PWGSC PROJECT #R.076368.002
UNDERWATER BENTHIC HABITAT SURVEY
Proposed Breakwater Extensions
North Head DFO-SCH
North Head, New Brunswick

DRAFT REPORT

Submitted to:
Public Works and Government Services Canada
Saint John, Nova Scotia

Submitted by:

Amec Foster Wheeler Environment & Infrastructure,
a Division of Amec Foster Wheeler Americas Limited
Saint John, New Brunswick

July 2015

TE131446.6000

31 July, 2015

TE131446.6000

Mr. Jason Keys
Environmental Officer
Environmental Services
Public Works and Government Services Canada
189 Prince William Street
Saint John, New Brunswick
E2L 2B9

Dear Mr. Keys:

Re: Underwater Benthic Habitat Survey at the North Head Fisheries and Oceans Canada Small Craft Harbour, North Head, New Brunswick – Draft Report

Amec Foster Wheeler Environment & Infrastructure, a Division of Amec Foster Wheeler Americas Limited (Amec Foster Wheeler), is pleased to provide Public Works and Government Services Canada with the findings of an Underwater Benthic Habitat Survey undertaken within the footprint of proposed construction and dredge areas at the North Head Fisheries and Oceans Canada – Small Craft Harbour in North Head, New Brunswick.

Amec Foster Wheeler appreciates the opportunity to provide services to your organization. Please do not hesitate to call if you have any questions regarding this or any other matter.

Respectfully submitted,

Amec Foster Wheeler Environment & Infrastructure,
a Division of Amec Foster Wheeler Americas Limited

DRAFT

Chyann Kirby, B.Sc., P.Tech, EP
Project Manager
Direct Tel.: 506.652.4530 (or 506.652.9497 ext. 226)
Direct Fax: 506.652.9517
E-mail: chyann.kirby@amecfw.com

BM/kk

Amec Foster Wheeler Environment & Infrastructure,
a Division of Amec Foster Wheeler Americas Limited
580 Main Street, Suite 105
Hilyard Place Building B
Saint John, NB E2K 1J5
Tel +1 (506) 652-9497
Fax +1 (506) 652-9517
www.amecfw.com

TABLE OF CONTENTS

PAGE

1.0 INTRODUCTION 1

2.0 SCOPE AND METHODOLOGY 1

3.0 UNDERWATER HABITAT SURVEY RESULTS 3
3.1 TRANSECT 1 (T1) 3
3.2 TRANSECT 2 (T2) 4
3.3 TRANSECT TIE LINE 1 (TT1) 5
3.4 TRANSECT TIE LINE 2 (TT2) 5
3.5 TRANSECT TIE LINE 3 (TT3) 6

4.0 FISH HABITAT 6

5.0 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC) 7

6.0 SUMMARY 7

7.0 CLOSING 8

LIST OF FIGURES

Figure 2.1 Benthic Transect Locations – North Head DFO-SCH, North Head, NB 2

LIST OF APPENDICES

Appendix A Transcript of Video and On-Site Observations
Appendix B Annotated Species List
Appendix C Photo Log
Appendix D Limitations

1.0 INTRODUCTION

At the request of Public Works and Government Services Canada (PWGSC), an Underwater Benthic Habitat Survey (UBHS) program was completed on 17 July, 2015 within the footprint of proposed construction and dredge areas at the North Head Fisheries and Oceans Canada (DFO) – Small Craft Harbour (SCH) in North Head, New Brunswick (NB).

2.0 SCOPE AND METHODOLOGY

Qualitative and quantitative observations were obtained from the footprint of the proposed construction and dredge areas using video survey techniques to map substrate types and document macrofaunal and macrofloral species presence and abundance. Amec Foster Wheeler Environment & Infrastructure, a Division of Amec Foster Wheeler Americas Limited (Amec Foster Wheeler) contracted Diversified Divers Inc. to perform the diving and video surveillance services. An Amec Foster Wheeler representative was on-site to guide the dive crew in the event that any issues arose and to obtain supporting habitat and biological information.

A total of 450 metres (m) of video surveillance was divided into two transects (T1 and T2) and three transect tie lines (TT1 to TT3) of various lengths from the footprint of the proposed construction and dredge areas at the North Head DFO-SCH (Figure 2.1).

A handheld Global Positioning System (GPS) was used to locate the pre-determined start and finish points of the transects.

The survey of the transects required the use of a video camera, operated by a Canadian Standards Association (CSA)-certified diver. Video at the North Head DFO-SCH were collected at high tide except for the last 25 m of T1. Photos were taken of this portion to assess the habitat in that area. Seabed characterization involved field observations made by the field crew and a review of the video survey recording. Observations along the video transect were made for every 5 m segment.

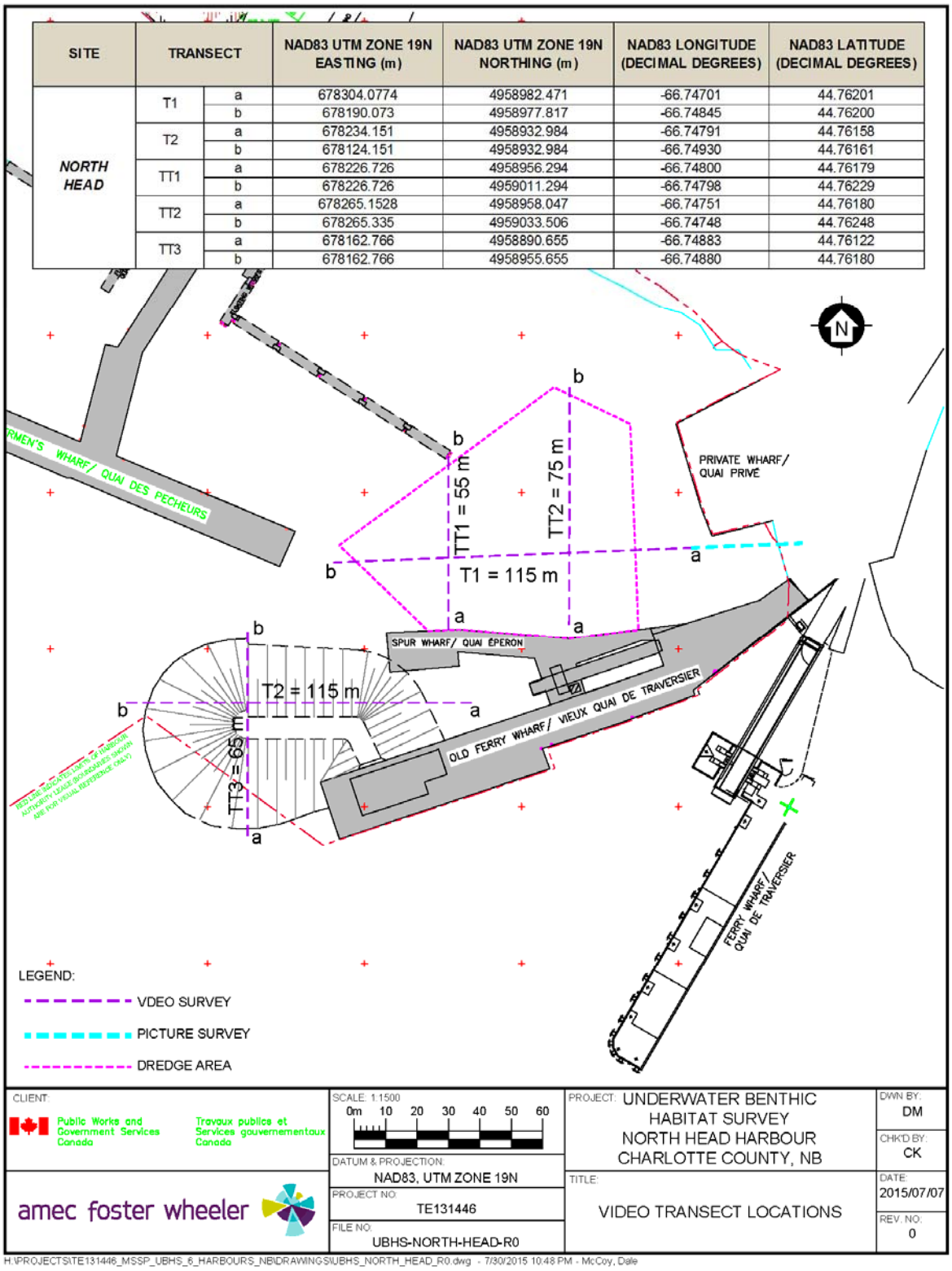


Figure 2.1 Benthic Transect Locations – North Head DFO-SCH, North Head, NB

3.0 UNDERWATER HABITAT SURVEY RESULTS

The results of the transect surveys for the proposed project footprint are presented in Appendix A (Tables A.1 to A.5), including the following information for each 5 m increment of transect line:

- visual determination of substrate type (in order of dominance);
- macrofaunal species identification and abundance; and
- macrofloral species identification and percent coverage.

A summary of the information provided in Tables A.1 to A.5 (Appendix A) is described in the following paragraphs. An annotated species list has been included in Appendix B. Photographs of the intertidal area of T1 at low tide have been included in Appendix C.

For the purposes of the video survey review and macrofaunal species identification and enumeration, four categories were developed to characterize the observed abundance levels. The categories are as follows:

A = Abundant
Numerous (not quantifiable) observations made throughout the entire 5 m segment.
C = Common
Numerous (not quantifiable) observations made intermittently along the 5 m segment.
O = Occasional
Quantifiable observations made intermittently along the 5 m segment.
U = Uncommon
Quantifiable observations made infrequently along the 5 m segment.

Observations of macrofaunal life were uncommon but noted along all five transects as further described in this section.

Macrofloral life was noted in all five of the transects as further described below and in the associated tables in Appendix A (where encountered). Macrofloral debris (i.e., detritus from macrofloral species) was noted along segments of transects T1, T2, TT2, and TT3.

Anthropogenic debris was observed in all five transects but most noticeably in T2. The debris in T2 included a piece of what appeared to be an old wharf seen clearly in the 50-55 m segment.

3.1 Transect 1 (T1)

Transect 1 (T1) was 135 m long, starting at shore and proceeding west into the harbour (Figure 2.1). The first 25 m of the transect was assessed using photographs of the area (Appendix C). The underwater video transect then starts at the 0 m mark and runs to the 110 m mark.

Substrate:
The substrate can be divided into three distinct zones. From the shoreline to the start of the video (assessed from picture in Appendix C) the substrate was predominantly silt and sand with lesser

amounts of cobble. The first 35 m of the video were a mix of cobble and gravel with lesser amounts of rock. From there to the 55 m mark the substrate was predominantly bedrock ledge with lesser amounts of silt, sand, and boulder. The remainder of the transect has a substrate that is predominantly silt with lesser amounts of cobble and sand with rare instances of boulder.

Macrofauna:
Macrofaunal life was composed primarily of periwinkles (*Littorina* sp.) and Northern rock barnacle (*Semibalanus balanoides*). They are noted as abundant or common through most of the transect, although periwinkle was observed as occasional in the 0-5 m segment and uncommon in the 90-95 and 95-100 m segments. Green crab (*Carcinus maenas*) was noted as uncommon in six segments throughout the transect. Other species noted in the transect included blue mussel (*Mytilus edulis*), white cross jellyfish (*Staurophora mertensi*), longhorn sculpin (*Myoxocephalus octodecemspinosus*), rock crab (*Cancer irroratus*), sand dollar (*Echinarachnius parma*), and unidentified fish species. These species were observed each in only one or two segments with an uncommon occurrence, except for blue mussel which had an occasional occurrence. Shell hash was noted throughout the transect.

Macroflora:
The macrofloral community, like the substrate, can be divided into three distinct zones. From the shoreline to the start of the video the macrofloral community appears to be sparse, with algal cover present where hard substrate is present. The first 35 m of the video was comprised primarily of spiny sour weed (*Desmarestia aculeata*) with lesser amounts of rockweed (*Ascophyllum nodosum*), brown alga (*Pilayella littoralis*), sea lettuce (*Ulva lactuca*), green alga (*Spongomorpha* sp.), and bladderwrack (*Fucus vesiculosus*). The macrofloral community from 35 to 50 m is dominated by rockweed and bladderwrack with lesser cover of the green and brown algae and spiny sour weed. From the 50 m mark to the shoreline the macroflora is dominated by sugar kelp (*Laminaria saccharina*) with lesser cover of spiny sour weed, rockweed, sea lettuce, green alga, and red alga (*Plumaria plumosa*). Macrofloral debris was noted in only one segment (80-85 m).

3.2 Transect 2 (T2)

Transect 2 (T2) was 115 m long starting between the spur wharf and old ferry wharf and proceeded in a westerly direction (Figure 2.1).

Substrate:
The substrate in T2 was comprised predominantly of silt with lesser amounts of sand. In rare instances there are small amounts of boulder, cobble, or rock.

Macrofauna:
Common observances of Northern rock barnacles and uncommon occurrences of green crab were noted in six of the twenty three segments. Frilled anemone (*Metridium senile*) was noted in four segments, burrowing anemone (*Cerianthus borealis*), rock crab and seastar (*Asterias* sp.) in two segments, and Bowerbank's halichondria *(Halichondria bowerbanki*) in one segment. A single flounder that could not be identified to Genus was noted in each of the 20-25 and 25-30 m segments. Shell hash was noted in twelve of the twenty three segments.

Macroflora:
Macrofloral life was noted in eleven of the twenty three segments with coverage ranging between 5 and 35%. Sugar kelp was the most prominent species with uncommon observances of sea lettuce, red alga, bladderwrack, dulse (*Palmaria palmata*) and sea colander (*Agarum clathratum*).

3.3 Transect Tie Line 1 (TT1)

Transect tie line 1 (TT1) was 55 m long, starting at the spur wharf and proceeding north to the floating docks (Figure 2.1).

Substrate:
The substrate was predominantly comprised of silt with lesser amounts of rock and cobble.

Macrofauna:
Macrofaunal life in TT1 was limited to uncommon occurrences of species except for a common occurrence of Northern rock barnacle in one segment. Hermit crab (*Pagarus acadianus*) and longhorn sculpin were noted in two segments and green crab and rock crab were noted in one segment each. Castings from benthic worms were noted in some segments. Shell hash was observed in seven of the eleven segments.

Macrofloral:
Macrofloral life was noted in every segment with coverage ranging between 25 and 65%. Sugar kelp was the dominant species with lesser cover of rockweed, sea colander, spiny sour weed, red alga, sea lettuce, bladderwrack, and encrusting algae (*Leptophyllum* sp.). Macrofloral debris was not observed in TT1.

3.4 Transect Tie Line 2 (TT2)

Transect tie line 2 (TT2) was 80 m long. This transect started against the spur wharf and proceeded north parallel to TT1 (Figure 2.1).

Substrate:
The first 10 m of the transect were predominantly silt with lesser amounts of gravel and sand. The next 20 m are comprised almost entirely of bedrock with small amounts of sand, silt, and cobble. From 20 to 70 m the substrate was predominantly cobble with lesser amounts of rock, boulder, and gravel. The last 10 m skirt the edge of a bedrock ledge.

Macrofauna:
Macrofaunal life in TT2 was dominated by common and abundant occurrences of Northern rock barnacles and periwinkles. There was also one uncommon occurrence and one occasional occurrence of periwinkle. The only other fauna observed was an uncommon occurrence of rock crab in the 0-5 m segment.

Macroflora:
Macrofloral life was noted in every segment with coverage ranging between 40 and 95%. Rockweed and bladderwrack were the dominant algal species along the transect. Other species that contributed to the overall community included sugar kelp, green alga, spiny sour weed, brown alga, sea lettuce, and spiny sour weed. Macrofloral debris was noted only in the 10-15 m segment.

3.5 Transect Tie Line 3 (TT3)

Transect tie line 3 (TT3) was 65 m long. It was oriented in a north-south orientation approximately two thirds of the way down T2 (Figure 2.1).

Substrate:
The transect was predominantly silt with lesser amounts of sand. A small amount of rock was present in two segments.

Macrofauna:
Macrofaunal life in TT3 was observed in six of the thirteen segments. All observations of fauna were uncommon (1 or 2 occurrences) and included green crab, frilled anemone, hermit crab and breadcrumb sponge (*Halichondria panacea*). A moon snail collar was observed in one segment and shell hash was present in all thirteen segments.

Macroflora:
No macrofloral life was noted in the transect, but macrofloral debris was observed in all thirteen segments.

4.0 FISH HABITAT

Portions of T1 and almost the entire length of TT2 run along a bedrock ledge. This substrate provides a base for a high degree of algal cover and excellent habitat for several different species. The portions of T1 that are not ledge provide less algal cover and suitable fish habitat, particularly as the transect moved into deeper water. Transect TT1 has a substrate that is mainly comprised of silt with a minimum of hard bottom. There is some algal cover though much of it is smaller plants like sea lettuce that do not provide quality habitat. Overall the habitat along this transect could be considered mediocre.

Transect T2 is predominantly silt and any larger algal species, mainly kelps, are attached to anthropogenic debris rather than hard bottom. Overall algal cover is low and is most prominent around a large piece of debris that appears to be an old wharf. This area provides excellent cover for fish and invertebrates because it supplies a substrate for algae and interstitial spaces for refuge. The remainder of the transect would be considered mediocre habitat. Transect TT3 provides no algal cover or hard bottom for refuge. The habitat observed in this transect would be considered poor.

5.0 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

The diving crew was directed by an on-site Amec Foster Wheeler representative (Mr. Bruce Moore, B.Sc.) who is experienced in data collection for environmental assessment project components. Mr. Moore was responsible for the data collection and overall data quality as well as for ensuring that all standard operating procedures were followed and that adequate health and safety measures were taken.

A Project Reviewer (Ms. Kerry Higgins, B.Sc, EP) has reviewed this report prior to its release. The limitations of this document are provided in Appendix D.

6.0 SUMMARY

Characterization of the substrate and benthic communities along five transects within the footprint of construction and dredge areas at the North Head DFO–SCH in North Head, NB was completed using a combination of visual field observations and underwater video survey techniques. A portion of the intertidal zone of T1 was not included in the video, but photographs are included in Appendix C. Anthropogenic debris was observed in all five transects but most noticeably in T2. The debris in T2 included a piece of what appeared to be an old wharf seen clearly in the 50-55 m segment.

The substrate of T1 had three different zones, consisting of a mix of cobble and gravel with lesser amounts of rock for the first 35 m, predominantly bedrock ledge for the next 20 m and then mainly silt with lesser amounts of cobble and sand for the remainder of the transect. The substrate of T2, TT1, and TT3 was predominantly silt with lesser amounts of sand, boulder, rock and cobble. The substrate of TT2 was predominantly cobble with lesser amounts of rock and gravel

Macrofaunal life was observed in all five of the transects and almost 75% of the 5 m segments with a total of 14 unique species. In areas with hard bottom, notably T1 and TT2, Northern rock barnacles and periwinkles were prevalent with common or abundant occurrences. The remainder of the species were limited to uncommon or occasional occurrences and included green crab, blue mussel, white cross jellyfish, longhorn sculpin, rock crab, sand dollar, seastar, frilled anemone, burrowing anemone, Bowerbank's halichondria, hermit crab, breadcrumb sponge and unidentified fish species. A flounder was noted in two segments but it could not be identified to the Genus. In addition worm castings and a moon snail collar were noted. Shell hash was observed throughout all five transects.

Macrofloral life was observed in four of the five transects surveyed. The algal cover was generally high, ranging between 25 and 95% but most commonly around 75%. As with the substrate, T1 could be divided into three unique zones. Spiny sour weed was the dominant alga for the for the first 35 m, rockweed and bladderwrack were most common for the next 20 m and sugar kelp was the dominant species for the remainder of the transect. T2 was a mix of sugar kelp and sea colander and TT1 and TT2 were a mix of sugar kelp and rockweed. Other species that were noted in all five transects to a lesser degree included sea lettuce, red alga, green alga, brown alga, sea colander, encrusting algae, and dulse.

Portions of T1 most of TT2 run offer excellent habitat, with the remainder of those transect offering little habitat. Transects TT1 and TT3 offer poor to mediocre habitat due to a lack of hard bottom and cover. Transect T2 has a large amount of anthropogenic debris that has created a “false” hard bottom that supports algal cover in some areas. The debris also provides areas of refuge for sever species.

7.0 CLOSING

This document has been prepared and reviewed by the following people:

Prepared by:	**Reviewed by:**
DRAFT	DRAFT
Bruce Moore, B.Sc. Marine Biologist / Intermediate Project Professional	**Kerry Higgins, B.Sc., EP** NB/PE Operations Manager / Senior Project Professional

APPENDIX A
Transcript of Video and On-Site Observations

Table A.1 135 m Survey – Transect T1, 17 July, 2015

Transect Distance (m)	Transect Tag Numbers	Substrate (Estimated % Coverage)	Macrofaunal Life Observed (Estimated Abundances*)	Macrofloral Life Observed (Estimated % Coverage)
Intertidal	Photos in Attachment C	Silt (70%); Sand (20%); Cobble (10%)	Barnacles likely on hard substrate	Small patches of algae where hard bottom exists, cover not more than 20% of the area
0-5 **T1 Start**	0-5	Gravel (50%); Cobble (35%); Rock (15%)	Barnacles (*Semibalanus balanoides*) (**A**); Green crab (*Carcinus maenas*) (**U:** 1 individual); Periwinkle (*Littorina* sp.) (**O:** 5-10 individuals); Blue mussel (*Mytilus edulis*) (**O:** 5-10 individuals)	Spiny sour weed (*Desmarestia aculeata*) (40%); Rockweed (*Ascophyllum nodosum*) (20%); Brown alga (*Pilayella littorialis*) (10%); Sea lettuce (*Ulva lactuca*) (5%); Green alga (*Enteromorpha* sp.) (5%)
5-10	5-10	Gravel (45%); Cobble (40%); Rock (15%)	Barnacles (*Semibalanus balanoides*) (**A**); Periwinkle (*Littorina* sp.) (**C**); Shell hash	Spiny sour weed (*Desmarestia aculeata*) (40%); Rockweed (*Ascophyllum nodosum*) (10%); Brown alga (*Pilayella littorialis*) (5%)
10-15	10-15	Cobble (60%); Gravel (25%); Rock (15%)	Periwinkle (*Littorina* sp.) (**C**); Shell hash	Spiny sour weed (*Desmarestia aculeata*) (50%); Rockweed (*Ascophyllum nodosum*) (5%); Brown alga (*Pilayella littorialis*) (5%); Bladderwrack (*Fucus vesiculosus*) (5%)
15-20	15-20	Cobble (60%); Gravel (25%); Rock (15%)	Periwinkle (*Littorina* sp.) (**A**); Barnacles (*Semibalanus balanoides*) (**C**); Green crab (*Carcinus maenas*) (**U:** 1 individual); Shell hash	Spiny sour weed (*Desmarestia aculeata*) (5%); Rockweed (*Ascophyllum nodosum*) (5%)
20-25	20-25	Cobble (60%); Gravel (25%); Rock (15%)	Periwinkle (*Littorina* sp.) (**A**); Barnacles (*Semibalanus balanoides*) (**C**); Shell hash	Spiny sour weed (*Desmarestia aculeata*) (80%); Bladderwrack (*Fucus vesiculosus*) (15%); Rockweed (*Ascophyllum nodosum*) (5%)
25-30	25-30	Cobble (60%); Gravel (25%); Rock (15%)	Periwinkle (*Littorina* sp.) (**A**); Barnacles (*Semibalanus balanoides*) (**C**); White cross jellyfish (*Staurophora mertensi*) (**U:** 1 individual); Shell hash	Spiny sour weed (*Desmarestia aculeata*) (80%); Bladderwrack (*Fucus vesiculosus*) (5%)
30-35	30-35	Cobble (40%); Rock (20%); Bedrock (15%); Gravel (15%); Boulder (10%)	Periwinkle (*Littorina* sp.) (**A**); Barnacles (*Semibalanus balanoides*) (**C**); Shell hash	Spiny sour weed (*Desmarestia aculeata*) (70%); Rockweed (*Ascophyllum nodosum*) (5%); Bladderwrack (*Fucus vesiculosus*) (5%)
35-40	35-40	Bedrock (50%); Cobble (20%); Rock (20%); Gravel (10%)	Periwinkle (*Littorina* sp.) (**A**)	Rockweed (*Ascophyllum nodosum*) (40%); Bladderwrack (*Fucus vesiculosus*) (20%); Spiny sour weed (*Desmarestia aculeata*) (20%); Brown alga (*Pilayella littorialis*) (15%)
40-45	40-45	Bedrock (100%)	Periwinkle (*Littorina* sp.) (**A**); Barnacles (*Semibalanus balanoides*) (**C**)	Rockweed (*Ascophyllum nodosum*) (40%); Bladderwrack (*Fucus vesiculosus*) (25%); Spiny sour weed (*Desmarestia aculeata*) (10%); Brown alga (*Pilayella littorialis*) (10%); Green alga (*Spongomorpha* sp.) (5%)
45-50	45-50	Bedrock (80%); Boulder (20%)	Periwinkle (*Littorina* sp.) (**A**); Barnacles (*Semibalanus balanoides*) (**C**)	Bladderwrack (*Fucus vesiculosus*) (45%); Rockweed (*Ascophyllum nodosum*) (15%); Spiny sour weed (*Desmarestia aculeata*) (10%); Brown alga (*Pilayella littorialis*) (10%); Green alga (*Spongomorpha* sp.) (5%)
50-55	50-55	Bedrock (50%); Silt (35%); Sand (15%)	Periwinkle (*Littorina* sp.) (**O:** 10-15 individuals); Shell hash	Sugar kelp (*Laminaria saccharina*) (20%); Bladderwrack (*Fucus vesiculosus*) (20%); Spiny sour weed (*Desmarestia aculeata*) (10%); Rockweed (*Ascophyllum nodosum*) (5%)

Transect Distance (m)	Transect Tag Numbers	Substrate (Estimated % Coverage)	Macrofaunal Life Observed (Estimated Abundances*)	Macrofloral Life Observed (Estimated % Coverage)
55-60	55-60	Silt (70%); Cobble (15%); Sand (15%)	Green crab (*Carcinus maenas*) (**U:** 1 individual); Shell hash	Spiny sour weed (*Desmarestia aculeata*) (30%); Sugar kelp (*Laminaria saccharina*) (15%); Green alga (*Spongomorpha* sp.) (5%)
60-65	60-65	Silt (65%); Cobble (15%); Sand (10%); Boulder (10%)	Barnacles (*Semibalanus balanoides*) (**A**); Green crab (*Carcinus maenas*) (**U:** 1 individual); Shell hash	Spiny sour weed (*Desmarestia aculeata*) (30%); Sugar kelp (*Laminaria saccharina*) (15%); Sea lettuce (*Ulva lactuca*) (5%)
65-70	65-70	Silt (50%); Boulder (35%); Sand (15%)	Barnacles (*Semibalanus balanoides*) (**C**); Green crab (*Carcinus maenas*) (**U:** 1 individual); White cross jellyfish (*Staurophora mertensi*) (**U:** 1 individual); Unidentified fish species (**U:** 1 individual)	Sugar kelp (*Laminaria saccharina*) (65%)
70-75	70-75	Silt (60%); Cobble (25%); Sand (15%)	Longhorn sculpin (*Myoxocephalus octodecemspinosus*) (**U:** 1 individual); Unidentified fish species (**U:** 1 individual)	Sugar kelp (*Laminaria saccharina*) (35%); Sea lettuce (*Ulva lactuca*) (5%); Red alga (*Plumaria plumosa*) (5%)
75-80	75-80	Silt (70%); Sand (25%); Cobble (5%)	Longhorn sculpin (*Myoxocephalus octodecemspinosus*) (**U:** 1 individual); Green crab (*Carcinus maenas*) (**U:** 1 individual)	Sugar kelp (*Laminaria saccharina*) (25%)
80-85	80-85	Silt (60%); Cobble (25%); Sand (15%)	No fauna observed	Sugar kelp (*Laminaria saccharina*) (35%); Spiny sour weed (*Desmarestia aculeata*) (5%); Sea lettuce (*Ulva lactuca*) (5%); Red alga (*Plumaria plumosa*) (5%); Green alga (*Enteromorpha* sp.) (5%); Macrofloral debris (5%)
85-90	85-90	Silt (70%); Sand (25%); Cobble (5%)	Rock crab (*Cancer irroratus*) (**U:** 1 individual); Shell hash	Sugar kelp (*Laminaria saccharina*) (15%); Sea lettuce (*Ulva lactuca*) (5%)
90-95	90-95	Silt (70%); Sand (25%); Cobble (5%)	Periwinkle (*Littorina* sp.) (**U:** 3 individuals); Shell hash	Sugar kelp (*Laminaria saccharina*) (15%); Sea lettuce (*Ulva lactuca*) (5%); Green alga (*Enteromorpha* sp.) (5%)
95-100	95-100	Silt (70%); Sand (25%); Cobble (5%)	Periwinkle (*Littorina* sp.) (**U:** 4 individuals); Sand dollar (*Echinarachnius parma*) (**U:** 1 individual); Shell hash	Green alga (*Enteromorpha* sp.) (5%)
100-105	100-105	Silt (75%); Sand (25%)	Rock crab (*Cancer irroratus*) (**U:** 1 individual); Shell hash	Sugar kelp (*Laminaria saccharina*) (15%)
105-110 **T1 End**	105-110	Silt (75%); Sand (25%)	Shell hash	No flora observed

Notes: *A = Abundant, C = Common, O = Occasional, U = Uncommon (See below).
Banded lobster claws were noted in the 0-5 and 5-10 m segments
Anthropogenic debris was noted from 5-25 m and 70-80 m

Table A.2 115 m Survey – Transect T2, 21 January, 2015

Transect Distance (m)	Transect Tag Numbers	Substrate (Estimated % Coverage)	Macrofaunal Life Observed (Estimated Abundances*)	Macrofloral Life Observed (Estimated % Coverage)
0-5 **T2 Start**	0-5	Silt (70%); Sand (20%); Cobble (10%)	Shell hash	Macrofloral debris (5%)
5-10	5-10	Silt (70%); Sand (25%); Boulder (5%)	Barnacles (*Semibalanus balanoides*) (**C**); Shell hash	Sugar kelp (*Laminaria saccharina*) (5%); Sea lettuce (*Ulva lactuca*) (5%); Red alga (*Plumaria plumosa*) (5%)
10-15	10-15	Silt (70%); Sand (25%); Boulder (5%)	Barnacles (*Semibalanus balanoides*) (**C**); Rock crab (*Cancer irroratus*) (**U:** 1 individual); Shell hash	Sugar kelp (Laminaria saccharina) (5%)
15-20	15-20	Silt (75%); Sand (25%)	No fauna observed	Sugar kelp (*Laminaria saccharina*) (5%)

Transect Distance (m)	Transect Tag Numbers	Substrate (Estimated % Coverage)	Macrofaunal Life Observed (Estimated Abundances*)	Macrofloral Life Observed (Estimated % Coverage)
20-25	20-25	Silt (70%); Sand (25%); Boulder (5%)	Barnacles (*Semibalanus balanoides*) (**C**); Green crab (*Carcinus maenas*) (**U:** 1 individual); Flounder (Not identified to Genus) (**U:** 1 individual)	Sugar kelp (*Laminaria saccharina*) (5%); Dulse (*Palmaria palmata*) (5%)
25-30	25-30	Silt (75%); Sand (25%)	Seastar (*Asterias* sp.) (**U:** 1 individual); Flounder (Not identified to Genus) (**U:** 1 individual); Shell hash	No flora observed
30-35	30-35	Silt (75%); Sand (25%)	Shell hash	No flora observed
35-40	35-40	Silt (75%); Sand (25%)	Frilled anemone (*Metridium senile*) (**U:** 1 individual)	Sugar kelp (*Laminaria saccharina*) (5%)
40-45	40-45	Silt (75%); Sand (25%)	Frilled anemone (*Metridium senile*) (**U:** 1 individual); Burrowing anemone (*Cerianthus borealis*) (**U:** 1 individual)	Macrofloral debris (5%)
45-50	45-50	Silt (65%); Sand (20%); Rock (10%); Boulder (5%)	Barnacles (*Semibalanus balanoides*) (**C**); Frilled anemone (*Metridium senile*) (**U:** 2 individuals); Green crab (*Carcinus maenas*) (**U:** 1 individual)	Spiny sour weed (*Desmarestia aculeata*) (10%); Red alga (*Plumaria plumosa*) (10%); Sugar kelp (*Laminaria saccharina*) (5%); Sea lettuce (*Ulva lactuca*) (5%); Macrofloral debris (5%)
50-55	50-55	Silt (65%); Sand (20%); Rock (10%); Boulder (5%)	Green crab (*Carcinus maenas*) (**U:** 2 individuals); Rock crab (*Cancer irroratus*) (**U:** 1 individual)	Sea colander (*Agarum clathratum*) (15%); Spiny sour weed (*Desmarestia aculeata*) (15%); Sea lettuce (*Ulva lactuca*) (5%)
55-60	55-60	Silt (75%); Sand (25%)	Shell hash	No flora observed
60-65	60-65	Silt (75%); Sand (25%)	Shell hash	Macrofloral debris (5%)
65-70	65-70	Silt (75%); Sand (25%)	Green crab (*Carcinus maenas*) (**U:** 1 individual); Shell hash	Macrofloral debris (5%)
70-75	70-75	Silt (75%); Sand (25%)	Barnacles (*Semibalanus balanoides*) (**C**); Green crab (*Carcinus maenas*) (**U:** 1 individual); Seastar (*Asterias* sp.) (**U:** 1 individual); Burrowing anemone (*Cerianthus borealis*) (**U:** 1 individual)	Sugar kelp (*Laminaria saccharina*) (5%); Macrofloral debris (10%)
75-80	75-80	Silt (75%); Sand (20%); Rock (5%)	Green crab (*Carcinus maenas*) (**U:** 1 individual); Frilled anemone (*Metridium senile*) (**U:** 1 individual); Bowerbank's halichondria (*Halichondria bowerbanki*); (**U:** 1 individual); Shell hash	Spiny sour weed (*Desmarestia aculeata*) (15%)
80-85	80-85	Silt (75%); Sand (25%)	Green crab (*Carcinus maenas*) (**U:** 1 individual); Shell hash	Macrofloral debris (5%)
85-90	85-90	Silt (75%); Sand (25%)	No fauna observed	No flora observed
90-95	90-95	Silt (75%); Sand (25%)	Shell hash	Macrofloral debris (5%)
95-100	95-100	Silt (75%); Sand (25%)	No fauna observed	Macrofloral debris (5%)
100-105	100-105	Silt (75%); Sand (25%)	Shell hash	Macrofloral debris (5%)
105-110	105-110	Silt (70%); Sand (20%); Rock (10%)	Barnacles (*Semibalanus balanoides*) (**C**); Shell hash	Bladderwrack (*Fucus vesiculosus*) (15%)
110-115 **T2 End**	110-115	Silt (70%); Sand (20%); Cobble (10%)	Green crab (*Carcinus maenas*) (**U:** 2 individuals)	Bladderwrack (*Fucus vesiculosus*) (5%)

Notes: *A = Abundant, C = Common, O = Occasional, U = Uncommon (See below).
Anthropogenic debris was noted from 0-20 m and 30-80 m

Table A.3 55 m Survey – Transect TT1, 17 July, 2015

Transect Distance (m)	Transect Tag Numbers	Substrate (Estimated % Coverage)	Macrofaunal Life Observed (Estimated Abundances*)	Macrofloral Life Observed (Estimated % Coverage)
0-5 **TT1 Start**	0-5	Silt (75%); Sand (25%)	Shell hash	Sugar kelp (*Laminaria saccharina*) (15%); Rockweed (*Ascophyllum nodosum*) (5%)
5-10	5-10	Silt (70%); Sand (20%); Rock (10%)	Longhorn sculpin (*Myoxocephalus octodecemspinosus*) (**U:** 1 individual); Green crab (*Carcinus maenas*) (**U:** 1 individual); Shell hash	Sugar kelp (*Laminaria saccharina*) (15%); Sea colander (*Agarum clathratum*) (10%); Spiny sour weed (*Desmarestia aculeata*) (5%); Red alga (*Plumaria plumosa*) (5%)
10-15	10-15	Silt (70%); Sand (20%); Rock (10%)	Shell hash	Sugar kelp (*Laminaria saccharina*) (25%); Sea colander (*Agarum clathratum*) (10%); Spiny sour weed (*Desmarestia aculeata*) (5%); Sea lettuce (*Ulva lactuca*) (5%)
15-20	15-20	Silt (65%); Sand (15%); Rock (20%)	Barnacles (*Semibalanus balanoides*) (**C**); Shell hash	Sugar kelp (*Laminaria saccharina*) (25%); Sea colander (*Agarum clathratum*) (10%); Spiny sour weed (*Desmarestia aculeata*) (5%); Sea lettuce (*Ulva lactuca*) (5%); Red alga (*Plumaria plumosa*) (5%)
20-25	20-25	Silt (65%); Sand (15%); Rock (20%)	Unidentified fish species (**U:** 1 individual); Shell hash	Sugar kelp (*Laminaria saccharina*) (15%); Sea lettuce (*Ulva lactuca*) (10%); Sea colander (*Agarum clathratum*) (5%); Red alga (*Plumaria plumosa*) (5%)
25-30	25-30	Silt (70%); Sand (20%); Cobble (10%)	Longhorn sculpin (*Myoxocephalus octodecemspinosus*) (**U:** 1 individual); Worm castings	Sugar kelp (*Laminaria saccharina*) (15%); Sea lettuce (*Ulva lactuca*) (5%); Sea colander (*Agarum clathratum*) (5%); Spiny sour weed (*Desmarestia aculeata*) (5%); Encrusting algae (*Leptophyllum* sp.) (5%)
30-35	30-35	Silt (65%); Sand (15%); Cobble (20%)	Rock crab (*Cancer irroratus*) (**U:** 1 individual); Hermit crab (*Pagarus acadianus*) (**U:** 1 individual); Unidentified fish species (**U:** 1 individual)	Sugar kelp (*Laminaria saccharina*) (50%); Sea colander (*Agarum clathratum*) (15%)
35-40	35-40	Silt (65%); Sand (15%); Cobble (20%)	Hermit crab (*Pagarus acadianus*) (**U:** 1 individual); Worm castings	Sugar kelp (*Laminaria saccharina*) (30%); Sea lettuce (*Ulva lactuca*) (5%); Red alga (*Plumaria plumosa*) (5%)
40-45	40-45	Silt (65%); Sand (15%); Cobble (20%)	Periwinkle (*Littorina* sp.) (**U:** 1 individual); Unidentified fish species (**U:** 1 individual)	Sugar kelp (*Laminaria saccharina*) (30%); Sea colander (*Agarum clathratum*) (5%)
45-50	45-50	Silt (65%); Sand (15%); Cobble (20%)	Worm castings; Shell hash	Sugar kelp (*Laminaria saccharina*) (35%); Sea lettuce (*Ulva lactuca*) (10%); Sea colander (*Agarum clathratum*) (5%); Red alga (*Plumaria plumosa*) (5%)
50-55 **TT1 End**	50-55	Silt (65%); Sand (15%); Cobble (20%)	Shell hash	Sugar kelp (*Laminaria saccharina*) (15%); Sea colander (*Agarum clathratum*) (5%); Bladderwrack (*Fucus vesiculosus*) (5%)

Notes: *A = Abundant, C = Common, O = Occasional, U = Uncommon (See below).
Anthropogenic debris was noted from 25-30 m and 40-50 m

Table A.4 80 m Survey – Transect TT2, 17 July, 2015

Transect Distance (m)	Transect Tag Numbers	Substrate (Estimated % Coverage)	Macrofaunal Life Observed (Estimated Abundances*)	Macrofloral Life Observed (Estimated % Coverage)
0-5 **TT2 Start**	0-5	Silt (70%); Sand (20%); Cobble (10%)	Rock crab (*Cancer irroratus*) (**U:** 5 individuals)	Sugar kelp (*Laminaria saccharina*) (50%)
5-10	5-10	Silt (60%); Cobble (30%); Sand (10%)	Periwinkle (*Littorina* sp.) (**U:** 1 individual)	Sugar kelp (*Laminaria saccharina*) (65%); Green alga (*Spongomorpha* sp.) (15%)
10-15	10-15	Bedrock (80%); Silt (15%); Sand (5%)	No fauna observed	Sugar kelp (*Laminaria saccharina*) (25%); Green alga (*Spongomorpha* sp.) (25%); Spiny sour weed (*Desmarestia aculeata*) (25%); Bladderwrack (*Fucus vesiculosus*) (15%); Macrofloral debris (15%)
15-20	15-20	Bedrock (90%); Rock (10%)	Barnacles (*Semibalanus balanoides*) (**A**)	Spiny sour weed (*Desmarestia aculeata*) (40%); Green alga (*Spongomorpha* sp.) (35%); Bladderwrack (*Fucus vesiculosus*) (10%)
20-25	20-25	Cobble (50%); Rock (25%); Bedrock (15%); Boulder (10%)	Barnacles (*Semibalanus balanoides*) (**A**)	Bladderwrack (*Fucus vesiculosus*) (40%); Spiny sour weed (*Desmarestia aculeata*) (15%); Green alga (*Spongomorpha* sp.) (15%); Rockweed (*Ascophyllum nodosum*) (15%)
25-30	25-30	Cobble (75%); Rock (25%)	Barnacles (*Semibalanus balanoides*) (**A**); Periwinkle (*Littorina* sp.) (**C**)	Rockweed (*Ascophyllum nodosum*) (60%); Bladderwrack (*Fucus vesiculosus*) (20%); Brown alga (*Pilayella littorialis*) (10%)
30-35	30-35	Cobble (75%); Rock (25%)	Barnacles (*Semibalanus balanoides*) (**A**); Periwinkle (*Littorina* sp.) (**C**)	Rockweed (*Ascophyllum nodosum*) (50%); Brown alga (*Pilayella littorialis*) (15%); Bladderwrack (*Fucus vesiculosus*) (10%)
35-40	35-40	Cobble (75%); Rock (25%)	Barnacles (*Semibalanus balanoides*) (**A**)	Rockweed (*Ascophyllum nodosum*) (60%); Bladderwrack (*Fucus vesiculosus*) (20%); Brown alga (*Pilayella littorialis*) (15%)
40-45	40-45	Cobble (75%); Rock (25%)	Barnacles (*Semibalanus balanoides*) (**A**); Shell hash	Rockweed (*Ascophyllum nodosum*) (40%); Bladderwrack (*Fucus vesiculosus*) (25%); Brown alga (*Pilayella littorialis*) (10%); Spiny sour weed (*Desmarestia aculeata*) (5%); Sea lettuce (*Ulva lactuca*) (5%)
45-50	45-50	Cobble (60%); Rock (25%); Gravel (15%)	Barnacles (*Semibalanus balanoides*) (**C**)	Rockweed (*Ascophyllum nodosum*) (30%); Bladderwrack (*Fucus vesiculosus*) (25%); Brown alga (*Pilayella littorialis*) (10%); Spiny sour weed (*Desmarestia aculeata*) (5%); Sea lettuce (*Ulva lactuca*) (5%)
50-55	50-55	Cobble (60%); Rock (25%); Gravel (15%)	Barnacles (*Semibalanus balanoides*) (**A**)	Bladderwrack (*Fucus vesiculosus*) (25%); Rockweed (*Ascophyllum nodosum*) (5%); Brown alga (*Pilayella littorialis*) (5%); Spiny sour weed (*Desmarestia aculeata*) (5%)
55-60	55-60	Cobble (50%); Rock (40%); Gravel (10%)	Barnacles (*Semibalanus balanoides*) (**A**)	Rockweed (*Ascophyllum nodosum*) (50%); Bladderwrack (*Fucus vesiculosus*) (20%); Brown alga (*Pilayella littorialis*) (15%)
60-65	60-65	Cobble (50%); Rock (40%); Gravel (10%)	Barnacles (*Semibalanus balanoides*) (**A**)	Rockweed (*Ascophyllum nodosum*) (50%); Bladderwrack (*Fucus vesiculosus*) (20%); Brown alga (*Pilayella littorialis*) (10%); Spiny sour weed (*Desmarestia aculeata*) (5%)
65-70	65-70	Silt (65%); Cobble (20%); Sand (15%)	No fauna observed	Sugar kelp (*Laminaria saccharina*) (60%)

Transect Distance (m)	Transect Tag Numbers	Substrate (Estimated % Coverage)	Macrofaunal Life Observed (Estimated Abundances*)	Macrofloral Life Observed (Estimated % Coverage)
70-75	70-75	Bedrock (100%)	Barnacles (*Semibalanus balanoides*) (**A**)	Sugar kelp (*Laminaria saccharina*) (80%); Sea lettuce (*Ulva lactuca*) (10 %); Sausage weed (*Scytosiphon simplicissimus*) (5%)
75-80 **TT2 End**	75-80	Bedrock (100%)	Barnacles (*Semibalanus balanoides*) (**A**); Periwinkle (*Littorina* sp.) (**O:** 5-10 individuals)	Rockweed (*Ascophyllum nodosum*) (60%); Bladderwrack (*Fucus vesiculosus*) (15%); Brown alga (*Pilayella littorialis*) (10%); Spiny sour weed (*Desmarestia aculeata*) (5%)

Note: *A = Abundant, C = Common, O = Occasional, U = Uncommon (See below).

Table A.5 65 m Survey – Transect TT3, 17 July, 2015

Transect Distance (m)	Transect Tag Numbers	Substrate (Estimated % Coverage)	Macrofaunal Life Observed (Estimated Abundances*)	Macrofloral Life Observed (Estimated % Coverage)
0-5 **TT3 Start**	0-5	Silt (75%); Sand (25%)	Green crab (*Carcinus maenas*) (**U:** 1 individual); Shell hash	Macrofloral debris (5%)
5-10	5-10	Silt (75%); Sand (25%)	Shell hash	Macrofloral debris (5%)
10-15	10-15	Silt (75%); Sand (20%); Rock (5%)	Breadcrumb sponge (*Halichondria panicea*) (**U:** 1 individual); Shell hash	Macrofloral debris (5%)
15-20	15-20	Silt (75%); Sand (20%); Rock (5%)	Shell hash	Macrofloral debris (5%)
20-25	20-25	Silt (75%); Sand (20%); Rock (5%)	Frilled anemone (*Metridium senile*) (**U:** 1 individual); Shell hash	Macrofloral debris (5%)
25-30	25-30	Silt (75%); Sand (25%)	Frilled anemone (*Metridium senile*) (**U:** 2 individuals); Shell hash	Macrofloral debris (5%)
30-35	30-35	Silt (75%); Sand (25%)	Shell hash	Macrofloral debris (5%)
35-40	35-40	Silt (75%); Sand (25%)	Shell hash	Macrofloral debris (5%)
40-45	40-45	Silt (75%); Sand (25%)	Green crab (*Carcinus maenas*) (**U:** 1 individual); anemone burrows; Shell hash	Macrofloral debris (5%)
45-50	45-50	Silt (75%); Sand (25%)	Shell hash	Macrofloral debris (5%)
50-55	50-55	Silt (75%); Sand (25%)	Shell hash	Macrofloral debris (5%)
55-60	55-60	Silt (75%); Sand (25%)	Hermit crab (*Pagarus acadianus*) (**U:** 1 individual); moon snail collar; Shell hash	Macrofloral debris (5%)
60-65 **TT3 End**	60-65	Silt (75%); Sand (25%)	Shell hash	Macrofloral debris (5%)

Notes: *A = Abundant, C = Common, O = Occasional, U = Uncommon (See below).
Anthropogenic debris was noted from 0-5 m and 10-15 m

A = Abundant
Numerous (not quantifiable) observations made throughout the entire 5 m segment.
C = Common
Numerous (not quantifiable) observations made intermittently along the 5 m segment.
O = Occasional
Quantifiable observations made intermittently along the 5 m segment.
U = Uncommon
Quantifiable observations made infrequently along the 5 m segment.

APPENDIX B
Annotated Species List

Table B1 Annotated Species List

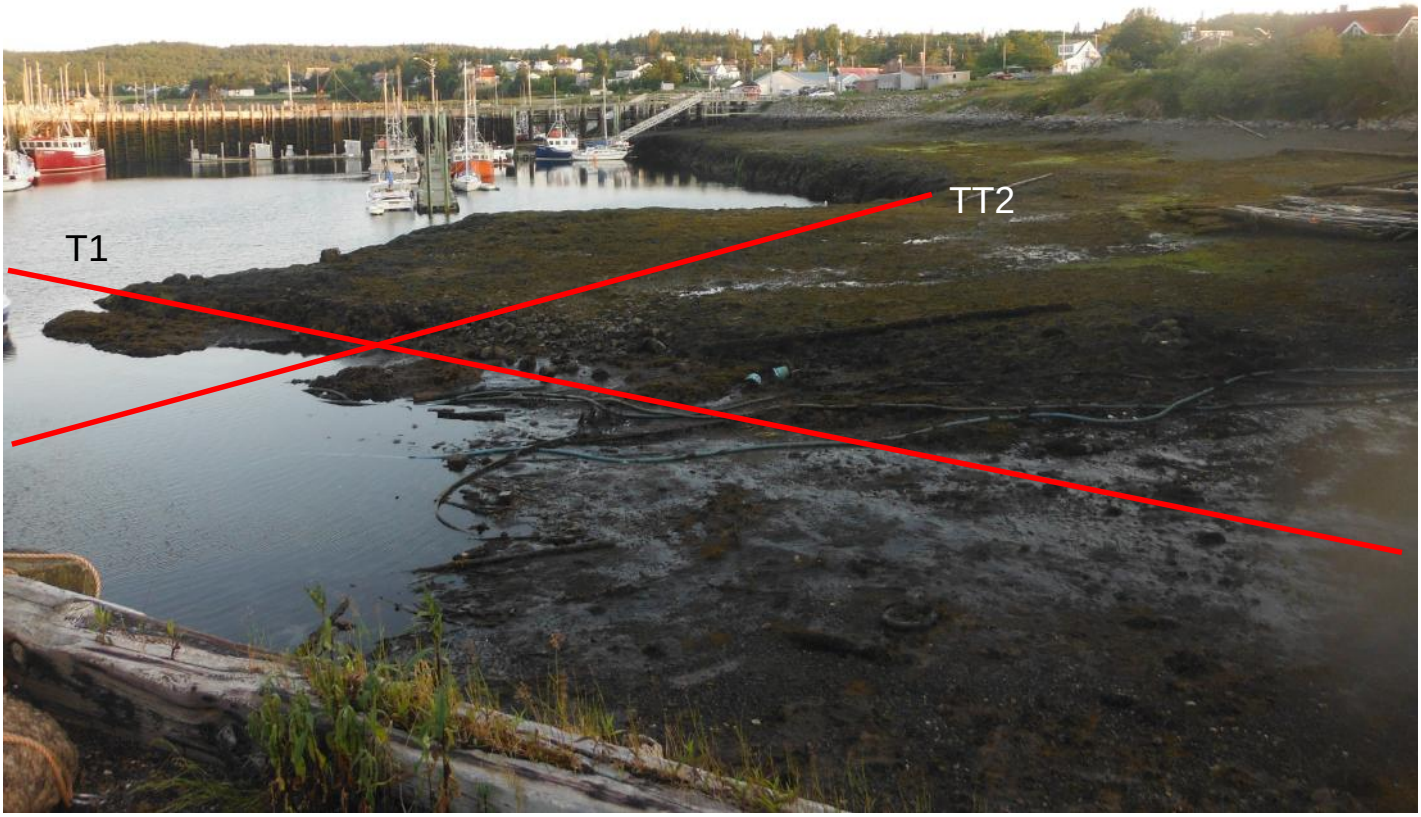
Classification	Common Name	Scientific Name
Macrofauna		
Crustacea	Northern rock barnacle	*Semibalanus balanoides*
	Rock crab	*Cancer irroratus*
	Green crab	*Carcinus maenas*
Cnidaria	Frilled anemone	*Metridium senile*
	Burrowing anemone	*Cerianthus borealis*
Porifera	Bowerbanks halichondria	*Halichondria bowerbanksi*
	Breadcrumb sponge	*Halichondria panicea*
Hydrozoa	White cross jellyfish	*Staurophora mertensi*
Arthropoda	Hermit crab	*Pagarus acadianus*
Mollusca	Periwinkle	*Littorina* sp.
Echinodermata	Seastar	*Asterias* sp.
Chordata	Longhorn sculpin	*Myoxocephalus octodecemspinosis*
	Flounder	Not identified
Miscellaneous	Unidentified Fish	-----
Macroflora		
Chlorophyta	Sea lettuce	*Ulva lactuca*
	Green alga	*Spongomorpha* sp.
	Green alga	*Enteromorpha* sp.
Rhodophyta	Red alga	*Plumaria plumosa*
	Dulse	*Palmaria palmata*
	Encrusting alga	*Leptophyllum* sp.
Phaeophyta	Sugar kelp	*Laminaria saccharina*
	Brown alga	*Pilayella littoralis*
	Spiny sour weed	*Desmarestia aculeata*
	Sea colander	*Agarum clathratum*
	Bladderwrack	*Fucus* sp.
	Rockweed	*Ascophyllum nodosum*

APPENDIX C
Photo Log

General Site Photos

Looking east from Fisherman's wharf at approximate location of TT2 and T1

General Site Photos



Looking northwest from Spur wharf at approximate location of TT2 and T1

APPENDIX D
Limitations

LIMITATIONS

1. The work performed in the preparation of this report and the conclusions presented are subject to the following:

    1. The Standard Terms and Conditions which form a part of our Professional Services Contract.
    2. The Scope of Services.
    3. Time and Budgetary limitations as described in our Contract.
    4. The Limitations stated herein.

2. The report has been prepared in accordance with generally accepted environmental study practices. No other warranties or representations, either expressed or implied, are made as to the professional services provided under the terms of our Contract, or the conclusions presented.
3. The objective of this report was solely to characterize the seabed footprint of the proposed Project area.
4. This report is for the sole use of the party to whom it is addressed unless expressly stated otherwise in the report or contract. Any use which any third party makes of the report, in whole or the part, or any reliance thereon or decisions made based on any information or conclusions in the report is the sole responsibility of such third party. Amec Foster Wheeler accepts no responsibility whatsoever for damages or loss of any nature or kind suffered by any such third party as a result of actions taken or not taken or decisions made in reliance on the report or anything set out therein.