of depth, substrate composition, macrofauna and macroflora for each 10 m increment of each transect and spot check is provided in Appendix B.

4.1.1 Transect T1

Transect 1 ran perpendicular to the shoreline; the transect was 245 m in the total length surveyed and reached a maximum depth of 20 m (67 ft) at the 245 m interval marker. The upper limit of the intertidal zone through to the 30 m, interval marker was dominated by cobble and, to a lesser extent, gravel and small boulders. Beyond the 30 m interval, fine materials including sand, mud, silt and organic detritus dominated. The percent composition of the substrate skewed heavily toward fines as depth and distance from the intertidal zone increased. The substrate was composed primarily of fines except for intermittent and scattered boulders and cobble beyond the 150 meter interval (see summary, Appendix B).

Species of macroflora were present throughout Transect 1; these included *Fucus sp*., *Ascophyllum nodosum*, *Chorda filum*, *Laminaria sp*., *Chondrus crispus*, *Polysiphonia sp*., *Corallina officinalis* and *Zostera marina*. *Fucus sp*. dominated where cobbles and gravel were present in abundance, but were not found beyond the 80 m interval. *Ascophyllum nodosum* grew alongside *Fucus sp*. on cobble and gravel to the 30 m interval. *Polysiphonia sp*. grew as an epiphyte on *Fucus* and was prevalent where *Fucus* dominated. Other algae noted above were observed on occasion throughout the transect. No algae were found in significant density beyond the 70 m interval (see Appendix B). Photographs of some of the species observed are provided in Appendix C.

Macrofaunal species observed include American lobster (*Homarus americanus*), rock crab (*Cancer irroratus*), green crab (*Carcinus maenas*), hermit crab (*Pagurus sp.*), rock barnacle (*Balanus sp.*), periwinkle (*Littorina sp*.), sea scallop (*Placopecten magellanicus*), sea star (*Asterias sp*.), plumose anemone (*Metridium senile*), northern cerianthid (*Cerianthus borealis*) and cunner (*Tautogolabrus adspersus*). Other fish and shrimp were observed throughout the transect, but could not be identified to species. Potential species of fish include sandlance (Ammodytes americanus), Atlantic silverside (*Menidia menidia*) and Atlantic herring (*Clupea harengus*). Potential species of shrimp include sand shrimp (*Crangon sp.*), mysid shrimp (*Mysis sp*.) and *Pandalus sp.* (see Table 4.1 and transect summary in Appendix B for further details). Photographs of some of the species observed are provided in Appendix C.

Encrusting invertebrates observed grew both epilithically and epiphytically throughout the transect and included colonial bryozoans (*Membranipora sp.* and *Electra sp.*), colonial hydrozoans and spiral tube worms (*Spirorbis sp.*).

4.1.2 Transect T2

Transect 2 ran perpendicular to the shoreline; the transect was 245 m in total length surveyed and reached a maximum depth of 19 m (62 ft) at the 245 m interval marker. The transect was dominated by a fine substrate composed of sand, silt, mud and organic detritus. Cobble and gravel comprised the major substrate from the intertidal zone to the 40 m interval after which the substrate transitioned to a sandy/muddy matrix with lesser amounts of cobble and gravel. The remaining 200 m of transect was dominated by increasingly fine sediment with occasional penetration by small boulders and small patches of cobbles and gravels (see summary, Appendix B).

Macrofloral observations were made throughout Transect 2. Observed species included *Fucus sp., Laminaria sp*., *Chondrus crispus*, *Polysiphonia sp*., *Corallina officinalis*, *Lithothamnium sp*. and *Zostera marina*. *Fucus* was abundant in the first 20 m of the transect, but was replaced by *Zostera marina* as the bottom transitioned to a softer fines-dominated substrate. *Zostera marina* was abundant to the 80 m interval, but was not observed beyond the 90 m interval, after which algal observations were uncommon and intermittent. Species observed beyond the 90 m interval included *Laminaria sp*. on small, isolated boulders, as well as and *Polysiphonia sp*. and *Corallina officinalis* on large cobble and small boulders. Photographs of some of the species observed are provided in Appendix C.

Species of macrofauna recorded during the second transect included American lobster (*Homarus americanus*), rock crab (*Cancer irroratus*), green crab (*Carcinus maenas*), hermit crab (*Pagurus sp.*), rock barnacle (*Balanus sp.*), periwinkle (*Littorina sp*.), sea scallop (*Placopecten magellanicus*), sea star (*Asterias sp*.), sand shrimp (*Crangon sp.*), plumose anemone (*Metridium senile*), northern cerianthid (*Cerianthus borealis*), lugworm (*Arenicola sp*.) and cunner (*Tautogolabrus adspersus*). Occasional observations of fish and shrimp that could not be identified were recorded. Potential species of fish include cunner (*Tautogolabrus adspersus*), sandlance (*Ammodytes americanus*), Atlantic silverside (*Menidia menidia*), Atlantic herring (*Clupea harengus*) and American eel (*Anguilla rostrata*). Potential species of shrimp include sand shrimp (*Crangon sp.*), mysid shrimp (*Mysis sp*.) and *Pandalus sp.* (see Table 4.1 and transect summary in Appendix B for further details). Photographs of some of the species observed are provided in Appendix C.

Encrusting invertebrates were observed growing epilithically and epiphytically throughout the transect. Species observed included colonial bryozoans (*Membranipora sp.*, *Electra sp.*), colonial hydrozoans and spiral tube worms (*Spirorbis sp.*).

4.1.3 Transect T3

Transect 3 ran perpendicular to the shoreline, was 200 m in total surveyed length and reached a maximum depth of 21 m (70 ft) at the 200 m interval marker. Substrate compositions varied throughout the third transect. The upper limit of the intertidal zone through the 70 m interval marker was dominated by cobble and gravel, with lesser amounts of small boulders and fines. Gravel and fines comprised the major substrates in the next 30 m, while fines alone composed the dominated substrate of the final 100 m (see summary, Appendix B).

Macrofloral species present throughout Transect 3 included *Fucus sp*., *Ascophyllum nodosum*, *Chorda filum*, *Laminaria sp*., *Agarum cribrosum*, *Chondrus crispus*, *Polysiphonia sp*., *Corallina officinalis,* and *Lithothamnium sp.* *Fucus* grew in abundance from the lower intertidal zone to the 70 m interval marker, after which the substrate became more fine-dominated and inappropriate for Fucoidal attachment. *Ascophyllum nodosum* and *Polysiphonia sp*. also grew in areas where *Fucus* dominated, and *Polysiphonia* was often epiphytically associated with the *Fucus*. Beyond the 70 m interval marker algal observations were intermittent. *Laminaria sp*., *Agarum cribrosum*, *Chondrus crispus*, *Corallina officinalis* and *Lithothamnium sp*. were, on occasion, observed growing on small, isolated boulders and exposed patches with larger cobbles. *Desmarestia sp*. may be present in this area, but this was not be confirmed. Photographs of some of the species observed are provided in Appendix C.

Macrofaunal species observed include American lobster (*Homarus americanus*), rock crab (*Cancer irroratus*), green crab (*Carcinus maenas*), hermit crab (*Pagurus sp.*), rock barnacle (*Balanus sp.*), periwinkle (*Littorina sp*.), sea scallop (*Placopecten magellanicus*), sea star (*Asterias sp*.), plumose anemone (*Metridium senile*), northern cerianthid (*Cerianthus borealis*), lugworm (*Arenicola sp*.), sand shrimp (*Crangon sp*.) and sandlance (*Ammodytes americanus*). Other fish and shrimp were observed throughout the transect, but could not be identified to species. Potential species of fish include sandlance (*Ammodytes americanus*), Atlantic silverside (*Menidia menidia*), and Atlantic herring (*Clupea harengus*). Potential species of shrimp include sand shrimp (*Crangon sp.*), mysid shrimp (*Mysis sp*.) and *Pandalus sp.* (see Table 4.1 and transect summary in Appendix B for further details). Photographs of some of the species observed are provided in Appendix C.

Encrusting invertebrates observed grew both epilithically and epiphytically throughout the transect and included colonial bryozoans (*Membranipora sp.*, *Electra sp.*), colonial hydrozoans and spiral tube worms (*Spirorbis sp.*).

4.1.4 Transect T4

Transect 4 was 450 m in total surveyed length and ran parallel from the west to the east of the shoreline. The transect was laid along a depth contour at 6 m (20 ft) beginning at the western property limit to the end of the 450 m transect line approximately midway to the eastern property limit. Divers swam at an average depth of 6 m (20 ft) and surveyed the entire 450 m transect in a single dive. The substrate upon initial entry was composed mainly of mixed cobble and gravel with small amounts of boulder and fines. After the 90 m interval marker, the substrate gradually transitioned to a more fines dominated substrate. At the 150 m interval marker the substrate was composed mainly of fines (sand, silt, mud and organics) with small amounts of cobble and gravel and occasional boulders. This substrate type continues until the 350 interval marker after which cobble and gravel begin to comprise the majority of the substrate to the end of the transect line. Depth varied between 15 and 26 ft and the substrate type was influenced by depth. At shallower intervals the substrate was comprised of a harder mix of cobbles and gravel, whereas deeper intervals tended to be dominated by fines (see summary, Appendix B).

Macroflora was present in abundance throughout much of Transect 4. Species noted include *Fucus sp*., *Ascophyllum nodosum*, *Chorda filum*, *Laminaria sp*., *Desmarestia sp*., *Chondrus crispus*, *Polysiphonia sp*., and *Lithothamnium sp.* *Fucus sp*. tended to dominate on substrates composed largely of cobble, gravel and small boulders. *Chondrus crispus* and *Polysiphonia sp*. also grew occasionally where *Fucus* dominated, and *Polysiphonia* often grew epiphytically upon *Fucus* algae. Where fine substrates dominated, *Polysiphonia sp*. and *Chondrus crispus* could be found upon isolated boulders and uncovered cobble, and *Laminaria sp*. was occasionally observed attached to small boulders. *Fucus sp.* tended to dominate the coarser substrates at shallower depths while algal coverage was sparsely present on the fines dominated substrates. Photographs of some of the species observed are provided in Appendix C.

Observed macrofaunal species included American lobster (*Homarus americanus*), rock crab (*Cancer irroratus*), green crab (*Carcinus maenas*), hermit crab (*Pagurus sp.*), rock barnacle (*Balanus sp.*), periwinkle (*Littorina sp*.), sea scallop (*Placopecten magellanicus*), sea star (*Asterias sp*.), plumose anemone (*Metridium senile*), northern cerianthid (*Cerianthus borealis*), lugworm (*Arenicola sp*.), sand shrimp (*Crangon sp*.), sculpin (*Myoxocephalus sp.*) and winter flounder (*Pseudopleuronectes americanus*). Other fish and shrimp were observed throughout the transect, but could not be identified to species. Potential species of fish include sandlance (*Ammodytes americanus*), Atlantic silverside (*Menidia menidia*), cunner (*Tautogolabrus adspersus*) and Atlantic herring (*Clupea harengus*). Potential species of shrimp include sand shrimp (*Crangon sp.*), mysid shrimp (*Mysis sp*.) and *Pandalus sp.* Clam siphons were observed on occasion, but no species were identified. (See Table 4.1 and transect summary in Appendix B for further details). Photographs of some of the species observed are provided in Appendix C.

Encrusting invertebrates observed grew both epilithically and epiphytically throughout the transect and included colonial bryozoans (*Membranipora sp.*, *Electra sp.*), colonial hydrozoans, spiral tube worms (*Spirorbis sp.*) and encrusting sponges.

Table 4.1: Summary of macrofauna identified during the interpretation of the UBHS video for Transects 1 – 4 and Spot Checks 1 - 10

Common Name	***Scientific Name***	***Transects***				***Spot Checks***	***Total Observations***
		T1	***T2***	***T3***	***T4***		
American Lobster	*Homarus americanus*	4	5	5	13	4	31
Rock Crab	*Cancer irroratus*	12	9	10	26	4	61
Green Crab	*Carcinus maenas*	5	1	3	11	0	20
Hermit Crab	*Pagurus sp.*	37	30	18	94	5	184
Sea Scallop	*Placopecten magellanicus*	2	6	6	14	1	29
Sea Star	*Asterias sp.*	4	4	4	27	0	39
Sand Shrimp	*Crangon sp.*	0	3	6	0	1	10
Northern Cerianthid	*Cerianthus borealis*	58	64	17	55	70	264
Plumose Anemone	*Metridium senile*	11	2	9	8	4	34
Cunner	*Tautogolabrus adspersus*	0	2	0	0	0	2
Winter Flounder	*Pseudopleuronectes americanus*		0	0	1	0	1
Flounder sp.	*Pleuronectes sp.*		2	0	0	1	3
White Hake	*Urophycis tenuis*		0	0	0	1	1
Sandlance	*Ammodytes americanus*		0	1	0	0	1
Sculpin sp.	*Myoxocephalus sp.*	0	0	0	1	0	1

Common Name	Scientific Name	Transects				Spot Checks	Total Observations
		T1	T2	T3	T4		
Lugworm	*Arenicola marina*	0	3	2	1	0	6
Unidentified Fish	*N/A*	4	3	18	28	12	65
Unidentified Shrimp	*Pandalus borealis, Mysis sp.,* or *Crangon septemspinosa*	3	5	0	4	3	15

4.2 Spot Checks

Spot checks were conducted at 10 locations throughout the study area (Figure 1.2). The intent of the spot checks was to increase the spatial resolution of the fisheries habitat survey without requiring further diver based video assessment.

The spot checks were predominately composed of fines with occasional patches of cobble, gravel and small boulders. The exceptions were SC1 and SC4. These two shallow spot checks had a substrate composed of mainly of cobble and gravel; cobble and gravel were the exclusive substrates in the case of SC1. At these locations *Fucus sp*., *Chondrus crispus* and *Polysiphonia sp*. were observed in abundance, with *Fucus* dominating in absolute coverage.

Where fine substrates dominated, algae was much less abundant or absent as in the case of SC3. *Laminaria sp*., *Polysiphonia sp*., *Chondrus crispus*, *Corallina officinalis*, and *Lithothamniums sp*. were observed occasionally in small numbers across the other seven spot checks (see summary, Appendix B). Photographs of some of the species observed are provided in Appendix C.

Macrofauna were observed across all 10 spot check locations and their distributions were not determined by substrate type. Species observed included American lobster (*Homarus americanus*), rock crab (*Cancer irroratus*), green crab (*Carcinus maenas*), hermit crab (*Pagurus sp.*), plumose anemone (*Metridium senile*), northern cerianthid (*Cerianthus borealis*), sea scallop (*Placopecten magellanicus*), sand shrimp (*Crangon sp.*) and white hake (*Urophycis tenuis*). A small flounder, likely winter flounder (*Pseudopleuronectes americanus*), was observed in SC3, but identification could not be confirmed. Other fish and shrimp were observed throughout the spot checks, but could not be identified to species. Potential species of fish include sandlance (*Ammodytes americanus*), Atlantic silverside (*Menidia menidia*), and Atlantic herring (*Clupea harengus*). Potential species of shrimp include sand shrimp (*Crangon sp.*), mysid shrimp (*Mysis sp*.) and *Pandalus sp.* (see Table 4.1 and spot checks in summaries in Appendix B for further details). Photographs of some of the species observed are provided in Appendix C.

CHAPTER 5 FISH HABITAT FUNCTIONAL ASSESSMENT

5.1 Habitat Types

Four generalized habitat types were observed within the project study area during the underwater benthic habitat video interpretation:

- Rocky intertidal habitat;
- Mixed substrate habitat;
- Eelgrass habitat; and
- Fines dominant habitat.

5.1.1 Rocky Intertidal Habitat

The rocky intertidal habitat type was observed at each of the three perpendicular transects which began at the upper limit of the intertidal zone at three distinct locations within the study area (see Figures 5.1 & 5.2). This habitat was comprised of a mixture of cobbles and gravels with intermittent small boulders and exposed sandy fines. This habitat type was not observed often beyond the lower limit of the intertidal zone. Transect 3, however, gradually transitioned to a mixed substrate type at the 70 m interval, whereas Transects 1 and 2 abruptly transitioned to fines dominated substrates around the 30 m interval; this coincided with the lower limit of the intertidal zone and the initial subtidal zone. At each of the three transects *Fucus sp*. dominated the algal cover and in some cases covered the entire observable area of the surveyed intervals (see Appendix B). *Ascophyllum nodosum* and *Polysiphonia sp*. were also occasionally noted in abundance. Macrofaunal observations consisted mainly of *Littorina sp*. and *Balanus sp*. Each of these were noted in abundance. Rock crab and small unidentified fish were observed intermittently in this area. At high tide the rocky intertidal habitat provides an abundance of feeding opportunities for motile species including fish and crab. It is likely that a larger number of motile individuals were present in this habitat type, but were not observed due to the cryptic nature of these species and the abundance of shelter provided by dense stands of *Fucus sp.* and other less abundant macroflora.

Figure 5.1: Rocky intertidal habitat type photographed at low tide.

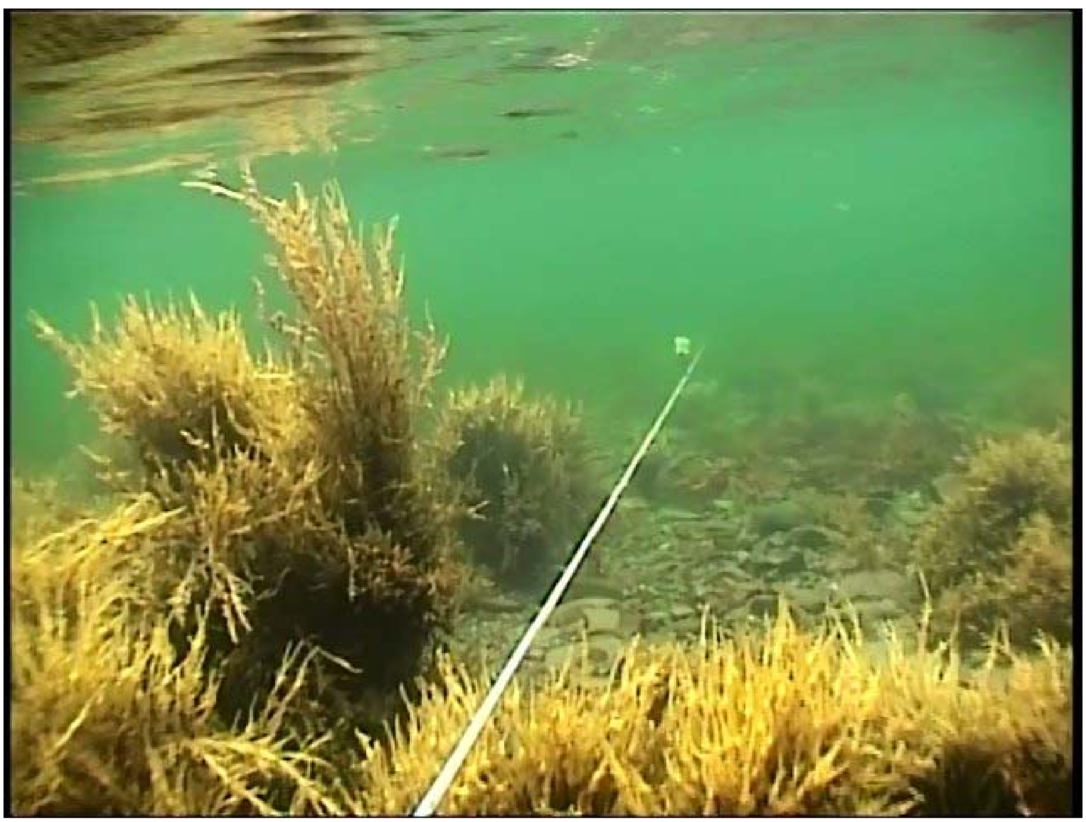

Figure 5.2: Rocky intertidal habitat. Note abundant *Ascophyllum nodosum* in the foreground and infrequent *Fucus sp*. in the background.

5.1.2 *Mixed Substrate Habitat*

The mixed substrate habitat type was observed in Transect 3 and Transect 4 (see Appendix B). This habitat is considered transitional in nature and was observed where coarse substrates gradually segued to fine substrates rather than abruptly shifted; it was comprised of an approximately even mix of cobbles, gravels and fines with occasional small boulders (see Figure 5.3). *Fucus sp.* was the most abundant macroflora observed where mixed substrates were found, but it was not always observed in abundance. Other algae observed in these areas included *Chondrus crispus*, *Polysiphonia sp.*, *Lithothamnium sp*. on exposed cobbles and small boulder, as well as small *Laminaria sp*. Macrofauna was similar to that observed in the other three habitat types and consisted of intermittent and occasional observations of lobster, crabs, small fish, anemones and sea scallops. Areas of the mixed substrate type consisted of dense *Fucus sp*. stands, and it is possible that some fauna was not observed during the video interpretation due to the cover provided by dense algae.

Figure 5.3: Mixed substrate habitat.

5.1.3 *Eelgrass Habitat*

The eelgrass habitat type was only observed in the second transect between the 20 m and 80 m intervals (see Appendix B). This habitat type requires a fine balance of physical factors including substrate type in order to endure (DFO, 2005). Where the eelgrass was present, the cobble intertidal zone transitioned sharply to a fines-dominated substrate composed of silty sand. The *Fucus sp.* observed in the intertidal zone quickly disappeared and gave way to a wide swath of eelgrass (*Zostera marina*) (see Figure 5.4). Eelgrass was abundant through to the 80 m interval after which it abruptly disappeared. Macrofauna was not observed in great abundance where the eelgrass was present and did not differ significantly to the other habitats present in the study area (see Appendix B). Small unidentified fish, crabs and *Crangon sp*. were observed in the eelgrass bed. However, as with other areas of dense macrofloral cover, it is likely that the observation of macrofauna was impeded in the benthic habitat survey video due to the increase in cryptic complexity and the cover provided by the eelgrass.

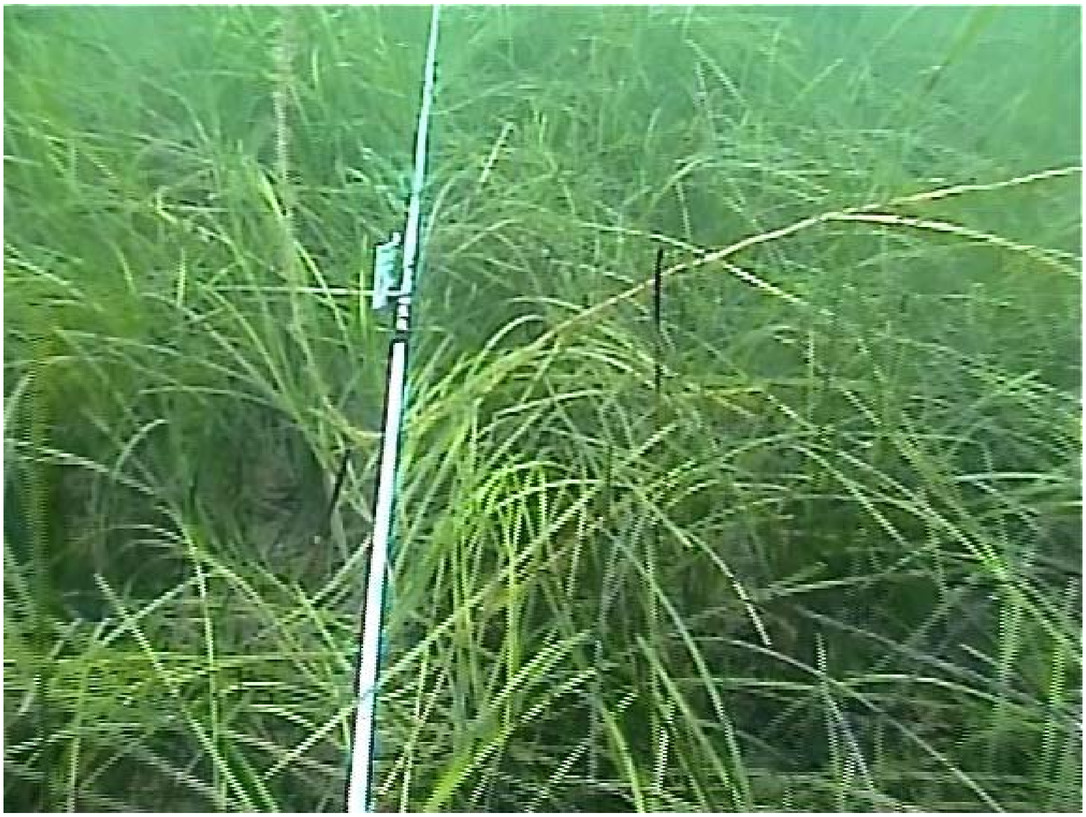

Figure 5.4: Eelgrass habitat.

5.1.4 Fines Dominant Habitat

The fines dominant habitat type was observed in each of the four transects conducted (see Appendix B). This habitat type was comprised of sand, silt, mud and organic detritus (see Figure 5.5). It would periodically include patches of coarse substrate such as cobble, gravel and small boulders. Where fines dominated and depth and distance from the shoreline increased, the substrate was almost entirely, if not exclusively, comprised of a silty or muddy substrate beneath a thin layer of organic detritus. There was little algal coverage in areas where fines dominated, however algae was present where small boulders and cobble or gravel were exposed. Macroflora observed in these areas include *Laminaria sp*., *Agarum cribrosum*, *Chondrus crispus*, *Lithothamnium sp*. and *Corallina officinalis*. Macrofauna was found throughout the areas dominated by fine substrate, both on the exposed fine benthos or sheltering and burrowing under small boulders and cobble with algal coverage. These fauna included lobster, crabs, small fish, shrimp, anemones and sea scallops. Anemones such as the plumose anemone (*Metridium senile*) and northern cerianthid (*Cerianthus borealis*) were observed in the fines dominated substrate, growing on submerged coarse substrate (*M. senile*) or burrowing into the soft benthos (*C. borealis*). Clams siphons and other burrowing invertebrates were observed throughout the fines dominant substrates, but were not noted in the other habitat types.

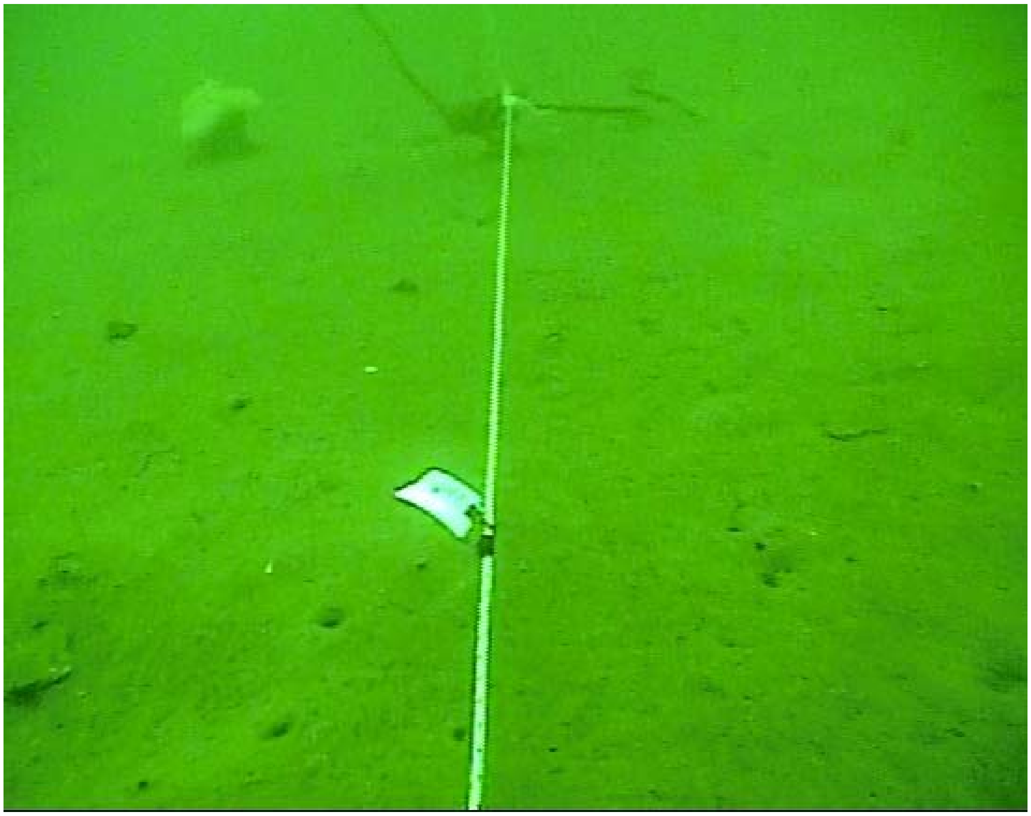

Figure 5.5: Fines dominant habitat. Note the Plumose anemone (*Metridium senile*) and transect anchor in background. Siphon holes are also visible in the foreground.

5.2 Habitat Functions

An assessment of the habitat function of CRA fish and fish that support a CRA fishery is detailed in Tables 5.1 (fines dominant habitat), 5.2 (mixed substrate habitat), 5.3 (eelgrass habitat) and 5.4 (rocky intertidal habitat). The rationale for choosing the fish listed in Tables 5.1-5.4 is provided in Chapter 3. Habitat descriptions of species which received an evaluation of “good” or “moderate to good” for three or more life history events is provided in Section 5.2.2. It should be noted that transects and spot checks were conducted at depths between 0 to 21 metres, which influences the results of the habitat evaluations (Tables 5.1-5.4).

5.2.1 Habitat Utilization

The four observed habitat types serve a variety of functions for the macroflora and macrofauna observed. Below is a brief discussion of the habitat utilization by the macrofauna on record.

5.2.1.1 Fines Dominant Habitat

Fine substrate was present in each of the four transects conducted and were the dominant substrate observed beyond the 6 m (20 ft) contour line, approximately 100 m from the shoreline. The fines were typically composed of a mix of sand, silt, mud and organic detritus. Sand composed

Table 5.1: Fines Dominant Habitat

Habitat Types	Species	Commercial, Recreational, Aboriginal	Habitat Function - Bear Head Water Lot: Spawning	Rearing	Overwintering	Adult Foraging	Cover	Migration	References
Fines Dominant Habitat	American Oysters	Recreational, Commercial	Poor	Poor	n/a	Poor	n/a	n/a	Cake 1983, DFO 2003
	American Eel	Aboriginal	None	Poor	Poor	Poor-Moderate	Poor-Moderate	Moderate-Good	COSEWIC 2012a, Facey and Avyle 1987
	Bar/Soft Shell Clams	Recreational	Good	Moderate-Good	n/a	Good	n/a	n/a	Cargnelli et al. 1999
	Cod	Commercial, Recreational	Moderate	Moderate	Poor	Poor-Moderate	Poor-Moderate	Moderate	COSEWIC 2010a, Fahay et al. 1999
	Hermit Crabs	Prey Species to CRA	Good	Good	Good	Good	Poor-Moderate	n/a	Christian et al. 2010
	Atlantic Herring	Commercial	Poor-Moderate	Moderate	Poor	Moderate	Poor-Moderate	Good	DFO 2012a, Reid et al. 1999, Messieh 1987
	Lobster	Commercial, Aboriginal	Poor	Poor	Poor	Poor	Poor	n/a	DFO 2009, Lawton et al. 2009, Mercaldo-Allen and Kuropat 1994, MacKenzie and Moring 1985
	Mackeral	Commercial, Recreational	Good	Good	Poor	Moderate-Good	Poor-Moderate	Good	Studholme et al. 1999
	Blue Mussel	Recreational	Poor-Moderate	Poor-Moderate	n/a	Poor-Moderate	n/a	n/a	Newell 1989
	Rock Crab	Commercial	Good	Poor	Good	Good	Moderate-Good	Good	DFO 2013b; DOFA 1999
	Snow Crab	Commercial, Aboriginal	Good	Moderate	Moderate-Good	Poor-Moderate	Poor-Moderate	Good	DFO 2013c, Lovrich et al. 1995
	Bluefin Tuna	Commercial	Poor	Poor	Poor	Poor	Poor	Poor	Rooker et al. 2007; DFO 2011
	American Plaice	Commercial	Poor-Moderate	Poor	Poor	Poor-Moderate	Poor-Moderate	Poor-Moderate	DFO 2011, Johnson 2004
	White Hake	Commercial	Poor	Moderate-Good	Poor	Moderate	Moderate	Moderate	Chang et al. 1999, Simon and Cook 2013, Simpson et al. 2012
	Sea Urchin	Commercial	Poor	Poor	Poor	Poor	n/a	n/a	Meidel and Scheibling 1998, Scheafer et al. 2004
	Atlantic Salmon	Recreational, Aboriginal	None	None	Poor	Poor-Moderate	Poor	Moderate	COSEWIC 2010b
	Brook Trout	Recreational, Aboriginal	None	None	Poor-Moderate	Poor-Moderate	Poor	Moderate	Raleigh 1982
	Sea Scallops	Commercial, Recreational	Moderate	Poor-Moderate	Poor-Moderate	Poor-Moderate	n/a	n/a	Christian et al. 2010, Moriyasu et al. 2001
	Mummichog	Prey Species to CRA	None	None	None	Poor	Poor	None	Abraham 1985
	Sandlances	Prey Species to CRA	Moderate	Good	Good	Good	Good	Moderate	Auster and Stewart 1986
	Sand Shrimp	Prey Species to CRA	Moderate-Good	Good	Poor	Good	Moderate-Good	Moderate	Christian et al. 2010
	Cunner	Prey Species to CRA	Poor	Poor	Poor	Poor	Poor	Poor	Auster 1989
	Three spine stickleback	Prey Species to CRA	None	None	Moderate-Good	Moderate-Good	Poor	Good	Evans et al. 2002
	Northern Shrimp	Commericial, Prey Species	Poor	Moderate	Poor-Moderate	Poor	Poor	Moderate	DFO 2012c, ASMFC n.d.
	Winter Flounder	Commericial, Recreational	Poor-Moderate	Poor-Moderate	Poor-Moderate	Good	Good	Good	USFWS 2001

Table 5.2 Mixed Substrate Habitat

Habitat Types	Species	Commercial, Recreational, Aboriginal	Habitat Function - Bear Head Water Lot: Spawning	Rearing	Overwintering	Adult Foraging	Cover	Migration	References
Mixed Substrate Habitat	American Oysters	Recreational, Commercial	Poor	Poor	n/a	Poor	n/a	n/a	Cake 1983
	American Eel	Commercial, Aboriginal	None	Poor	Poor	Moderate	Moderate	Moderate	COSEWIC 2012a, Facey and Avyle 1987
	Bar/Soft Shell Clams	Recreational	Poor	Poor-Moderate	n/a	Poor	n/a	n/a	Cargnelli et al. 1999
	Cod	Commercial, Recreational	Moderate	Moderate-Good	Poor	Moderate	Moderate	Moderate	COSEWIC 2010a, Fahay et al. 1999
	Hermit Crabs	Prey Species to CRA	Moderate-Good	Moderate-Good	Moderate-Good	Moderate-Good	Good	n/a	Christian et al. 2010
	Atlantic Herring	Commercial	Moderate-Good	Moderate-Good	Poor	Moderate-Good	Moderate-Good	Good	DFO 2012a, Reid et al. 1999, Messieh 1987
	Lobster	Commercial, Aboriginal	Good	Good	Good	Good	Good	n/a	DFO 2012a, Lawton et al. 2009, Mercaldo-Allen and Kuropat 1994, MacKenzie and Moring 1985
	Mackeral	Commercial, Recreational	Good	Good	Poor	Moderate-Good	Moderate	Good	Studholme et al. 1999
	Blue Mussel	Recreational	Good	Moderate-Good	n/a	Good	n/a	n/a	Newell 1989
	Rock Crab	Commercial	Moderate	Moderate	Moderate-Good	Moderate-Good	Moderate-Good	Moderate-Good	DFO 2013a, DOFA 1999
	Snow Crab	Commercial, Aboriginal	Good	Moderate-Good	Moderate-Good	Poor-Moderate	Moderate	Good	DFO 2013b, Lovrich et al. 1995
	Bluefin Tuna	Commercial	Poor	Poor	Poor	Poor	Poor	Poor	Rooker et al. 2007; DFO 2011
	American Plaice	Commercial	Poor	Poor	Poor	Poor-Moderate	Poor	Poor-Moderate	DFO 2011, Johnson 2004
	White Hake	Commercial	Poor	Poor-Moderate	Poor	Poor-Moderate	Poor-Moderate	Moderate	Chang et al. 1999, Simon and Cook 2013, Simpson et al. 2012
	Sea Urchin	Commercial	Moderate	Moderate	Moderate	Moderate	n/a	n/a	Meidel and Scheibling 1998, Scheafer et al. 2004
	Atlantic Salmon	Recreational, Aboriginal	None	None	Poor	Moderate	Moderate	Moderate	COSEWIC 2010b
	Brook Trout	Recreational, Aboriginal	None	None	Poor-Moderate	Moderate	Moderate	Moderate	Raleigh 1982
	Sea Scallops	Commercial, Recreational	Moderate-Good	Moderate-Good	Moderate-Good	Moderate-Good	Moderate-Good	n/a	Christian et al. 2010, Moriyasu et al. 2001
	Mummichog	Prey Species to CRA	None	None	None	Nil-Poor	Nil-Poor	None	Abraham 1985
	Sandlances	Prey Species to CRA	Poor-Moderate	Poor	Poor	Poor-Moderate	Poor	Moderate	Auster and Stewart 1986
	Sand Shrimp	Prey Species to CRA	Poor-Moderate	Poor-Moderate	Moderate	Moderate	Moderate	Moderate	Christian et al. 2010
	Cunner	Prey Species to CRA	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Auster 1989
	Three spine stickleback	Prey Species to CRA	None	None	Moderate-Good	Moderate-Good	Moderate-Good	Good	Evans et al. 2002
	Northern Shrimp	Commericial, Prey Species	Poor	Poor-Moderate	Poor-Moderate	Poor	Poor	Moderate	DFO 2012c, ASMFC n.d.
	Winter Flounder	Commericial, Recreational	Poor-Moderate	Poor-Moderate	Poor	Poor-Moderate	Poor-Moderate	Poor-Moderate	USFWS 2001

Table 5.3 Eel Grass Habitat

Habitat Types	Species	Commercial, Recreational, Aboriginal	Habitat Function - Bear Head Water Lot: Spawning	Rearing	Overwintering	Adult Foraging	Cover	Migration	References
Eel Grass Habitat	American Oysters	Recreational, Commercial	Poor	Poor	n/a	Poor	n/a	n/a	Cake 1983, DFO 2003
	American Eel	Aboriginal	None	Poor	Poor	Moderate-Good	Moderate-Good	Moderate	COSEWIC 2012a, Facey and Avyle 1987
	Bar/Soft Shell Clams	Recreational	Poor	Poor-Moderate	n/a	Poor	n/a	n/a	Cargnelli et al. 1999
	Cod	Commercial, Recreational	Moderate	Good	Poor	Good	Good	Moderate-Good	COSEWIC 2010a, Fahay et al. 1999
	Hermit Crabs	Prey Species to CRA	Good	Good	Good	Good	Good	n/a	Christian et al. 2010
	Atlantic Herring	Commercial	Moderate	Good	Poor	Good	Good	Good	DFO 2012a, Reid et al. 1999, Messieh 1987
	Lobster	Commercial, Aboriginal	Good	Good	Good	Good	Good	n/a	DFO 2012a, Lawton et al. 2009, Mercaldo-Allen and Kuropat 1994, MacKenzie and Moring 1985
	Mackeral	Commercial, Recreational	Good	Good	Poor	Moderate-Good	Moderate-Good	Good	Studholme et al. 1999
	Blue Mussel	Recreational	Poor-Moderate	Poor-Moderate	n/a	Poor-Moderate	n/a	n/a	Newell 1989
	Rock Crab	Commercial	Good	Poor	Good	Good	Moderate-Good	Good	DFO 2013a, DOFA 1999
	Snow Crab	Commercial, Aboriginal	Good	Moderate	Moderate-Good	Poor-Moderate	Poor-Moderate	Good	DFO 2013b, Lovrich et al. 1995
	Bluefin Tuna	Commercial	Poor	Poor	Poor	Poor	Poor	Poor	Rooker et al. 2007; DFO 2011
	American Plaice	Commercial	Poor-Moderate	Poor	Poor	Moderate	Moderate	Moderate	DFO 2011, Johnson 2004
	White Hake	Commercial	Poor	Good	Poor	Moderate-Good	Moderate-Good	Moderate	Chang et al. 1999, Simon and Cook 2013, Simpson et al. 2012
	Sea Urchin	Commercial	Moderate	Moderate	Moderate	Moderate	n/a	n/a	Meidel and Scheibling 1998, Scheafer et al. 2004
	Atlantic Salmon	Recreational, Aboriginal	None	None	Poor	Good	Moderate-Good	Moderate	COSEWIC 2010b
	Brook Trout	Recreational, Aboriginal	None	None	Poor	Good	Moderate-Good	Moderate	Raleigh 1982
	Sea Scallops	Commercial, Recreational	Moderate	Moderate	Moderate	Moderate	Moderate	n/a	Christian et al. 2010, Moriyasu et al. 2001
	Mummichog	Prey Species to CRA	None	None	None	Poor-Moderate	Poor-Moderate	None	Abraham 1985
	Sandlances	Prey Species to CRA	Moderate-Good	Good	Good	Good	Good	Moderate	Auster and Stewart 1986
	Sand Shrimp	Prey Species to CRA	Good	Good	Good	Good	Good	Good	Christian et al. 2010
	Cunner	Prey Species to CRA	Good	Good	Good	Good	Good	Good	Auster 1989
	Three spine stickleback	Prey Species to CRA	None	None	Moderate-Good	Good	Good	Good	Evans et al. 2002
	Northern Shrimp	Commericial, Prey Species	Poor	Moderate	Poor-Moderate	Poor	Moderate	Moderate	DFO 2012c, ASMFC n.d.
	Winter Flounder	Commericial, Recreational	Poor-Moderate	Poor-Moderate	Poor	Moderate	Moderate	Moderate	USFWS 2001

Table 5.4 Rocky Intertidal Habitat

Habitat Types	Species	Commercial, Recreational, Aboriginal	Habitat Function - Bear Head Water Lot: Spawning	Rearing	Overwintering	Adult Foraging	Cover	Migration	References
Rocky Intertidal Habitat	American Oysters	Recreational, Commercial	Poor	Poor	n/a	Poor	n/a	n/a	Cake 1983
	American Eel	Aboriginal	None	Poor	Poor	Moderate-Good	Moderate-Good	Moderate	COSEWIC 2012a, Facey and Avyle 1987
	Bar/Soft Shell Clams	Recreational	Poor	Poor	n/a	Poor	n/a	n/a	Cargnelli et al. 1999
	Cod	Commercial, Recreational	Moderate	Moderate-Good	Poor	Moderate	Moderate	Moderate	COSEWIC 2010a, Fahay et al. 1999
	Hermit Crabs	Prey Species to CRA	Moderate-Good	Moderate-Good	Moderate-Good	Moderate-Good	Good	n/a	Christian et al. 2010
	Atlantic Herring	Commercial	Poor-Moderate	Poor-Moderate	Poor	Moderate	Poor-Moderate	Moderate	DFO 2012a, Reid et al. 1999, Messieh 1987
	Lobster	Commercial, Aboriginal	Good	Good	Poor-Moderate	Good	Good	n/a	DFO 2012a, Lawton et al. 2009, Mercaldo-Allen and Kuropat 1994, MacKenzie and Moring 1985
	Mackeral	Commercial, Recreational	Poor-Moderate	Poor-Moderate	Poor	Poor-Moderate	Poor-Moderate	Poor-Moderate	Studholme et al. 1999
	Blue Mussel	Recreational	Good	Moderate-Good	n/a	Good	n/a	n/a	Newell 1989
	Rock Crab	Commercial	Moderate	Moderate	Moderate-Good	Moderate-Good	Moderate-Good	Moderate-Good	DFO 2013a, DOFA 1999
	Snow Crab	Commercial, Aboriginal	Moderate-Good	Moderate-Good	Moderate-Good	Poor	Poor-Moderate	Moderate-Good	DFO 2013b, Lovrich et al. 1995
	Bluefin Tuna	Commercial	Poor	Poor	Poor	Poor	Poor	Poor	Rooker et al. 2007; DFO 2011
	American Plaice	Commercial	Poor	Poor	Poor	Poor	Poor	Poor	DFO 2011, Johnson 2004
	White Hake	Commercial	Poor	Poor-Moderate	Poor	Poor-Moderate	Poor-Moderate	Moderate	Chang et al. 1999, Simon and Cook 2013, Simpson et al. 2012
	Sea Urchin	Commercial	Good	Good	Good	Good	n/a	n/a	Meidel and Scheibling 1998, Scheafer et al. 2004
	Atlantic Salmon	Recreational, Aboriginal	None	None	Poor	Moderate	Moderate	Moderate	COSEWIC 2010b
	Brook Trout	Recreational, Aboriginal	None	None	Poor-Moderate	Moderate	Moderate	Moderate	Raleigh 1982
	Sea Scallops	Commercial, Recreational	Moderate-Good	Moderate-Good	Moderate-Good	Moderate-Good	Moderate-Good	n/a	Christian et al. 2010, Moriyasu et al. 2001
	Mummichog	Prey Species to CRA	None	None	None	Nil-Poor	Nil-Poor	None	Abraham 1985
	Sandlances	Prey Species to CRA	Poor	Poor	Poor	Poor-Moderate	Poor	Moderate	Auster and Stewart 1986
	Sand Shrimp	Prey Species to CRA	Poor-Moderate	Poor-Moderate	Moderate	Moderate	Moderate	Moderate	Christian et al. 2010
	Cunner	Prey Species to CRA	Good	Good	Good	Good	Good	Good	Auster 1989
	Three spine stickleback	Prey Species to CRA	None	None	Moderate-Good	Moderate-Good	Moderate-Good	Good	Evans et al. 2002
	Northern Shrimp	Commericial, Prey Species	Poor	Poor-Moderate	Poor-Moderate	Poor	Poor	Moderate	DFO 2012c, ASMFC n.d.
	Winter Flounder	Commericial, Recreational	Poor-Moderate	Poor-Moderate	Poor	Poor-Moderate	Poor	Poor-Moderate	USFWS 2001

the majority of the fines after the transition from mixed habitat or eelgrass, but as the depth of the transect increased, the composition of the fine substrate tended toward a muddier or siltier composition. Species commonly observed on the fine substrate include rock crab, hermit crab and sandlance. Each of these species prefer sandy substrate to rocky habitat which could explain the number of observations of these species in this habitat type. For example, sandlance and rock crab will often burrow themselves into the soft substrate as they rest between foraging activities. Lobsters were also often observed in the areas composed of fine substrates, either foraging or burrowed under small boulders (see Appendix B).

Habitats composed of fine substrates can also provide shelter and cover from predators. Species such as flounders, skates and shrimp have adapted to use camouflage, having similar colouration to the sea floor, making them difficult for predators to spot (Tyrell, 2005).

The fines dominant habitat provides good or moderate to good habitat for some CRA fisheries, including (see Table 5.1):

- Bar/Soft shell clams;
- Hermit crab;
- Mackerel;
- Rock crab;
- Snow crab;
- Sandlance;
- Sand shrimp;
- Threespine stickleback; and
- Winter flounder.

5.2.1.2 Mixed Substrate Habitat

Fauna species may have been present in larger numbers in the mixed habitat sections of Transects 3 and 4 than was observed during the video interpretation. Species such as lobster and crab are sedentary for extended periods of time and may have taken cover under macroflora or within crevices impeding their observation on video. For example, Bologna and Steneck (1993) found lobster density and biomass to be significantly higher in artificial kelp when compared to non-kelp control sites. Essentially, lobster were shown to seek cover under the artificial kelp (Bologna and Steneck, 1993). In addition, many marine fauna species require complex environments, such as variable substrates, larger cobbles and boulders, as well as dense vegetation to meet the needs of one or more stages of their lifecycle (see Table 5.1). Marine habitats with increased structural complexity are typically inhabited by more species than areas that are less complex of this due to the increase in niche (functional) diversity (Dustan *et al.*, 2013). Habitat complexity can be measured by rugosity of the substratum, diversity of the substratum, variety of refuge hole sizes, height of substratum, percentage of live cover (i.e., seagrasses, corals) and percentage of hard substrate. A more complex and variable habitat shows greater species diversity and abundance (Gratwicke and Speight, 2004). The rugosity and percentage of hard substrate are mediums in which microscopic algae, macroalgae, corals, sponges and mussels can fasten upon and thrive. They generally will not grow on soft substrates due to instability (shifting sands). These organisms can be a food source, provide cover from predators, or provide spawning grounds for many other species

(Gratwicke and Speight, 2004). Having structures with varying forms and heights (i.e., rocks, algae, corals) will provide different functionalities for many species (microhabitats). Thus, the assortment of physical and biotic characteristics produces a more suitable habitat and therefore increased biodiversity (Friedman *et al.*, 2012).

The mixed substrate habitat provides good or moderate to good habitat for some CRA fisheries including (see Table 5.2):

- Hermit crab;
- Atlantic herring;
- American lobster;
- Mackerel;
- Blue mussel;
- Rock crab;
- Snow crab;
- Sea scallops; and
- Threespine stickleback.

5.2.1.3 Eelgrass Habitat

Eelgrass is a marine macrophyte rather than a marine macroalgae. It is found in sandy or muddy substrates where roots can penetrate and spread, stabilizing the benthic substratum. It forms subtidal habitat widely recognized as important nearshore refuge for juvenile and adult invertebrates and fish. The beds provide cover from predation, reduce local current regimes (allowing for settlement of organisms) and increase secondary productivity by adding to local habitat complexity and surface area. The eelgrass bed present in in the second transect (see Figure 1.2) provided habitat for an abundance of *Littorina* sp., which were observed feeding on the blades of the eelgrass, as well as crabs, shrimp and small fish that were not identifiable (see Appendix B). The diversity of species observed within the eelgrass patch did not differ significantly from that in other habitat types, nor were the species found in greater numbers. However, as observed for the dense algae of the rocky intertidal habitat and the subtidal mixed substrate habitat, the density of the eelgrass along with the cryptic nature of juvenile and adult invertebrates and fish likely prevented the observation of a larger and more diverse array of species.

Eelgrass habitat provides good or moderate to good habitat for a number of CRA fisheries including (see Table 5.3):

- Cod;
- Hermit crab;
- Atlantic herring;
- American lobster;
- Mackerel;
- Rock crab;
- Snow crab;
- White hake;
- Brook trout;
- Sandlance;

- Sand shrimp;
- Cunner; and
- Threespine stickleback.

5.2.1.4 Rocky Intertidal Habitat

The coastal rocky intertidal zone in the study area is repeatedly and repetitively submerged and flushed of sea water over a roughly 12 hour cycle. As such, the area is periodically submerged and periodically exposed to the sun. Macroflora and macrofauna species have developed the ability to withstand the intense and prolonged period in which desiccation is possible as well as the ability to remain attached to a substrate when exposed to high energy wave action. A few common species observed in the local area included *Fucus sp*., *Ascophyllum nodosum*, Balanus sp., *Mytilus edulis* and *Littorina sp*. *M. edulis* was not observed during the video interpretation of the study area, but is a common intertidal species found in the Chedabucto Bay area (Gentile, Paul. *Pers. Comm*. 2015). At low tide these non-motile species are protected from motile predatory species, but as the tide rises, motile species can move in and feed on the inhabitants of the intertidal zone. It is therefore likely that although the intertidal zone is not suitable for long stretches of inhabitation by CRA or CRA supporting species, it does provide important foraging opportunities. It is also possible for motile juveniles to shelter in the tide pools and sea water retained by exposed intertidal macroflora at low tide, providing both shelter and feeding opportunities for juvenile CRA and CRA supporting species. It should also be noted that species of fauna may have been present in the algal cover of the intertidal zone but were not visible due to the abundance of cover provided by the presence of dense stretches of macroalgae.

The rocky intertidal identified provides good or moderate to good habitat for some CRA fisheries including (see Table 5.3):

- Hermit crab;
- American lobster;
- Blue mussel;
- Rock crab;
- Snow crab;
- Sea urchin;
- Sea scallops;
- Cunner; and
- Threespine stickleback.

5.2.2 Species Descriptions

The following subsections provide descriptions for those species seen or for which habitat exists on the transect and spot check locations.

5.2.2.1 Sandlances (*Ammodytes* sp.)

Sandlance was observed within the fines dominant habitat. Sandlances, although not considered a CRA fishery in Atlantic Canada, are an important prey species for common CRA fisheries such as cod and Atlantic salmon. The sandlance is a slender species, reaching an average length of 20 to 25 cm. They reside in shallow waters (< 90 m deep) along coastlines with sand or light-gravel bottoms (DFO, 2013a). They are known for their sand burrowing behaviour between periods of feeding activities. The sandy habitat is ideal for the various lifecycles of this species. Sandlances spawn from November to March in shallow (inshore) waters, with some evidence of offshore spawning occurring on sand and/or gravel substrates. Hatching occurs between November and May depending on water temperatures (<10°C) with the larvae ascending into the water column and entering a planktonic stage. This continues for two to three months before they descend back to the bottom. Juveniles and adults are routinely found in schools throughout the day, with larger schools developing in deeper waters. Juveniles and adults will often reside over sandy substrates. This substrate provides cover and a resting place as the fish burrow into the sand to either partially or completely conceal themselves (Auster and Stewart, 1986).

5.2.2.2 Bar / Soft Clams (Spisula solidissima / Mya arenaria)

Clam siphons were identified in the fines dominant habitat. Bar clams, also known as Atlantic surf clams, spawn during the summer and early fall with fertilization occurring in the water column above the clam beds. The survival and success rate for bar clams is tied to water temperature. The optimal temperature rate for fertilization are between 6-24°C and larvae development between 14-22°C. The most abundant concentrations of bar clams are found on medium coarse sand and occasionally fine coarse sand with gravel or silty-sand. This buried species are generally found in the intralittoral zone to 20 m deep but have also been reported in depths up to 66 m (Cargnelli *et al.*, 1999).

5.2.2.3 Rock Crab (Cancer irroratus)

The rock crab is a commonly found species along the shores of Atlantic Canada, distributed between southern Labrador to South Carolina (DFO, 2013b). On the eastern coasts of Canada, the rock crab frequents shallow waters with sandy bottoms with depths ranging between 5 to 20 m. Although a sandy substrate is preferred, rock crabs can be found on all substrate types. This was confirmed by the numerous observations of rock crab inhabiting all habitat types. Spawning and egg laying occur in autumn and can continue into the following year. The egg mass is attached to the stomach of the female until they are ready to hatch, which occurs the following year during the late spring or early summer months. The larvae remain in the upper reaches of the water column until they complete six moulting stages, after which they settle on the ocean floor. The juvenile crab prefers to remain inshore inhabiting areas with rocky substrates (i.e., gravels and cobbles) (DOFA, 1999).

5.2.2.4 Winter Flounder (Pleuronectes americanus)

Winter flounder was observed in habitat dominated by fines. This species can be found in shallow waters (near the tideline) to depths greater than 140 m. Their movements are correlated to seasonal warming, moving to warmer offshore depths during the winter months and the warmer inshore, shallow waters during the summer. Coastal populations will tend to spawn near the mouths of estuaries (peak times during March and April) over sandy or muddy bottoms. Juveniles will remain in the shallow, sandy estuaries for a period of two to three years. Adults also prefer sandy or muddy bottoms but can also be found in areas with pebbly and gravelly substrate (USFWS, 2001).

5.2.2.5 Hermit Crabs (*Pagurus* sp.)

Hermit crabs were observed in all identified habitat types. These included the three species (*P. acadianus, P. arcuatus, and P. pubescens*) of hermit crab that are present in the northwest Atlantic and are generally found in the shallow subtidal zone. Spawning occurs in the summer months. Studies have found that hermit crabs, particularly *P. pubescens*, prefer a sandy environment, but also inhabit sand/gravel/shell substrates with a wide variation of temperatures and wave energy exposures in depths ranging between 5 and 15 m (Christian *et al*., 2010).

5.2.2.6 American Lobster (*Homarus americanus*)

American lobster were found in rocky intertidal, mixed substrate and fines dominant habitats. American lobster is found throughout Atlantic Canada with major fisheries occurring in the Gulf of St. Lawrence and the Gulf of Maine. The highest concentration of lobster occurs near coastal waters, with lower concentrations in deeper warm waters (e.g., Gulf of Maine). All the important life history events such as molting, mating, egg extrusion and hatching typically occur between mid-July to mid-September (DFO, 2009). Mature females mate in late summer and carry their eggs under their tails for 10 to 12 months. Eggs hatch between May and September depending on water temperatures (DFO, 2009); the larvae will live near the surface of the water for 30 to 60 days (Pezzack et al*.,* 2009). After completing one pre-larval and four free-swimming larval stages, the larva will descend to the bottom where they will molt into juveniles (MacKenzie and Moring, 1985). Juveniles and adults either inhabit natural crevices for shelter found in cobble/boulder environments or excavate space in the absence of natural shelters (i.e., sand-boulder habitats). Young lobster will rarely leave the safety of their shelters. Juveniles (with a carapace length greater than 45 mm) and adults will usually travel no more than 300 m from their shelters when foraging. Lobsters will migrate to shallow water in the summer and deeper water in the winter (Pezzack et al*.,* 2009) with adults travelling distances of up to 20 km. Although a rocky substrate is preferable, lobster may be present in the fines dominant habitat during seasonal movements, or when foraging for food.

5.2.2.7 Blue Mussels (*Mytilus edulis*)

Blue mussel shell debris were observed within the water lot. Only shell debris was observed in the habitat video interpretation. No live mussels were observed. The rocky intertidal habitat provides a hard substrate for the mussels to attach. Blue mussels are semi-sessile epibenthic molluscs that are common in the commercial aquaculture industry. Blue mussels have an elongated shell, narrowing at one end and are dark blue to black in color. They anchor to submerged surfaces or attach to other mussels in habitats ranging from slightly brackish estuaries to saline deep offshore environments (Newell, 1989). They can tolerate a wide range of salinity, from 0 ppt to 31 ppt and a wide range of temperatures, from below 0 to 25°C (DFO, 2003). They are highly efficient suspension feeders and feed actively by filtering particles from the water, with phytoplankton constituting the main source of food (DFO, 2003). They are preyed upon by sea ducks, starfish, crabs and humans. Spawning occurs between May and August, usually in response to environmental triggers such as high food levels, temperature fluctuations and physical disturbance (DFO, 2003). Eggs and sperm are released concurrently into the water column where fertilization occurs (Newell, 1989). The embryos quickly differentiate into free-swimming larvae. Larvae are free swimming for three to four weeks until the final metamorphosis when they seek to settle. To secure themselves to substrates they secrete byssal threads that adhere to hard surfaces (DFO, 2003). Although still technically mobile as they continue to grow, movement becomes harder as they become heavier (DFO, 2003).

5.2.2.8 Threespine Stickleback (*Gasterosteus aculeatus*)

Although not observed during the underwater video survey, this species is suspected to occur in the water lot (SNC Lavalin, 2015). Threespine stickleback inhabit a variety of habitats including rivers, lakes and ponds, estuaries, coastal shores and ocean waters. The anadromous population spawns in freshwater beginning in the spring and returns to saline waters in summer/autumn. Adult males create a nest with submergent vegetation and will entice females to lay their eggs. Males are aggressive defenders of their nests. Juveniles will leave freshwater streams and estuaries, travelling to the nearshore coast with suitable vegetation for cover and will not move to the open sea until later in the fall. Adults remain in the marine environment until spawning occurs (Evans *et al*., 2002). Most of the Bear Head water lot could provide moderate to good habitat for juvenile and adults sticklebacks during rearing, overwintering, foraging and migratory life stages.

5.2.2.9 Snow Crab (Chionoecetes opilio)

Although not observed during the underwater video survey, this species is suspected to occur in the water lot (SNC Lavalin, 2015). The snow crab is an important commercial fishery species. Snow crabs have a flat, roundish carapace and five pairs of spidery, long legs. They molt annually until they reach adulthood, which for males occurs when they have developed large claws on their front legs and for females when their carapace has grown large enough to hold eggs (DFO, 2013c). Mating occurs in the spring, right after the females final moulting. Male snow crabs will assist females though their molt and protect females during the soft shell stage. The competition for females may be fierce and occasionally a female will die trying to fight off unwanted mating partners. The females will carry the fertilized eggs in her abdomen for up to two years before they hatch (DFO, 2013c). Adult crabs are found primarily on muddy-sandy substrates at depths ranging from 50-280 m and water temperatures from -1 to 11°C (Hébert *et al*., 2011). Smaller crabs prefer more complex habitats and are often found on harder, rocky substrates. Although the habitat at the proposed Bear Head water lot provides good sand and rocky substrate, it is shallower than their ideal deep summer habitat. Between October and May, adult males and females in the Gulf have been known to migrate from deep to shallow waters between 4 to 80m in depth. Movement of crabs to shallow waters is likely associated with mating, molting or temperature requirements (see Lovrich et al., 1995). Snow crabs feed on fish, bivalves and gastropods, polychaete worms, sea urchins, brittle stars, shrimp, large zooplankton and smaller snow crabs (Hébert et al., 2011; DFO, 2013c). Their predators include halibut, skates, cod, seals, squids, American plaice and larger crabs (Hébert et al., 2011).

5.2.2.10 Atlantic Herring (Clupea harengus)

Although not confirmed, Atlantic herring were potentially observed within the Bear Head water lot. The eelgrass habitat especially provides good habitat for most life history stages of this species. Herring are a pelagic species, occurring in the upper portions of the water column. There are two spawning periods: the spring spawning from April to May usually in water depths of less than 10 m and the fall spawning between August and October in water depths of between 5 to 20 m (DFO, 2012a). Herring deposit their eggs on a variety of substrates such as boulders, rocks, gravel, sand, shell pieces and vegetation (macrophytes) (Reid, 1999). The pelagic free-floating larvae remain in this life stage for 4 to 8 months, depending on the spawning time, with some remaining at the hatching site during this period. The following spring, juveniles form large schools. Juveniles will often move to nearshore waters in the summer and fall to overwinter. Adult herring exhibit extensive migrations for feedings, spawning and overwintering purposes (Reid *et al*., 1999).

5.2.2.11 WHITE HAKE (UROPHYCIS TENUIS)

White hake were observed within the mixed substrate habitat. The eelgrass habitat provides good rearing habitat for this species. While adult white hake inhabit waters of varying depth and temperature within the continental slope and shelf, juveniles prefer estuaries and waters near shore. Adult white hake are sexually dimorphic, as females are larger than males and can grow up to 135 cm in length. Adult hake feed primarily on fish, shrimp and other crustaceans. Juveniles tend to feed on annelid worms (e.g., polychaetes) and crustaceans (e.g., shrimp). Small juveniles are often predated upon by adult hake and other fish species, while seabirds, such as the Atlantic puffin and Artic tern, have been found to feed on larger juveniles occurring near the water surface. On the Scotian shelf, white hake spawn offshore in late summer, from August to September. Eggs remain at the surface of the water and hatch within three to seven days. Both adults and juveniles migrate near shore during the warmer months and return to deeper waters during the colder months. White hake of all ages prefer muddy and fine-grained sandy bottoms; eelgrass is particularly important habitat for juveniles (Chang et al., 1999).

5.2.2.12 SEA SCALLOP (PLACOPECTEN MAGELLANICUS)

Sea scallops were observed in the mixed substrate habitat and fines dominant habitat within the water lot. Scallops are bivalve molluscs that inhabit coastal waters (Moriyasu et al., 2001). They are particularly abundant within gravel bottom waters that are well mixed by the ebb and flow of the tide (Schaefer et al., 2004). Sexual differentiation occurs after 1 year of age, and sexual maturity typically takes place once shell height has reached 70 mm (Moriyasu et al., 2001). Sea scallop spawning occurs between August and October (Schaefer et al., 2004). Spat is free floating within the water column for four to six weeks before attaching to substrates on rocky, sandy, sand-gravel and occasionally muddy bottoms. Scallops tend to aggregate in scallop beds at depths of 20-40 m but can inhabit waters as shallow as 2 m in depth (Moriyasu et al., 2001).

5.2.2.13 GREEN SEA URCHIN (STRONGYLOCENTROTUS DROEBACHIENSIS)

A potential observation of a green sea urchin was identified in the mixed substrate habitat (Appendix B). Urchins inhabit shallow subtidal areas comprised of rock bottoms and are particularly abundant in exposed areas where depths range from 5 to 10 m. Urchin spawning occurs between March and April, and larvae remain free floating until setting between June and July (Schaefer et al., 2004). Fluctuation of *S. Droebachiensis* population densities are correlated with differences in food availability among habitat types (e.g., kelp beds versus barren grounds) as well as disease. Green sea urchins prefer algal foods, such as *Laminaria longicruris* and *L. digitata*, and have converted extensive coastline kelp beds comprised of *Laminaria spp*. into barrens as a result of grazing. Feeding rates in green sea urchins have been shown to vary seasonally due to changes water temperature and reproductive condition (Scheibling and Anthony, 2001).

5.2.2.14 Shrimp (*Pandalus borealis*)

Shrimp were identified throughout all habitat types within the Bear Head water lot. Shrimp could not always be identified to species during the underwater video interpretation. The northern shrimp is suspected to occur in the water lot (SNC Lavalin, 2015). The Northern shrimp is found throughout the North Atlantic, North Pacific and Arctic oceans (ASMFC n.d.). They are typically found in habitats comprised of soft mud and silt substrates and occasionally gravel/rock or sand substrates (Christian *et al.*, 2010). The distribution of adult northern shrimp is correlated with seasonal changes in water temperature (ASMFC n.d.). The areas of the North Atlantic where northern shrimp are the most abundant range in temperature from one to six degrees Celsius. Distribution within the water column also varies temporally, as northern shrimp can feed on worms, small crustaceans, detritus and vegetation near the bottom during the day and migrate upwards to feed on copepods and euphausiids at night (Christian et al., 2010). Spawning occurs annually in offshore waters during late summer (ASMFC n.d.). Upon release, eggs are attached to females' abdomens. Egg bearing females migrate to cooler coastal waters in late autumn-early winter, where they remain until the eggs are hatched (February through April). After hatching, females return offshore. Larvae develop nearshore into juvenile males and migrate to deeper waters to continue development after around 20 months. After one to several years as males, northern shrimp will then sexually transition into females by their fourth year (ASMFC n.d.).

5.2.2.15 Sand Shrimp (*Crangon septemspinosa*)

Sand shrimp were identified within the mixed substrate and fines dominant habitat. The sand shrimp is a small decapod crustacean that typically occupies sandy habitats (Reebs et al., 2011) in coastal and estuarine waters ranging from the lower intertidal zone to depths of 450 m along the Atlantic coast from Newfoundland to Florida (Corey, 1980). Sand shrimp prefer depths ranging from 0-90m (Squires, 1990 in Christian et al., 2010). They overwinter offshore and migrate inshore to spawn. Sand shrimp exhibit both continuous and distinct spawning seasons. In Passamaquoddy Bay, New Brunswick, sand shrimp exhibit two distinct spawning periods: spring spawning (March to early June) occurs typically by large females and summer spawning (mid-July to August) by smaller females (Corey, 1987 in Christian et al., 2010). Whereas, larger females in Kouchibouguac River, New Brunswick, spawn in May and June while smaller females spawn in summer and fall; reproduction is continuous throughout the spring and summer (Locke et al., 2005). Hatching of planktonic larvae varies geographically, ranging from early spring to late fall (Christian et al., 2010). Sand shrimp feed on small crustaceans, other invertebrates and detritus and are an important food source for both commercial and non-commercial fish (Modlin, 1980).

5.2.2.16 Atlantic cod (*Gadus morhua*)

Although not observed during the underwater video survey, this species is suspected to occur in the water lot (SNC Lavalin, 2015). Atlantic cod inhabit the Northwest Atlantic from Greenland to North Carolina. Outside the U.S., the highest densities of Atlantic Cod are found off Newfoundland, the Gulf of St. Lawrence and the Scotian Shelf (Lough, 2004). Atlantic cod are known to have summer and winter concentration areas. In the summer, Atlantic cod concentrate within the Cabot Strait south of the Laurentian Channel and off the coast of southern Newfoundland. Cod are also known to overwinter within the Cabot Strait and the Laurentian Channel. The highest densities of overwintering locations area are located off the coast of southern Newfoundland as well as north and south of the Laurentian Channel (Swain *et al.,* 2001). Atlantic cod leave deep oceanic waters where they overwinter to migrate to summer feeding areas near shore (Lough, 2004).

Specific habitat requirements for the Atlantic cod are not well known (COSEWIC, 2010a). Spawning can occur at all depths up to 182 m (Scott, 1983) between January-February, September-October and July and August (Hanks et al*.,* 2000). Some documented areas for spawning include Browns Banks, Western Banks, Emerald Banks, northern Sable Island Banks, Middle Bank, Banquereus and Sydney Bight. Once the eggs hatch, the larvae inhabit the upper 10 to 15 m of the water column. An important nursery area exists for groundfish such as cod in Sydney Bight (Locke, 2001). As juveniles, cod live on the ocean bottom for one to four years and may favour eelgrass, *Zostera marina*, in nearshore waters and macroalgae and other deep-water emergent structures in deeper water (e.g., corals). Young and adult Atlantic cod may favour corals, such as sea pens. Fishermen fishing from the Port-Aux Basques area have reported that cod are abundant in areas with sea pens (Colpron *et al.,* 2010). Not much is known about the depth and bottom-substrate requirements of adult cod (COSEWIC, 2010a). Habitat suitability for all life stages is likely dependant on food availability and temperature. Habitat that may be limiting for Atlantic cod include vertical structures on the ocean floor such as plants, rocks and corals. These structures not only provide protection from predators, they also provide habitat for small fish and invertebrates that cod eat (COSEWIC, 2010a).

5.2.2.17 Mackerel (Scomber scombus)

Although not observed during the underwater video survey, this species is suspected to occur in the water lot (SNC Lavalin, 2015). Atlantic mackerel spawn in the southern Gulf of St. Lawrence (Grégoire et al., 2013) from the end of May to mid-August. They are also known to spawn in the Mid-Atlantic Bight and Gulf of Maine from mid-April to June (Studholme et al., 1999). Rearing habitat typically ranges between 10-130 m depths at temperatures ranging from 6-22^{o}C (Studholme et al., 1999). During fall and winter, mackerel are usually found at the edge of the continental shelf (DFO, 2012a) and at depths of 10-270 m, with the majority found between 20-30 m of water (Studholme et al., 1999). In the spring and summer, mackerel are found in inshore waters (DFO, 2012b) and at depths of 10-180 m, with the majority between 50-70 m (Studholme et al., 1999). Mackerel feed primarily on plankton, copepod nauplii, copepod larvae and fish larvae (yellowtail flounder, silver hake, redfish, conspecifics) (Studholme et al., 1999).

5.2.2.18 Cunner (Tautogolabrus adspersus)

Cunner were observed in the fines dominant habitat within the water lot. Cunner inhabit shallow waters from Newfoundland to Chesapeake Bay. Juvenile and adult cunner are active in the day and lethargic at night and thus prefer habitats with suitable cover for protection. Such habitats can include rocky areas, eelgrass, kelp and gravel. Cunner are omnivores and feed primarily on blue mussels, barnacles, soft shell clams, amphipods, shrimp and small lobster. During the summer, cunner disperse to seasonal habitats comprised of eelgrass, macro algae or mussels. They return to perineal sites during the fall where they overwinter in a state of torpor under rocks, in crevices and other areas providing adequate protection when water temperatures reach between 5-8 degrees Celsius (Auster, 1989).

CHAPTER 6 CONCLUSIONS

6.1 Fisheries Habitat Summary

There were four distinct habitat types identified during the analysis of the video transect and spot check surveys of the Bear Head LNG water lot:

- Rocky intertidal habitat;
- Mixed substrate habitat;
- Eelgrass habitat; and
- Fines dominant habitat.

The physical complexity of the rocky intertidal habitat and mixed substrate habitat exhibited more macrofloral species diversity and abundance than either the eelgrass or fines dominant environments. The eelgrass habitat along Transect 2 was densely populated by *Zostera marina*, but the macrofloral species diversity was low. The fines dominant habitat exhibited sparse algal coverage except where small boulders and cobbles were exposed (see Appendix B).

Motile macrofauna diversity and abundance was homogenous throughout the study area, but sessile and low motility macrofauna were observed to exhibit habitat preferences (see Appendix B). *Balanus sp*. were found exclusively in the rocky intertidal habitat, whereas the northern cerianthid was most abundant in the fines dominant habitat. Species exhibiting greater motility, such as lobster and rock crab, were found to be homogenously distributed within the study area. It is possible that this was due, not to the species habitat preference, but rather to the limitations of video transect interpretation in complex habitats with dense algal and macrophyte coverage. Marine habitats with increased structural complexity are typically inhabited by more species than areas that are devoid of this due to the increase in niche (functional) diversity (Dustan *et al*., 2013). Habitat complexity can be measured by rugosity (measure of complexity/degree of roughness) of the substratum, diversity of the substratum, variety of refuge hole sizes, height of substratum, percentage of live cover (i.e., seagrasses, corals) and percentage of hard substrate. A more complex and variable habitat shows greater species diversity and abundance (Gratwicke and Speight, 2004). The rugosity and percentage of hard substrate are mediums in which microscopic algae, macroalgae, corals, sponges and mussels can fasten upon and thrive. They generally will not grow on soft substrates due to instability (shifting sands). These organisms can be a food source, provide cover from predators, or provide spawning grounds for many species (Gratwicke and Speight, 2004). Having structures with varying forms and heights (i.e., rocks, algae, corals) will provide different functionalities for many species (microhabitats). It is therefore possible that a wider and more voluminous array of macrofauna may have been present in each of the rocky intertidal, mixed substrate and eelgrass habitats, but were not observed due to the cryptic complexity of the surveyed environments.

Fines dominated habitats can be dynamic and influenced by tidal currents and waves. The nature of this environment influences species abundance and diversity. Although this environment has less diversity when compared to more structurally complex areas, some species have adapted to utilize the functions that fine substrates provide. Species, such as the sandlance and rock crab, will bury themselves in the soft substrate as they rest between foraging activities. Fine substrates can also provide shelter and cover from predators. Species such as flounders, skates and shrimp have adapted to use camouflage, having similar colouration to the sea floor, making them difficult for predators to spot (Tyrell, 2005).

DFO has indicated that the Bear Head water lot is within the bounds of active lobster fishing grounds. The majority of the western portion of the Bear Head water lot contains suitable habitat for the entire lifecycle of American lobster (see Tables 5.1-5.4). Their presence at each life stage was confirmed during the video interpretation of the transects undertaken; a juvenile lobster, for example, was captured on video having recently settled out of the planktonic larvae (see Appendix C), and adults were seen throughout each transect and spot check.

The deposition of materials for the purpose of constructing an offloading wharf on habitat that supports CRA fisheries, notably lobster, could cause harm to CRA fisheries and require authorization pursuant to Section 35 of the *Fisheries Act*. The underwater benthic survey of the western portion of the Bear Head water lot revealed that the nearshore habitat should be considered appropriate habitat for CRA fisheries species, including lobster, and those species that support CRA fisheries.

Habitats occurring outside of the four transect and ten spot check locations reviewed have not been characterized and may contain alternative habitat types and functions.

6.2 Sensitive Habitat Features

An eelgrass bed (*Zostera marina*) was identified in Transect 2 in addition to a small patch identified in Transect 1 (see Appendix B). The bed appears to be functionally healthy. Eelgrass is known to be an ecologically sensitive species due to its strict physical, biological and chemical requirements for growth and its vulnerability to anthropogenic activities (Vandermeulen, 2005). Eelgrass beds are also valuable to marine organisms and support high abundances and diversity of a wide variety of species. Eelgrass beds are well known for their role in providing fish with important foraging and rearing habitat as well as cover from predation (Joseph et al., 2013).

Construction of the permanent offloading wharf and tug wharf or temporary wharf in the eelgrass would be considered harmful to the function of the bed; this is not proposed. Construction on or near to the bed and suspended sediments in the water column could affect both water quality and light penetration. The eelgrass bed was identified in Transect 2 (Figure 1.2), i.e., approximately

150 m distant from the proposed material off-loading wharf. Although the length of the eelgrass bed was delineated, the width of the bed was not. The total extent of the eelgrass bed is therefore unknown. A small amount of eelgrass was identified in Transect 1. No other eelgrass habitat was identified in any of the other transects or spot check locations (Figure 1.2).

6.3 Concluding Observations

The proposed offloading wharf and tug mooring is located to the west of Transect 1 (Figure 1.2). Transect 4 runs through the proposed structure and Spot Check 4 (SC4) was conducted within the proposed infill area. The habitat types can be characterized primarily as intertidal rocky habitat and mixed substrate habitat typical of the area at large. A small patch of eel grass (~2 m^2) was observed in the 30 m to 40 m interval to the west of Transect 1 at a depth of 3 m. This and the larger area of eelgrass identified on Transect 2 indicates that the physical, biological and chemical requirements for its growth are present in the area. Based on the work undertaken, it is determined that no distinctive or highly valued habitat will be impacted by the proposed marine works.

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CHAPTER 7 **CLOSURE**

This report has been prepared for the sole benefit of Bear Head LNG and Fisheries and Oceans Canada. The report may not be relied upon by any other person or entity without the express written consent of CBCL Limited, Bear Head LNG, and Fisheries and Oceans Canada.

Any use which a third party makes of this report and any reliance on decisions made based on it, are the responsibility of such third parties. CBCL Limited accepts no responsibility for damages, if any, suffered by any third party as a result of decisions or actions made based on this report.

The conclusions and recommendations presented represent the best judgement of the assessor based on current environmental standards and on the observed site conditions. The conclusions are based on results from specific underwater video spot locations and transects and can only be extrapolated to an undefined limited area around these locations.

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Table of Contents

LIST OF TABLES

LIST OF FIGURES

1.0 INTRODUCTION

Bear Head LNG Corporation Inc. (Bear Head LNG) is proposing a permanent material offloading wharf with tug mooring within the western portion of their water lot on the northern shore of the Canso Strait in the Point Tupper Industrial Park in Richmond County (Figure 1.1). An underwater benthic habitat survey was conducted on the western portion of the water lot to support a “Request for Review” to Fisheries and Oceans Canada (DFO). The underwater survey of benthic habitat consisted of four transects filmed by scuba divers and 10 spot checks filmed by a submersible ROV (remotely operated vehicle) (CBCL 2016).

The report identified the presence of eelgrass along one two of the underwater transects filmed by scuba divers. Although the length of the eelgrass bed was identified from the collected underwater video, the width of the bed was not. The total extent of the eelgrass bed is therefore unknown.

Stantec was engaged by Bear Head LNG to complete an acoustic habitat survey of the area to further delineate the eelgrass habitats. The survey was implemented in September 2022 with the collection of hydroacoustic surveys to assess the current eelgrass distribution, percent cover and canopy height within the Target Survey Areas. The following report outlines the conditions encountered.

1.1 LOCATION

The proposed marine facility is located to the west of the approved LNG marine terminal. The proposed facility includes a piled wharf located approximately parallel to the shoreline. The piled wharf structure consists of two segments: a barge unloading wharf and a tug wharf. The barge unloading wharf is approximately 50 m long by 24 m wide; the tug wharf is approximately 116 m long by 15 m wide. A rubble mound infill approach connects the shoreline to the back of the barge unloading wharf. This rubble mound approach is designed to have 2:1 side slopes with armourstone coverage. There are three breasting dolphins and two mooring dolphins running perpendicular to the barge unloading dock to accommodate the stern first berthing of the barge. The mooring dolphins are set back from the property line to provide a set-back of the piles underwater to ensure that they are within the water lot.

The survey transects and the spot check locations were completed within the western portion of the Bear Head LNG water lot located in the Point Tupper Industrial Park on the northern shore of the Strait of Canso.

2.0 METHODOLOGY

The survey methodology implemented for this project was developed to delineate the eelgrass habitat and characterize its functionality within the western portion of the Bear Head water lot. The following section details the survey methodology utilized.

2.1 ACOUSTIC SURVEYS

A focused acoustic habitat survey was conducted to obtain data on vegetation, substrate, and depth within the Target Survey Areas. Acoustic data were collected using a vessel-mounted, single-beam sonar echosounder (Habitat MX Echosounder, BioSonics, Seattle Washington, USA). The primary acoustic survey equipment included the BioSonics transducer (204.8 kHz transducer, 8.6-degree conical beam angle, range accuracy 1.7 cm ± 0.2% of depth), BioSonics deck unit with integrated differential GPS (positional accuracy <3 m, 95% typical), and a field laptop (Toughbook 31, Panasonic Corporation of North America, Newark, NJ, USA).

Vessel-based transects were spaced approximately 10 m apart, Figure 2.1, within the Target Survey Area. Using the integrated differential GPS, the survey vessel navigated along each transect at approximately 4 to 5 km/h (approximately 2.5 knots; speed-over-ground).

The BioSonics hydroacoustic transducer provides two-dimensional information (linear distance vs. depth) in the form of an echogram on echo intensity returns along each transect (Figure 2.2, Panel A). In this sample echogram, an unvegetated bottom (black rectangle) can clearly be differentiated from a vegetated bottom (red rectangle). An unvegetated bottom is characterized by the steepest rise in amplitude of signal intensity in the oscilloscope (Figure 2.2, Panel B, black arrow) relative to background noise (blue arrow) and a reflected acoustic signal (grey arrow) near the bottom of the echogram and oscilloscope. In contrast, Figure 2.2 Panel D shows the typical oscilloscope signature of a bottom vegetated with plants indicating a more gradual rise in signal intensity (green arrow) immediately above the bottom signal (black arrow). The plant signal (green arrow) has a weaker intensity than the harder bottom signal (black arrow; Figure 2.2, Panel D). The magnitude of the plant signal relative to the bottom signal is used by the BioSonics algorithm to calculate the canopy height of the plants.

The BioSonics algorithm exploits differences in acoustic signatures from each echo return ("ping") to characterize the substrate condition and characteristics of any vegetation encountered. Percent cover of vegetation is calculated by aggregating data over pre-determined ping cycles (n = 10). For example, in a 10-ping cycle, if 4 of 10 echo returns indicate the presence of vegetation, the algorithm calculates the vegetation percent cover as 40% (4/10 x 100 = 40%). Similarly, the canopy heights of these four individual pings would be averaged to produce a mean canopy height for this same 10 ping cycle.

Title
Bear Head Eelgrass Survey

Client/Project 121431287-040

Bear Head Energy
Regulatory Permitting Support

Project Location Prepared by NWhite on 2022-12-01
Port Richmond
Richmond County, NS

N
0 100 200 Metres
(At original document size of 8.5x11)
1:9,500

Legend

Survey Tracks

Study Area

Previously Identified Eelgrass Habitat

Project Location

Notes
1. Coordinate System: NAD 1983 CSRS UTM Zone 20N
2. Data Sources: Stantec
3. Background: ESRI Aerial / Topographic 2022

Stantec

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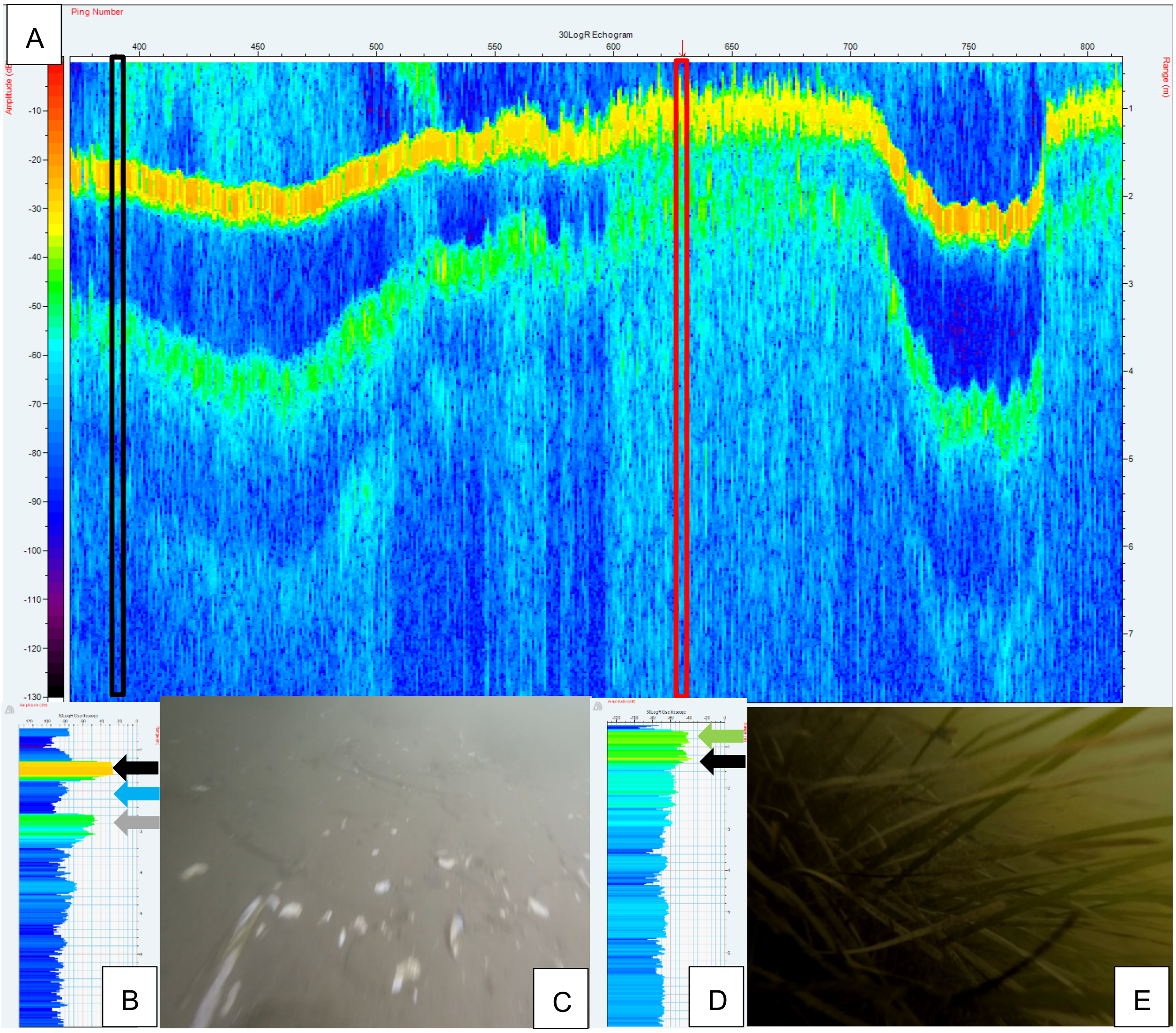

Figure 2.2 BioSonics Processing

The following outputs were produced from the acoustic data using the Visual Aquatic software package (BioSonics, Seattle Washington, USA):

- bathymetric mapping
- eelgrass percent cover mapping
- eelgrass canopy height mapping
- sediment type mapping

3.0 AQUATIC HABITAT MAPPING RESULTS

3.1 BATHYMETRY

Hydroacoustic data collected during the acoustic surveys were used to create a bathymetric layer within the Survey Area. The interpolated bathymetric map (Figure 3.1) was created from data collected in the field (Figure 2.1), corrected to chart datum (CD), and used to calculate water depths between sample points to create a smooth bathymetric contour map of the surveyed area.

Water depths in the Target Survey Area ranged from 1.5 m CD to 34.0 m CD. The seafloor slope was generally consistent from the shoreline to the outer extent of the Target Survey Area with the maximum depth observed at the southwest corner.

Bathymetry could not be determined from the acoustic data in 20 of 15,564 data points (0.1%). This was due to multiple causes including: dense vegetation which obscured the acoustic return from the seafloor; loss of signal from water column irregularities; and abrupt changes in depths where the bottom signal was lost. The invalid data points were spread throughout the Target Survey Areas and do not change the results of the interpolation.

Title
Bear Head
Eelgrass Survey

Client/Project 121431287-040

Bear Head Energy
Regulatory Permitting Support

Project Location Prepared by NWhite on 2022-12-01
Port Richmond
Richmond County, NS

N

0 100 200
Metres
(At original document size of 8.5x11)
1:9,500

Legend

Survey Tracks

Study Area

Bathymetry (m,CD)

0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
18.0
20.0
22.0
24.0
26.0
28.0
30.0
32.0
34.0
36.0
38.0
40.0

Project Location

Notes
1. Coordinate System: NAD 1983 CSRS UTM Zone 20N
2. Data Sources: Stantec
3. Background: ESRI Aerial / Topographic 2022

Stantec

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3.2 EELGRASS DISTRIBUTION

Hydroacoustic data collected during the acoustic survey were used to create a vegetation distribution map within the Target Survey Area. The interpolated vegetation distribution layer was created from data collected in the field, and ground-truthed using observations from the Marine Benthic Report (CBCL 2016).

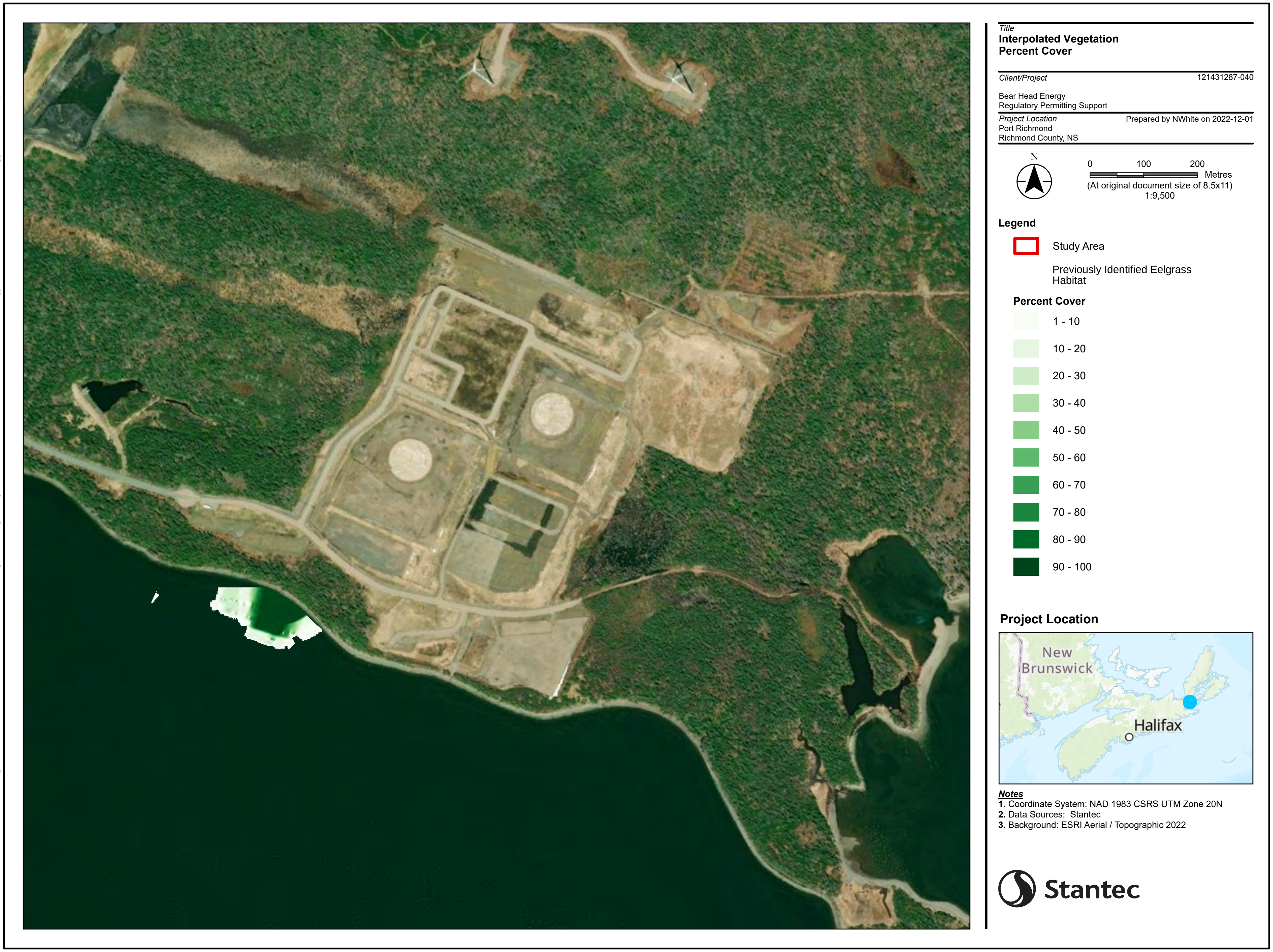
Figure 3.3 represents the interpolated mapping of the percent cover of eelgrass for the Target Survey Areas, in which the raw data (Figure 2.1) were used to create SAV coverage mapping for the entire area.

Figure 3.4 represents the raw data for eelgrass canopy height for the Target Survey Areas. Interpolation of vegetation height is generally avoided as height of plants is independent of the height of adjacent plants so interpolated values are highly biased.

Summary statistics listing the median eelgrass coverage and height along with the interquartile range (IQR) and total area for the eelgrass bed is included in Table 3.1. Median eelgrass coverage was 80%. The IQR was 80% as the eelgrass bed was generally dense, with a rapid decrease in coverage near the edges. Eelgrass canopy height ranged from 0.23 m to 0.79 m, with median values of 0.41 m (Table 3.1, Figure 3.4).

Table 3.1 Eelgrass Summary Statistics for Target Survey Area

Median Coverage (%)	Coverage IQR (%)	Median Height (m)	Height IQR (m)	Total area of Eelgrass Habitat (m^2)
80	80	0.41	0.12	7,997



Title
Interpolated Vegetation Percent Cover
Client/Project
121431287-040
Bear Head Energy
Regulatory Permitting Support
Project Location
Prepared by NWhite on 2022-12-01
Port Richmond
Richmond County, NS
N
0
100
200
Metres
(At original document size of 8.5x11)
1:9,500
Legend
Study Area
Previously Identified Eelgrass Habitat
Percent Cover
1 - 10
10 - 20
20 - 30
30 - 40
40 - 50
50 - 60
60 - 70
70 - 80
80 - 90
90 - 100
Project Location
New Brunswick
Halifax
Notes
1. Coordinate System: NAD 1983 CSRS UTM Zone 20N
2. Data Sources: Stantec
3. Background: ESRI Aerial / Topographic 2022
Stantec

Title
Eelgrass Plant Height

Client/Project 121431287-040

Bear Head Energy
Regulatory Permitting Support

Project Location Prepared by NWhite on 2022-12-01
Port Richmond
Richmond County, NS

N

0 100 200 Metres
(At original document size of 8.5x11)
1:9,500

Legend

Study Area

Plant Height (m)

0.15 - 0.25

0.25 - 0.50

0.50 - 0.75

0.75 - 0.79

Project Location

Notes
1. Coordinate System: NAD 1983 CSRS UTM Zone 20N
2. Data Sources: Stantec
3. Background: ESRI Aerial / Topographic 2022

Stantec

4.0 CLOSURE

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This assessment design includes descriptions, methodologies and technologies described herein that shall not be duplicated, used, or disclosed in whole or in part for any purposes other than for evaluation. The conclusions presented in this report represent the best technical judgement of Stantec at the time the work was conducted and is based on information obtained by and/or provided to Stantec at that time. There are no assurances regarding the accuracy and completeness of this information. All information received from the client or third parties in the preparation of this report has been assumed by Stantec to be correct. Stantec assumes no responsibility for any deficiency or inaccuracy in information received from others. The conclusions are based on the site conditions encountered by Stantec at the time the work was performed at the specific locations and can only be extrapolated to an undefined limited area around these locations.

If any conditions become apparent that differ significantly from our understanding of conditions as presented in this report, we request that we be notified immediately to reassess the conclusions provided herein.

5.0 REFERENCES

2016. CBCL Limited. Benthic Habitat Survey