Newfoundland and Labrador Refinery Project

Environmental Impact Assessment
Component Study

FRESHWATER FISH AND FISH HABITAT COMPONENT STUDY

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Newfoundland and Labrador Refinery Project
Southern Head, Placentia Bay, NL
Freshwater Fish and Fish Habitat Component Study

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Executive Summary

Fish and fish habitat adjacent to, and within, the Project footprint of the proposed oil refinery in Southern Head, NL, were classified and quantified under the federal Department of Fisheries and Oceans quantification guidelines in order to characterize fish habitat near the facility and to determine the potential HADD (habitat alteration, disruption or destruction) from proposed construction, operation and processing activities associated with the Project. The assessment and classification of habitat included thirteen field sampled ponds within the Project footprint and nine field sampled streams. Table E1 provides a brief summary of the surveyed ponds and streams which contained fish habitat.

Table E1. Summary of fish habitat quantification, Refinery, Placentia Bay, NL.

Study Area	Species Present	Total Area/Units	Total Area/Units by Habitat Type
Pond 1 (2007)	Brook Trout Threespine Stickleback Atlantic Salmon	7.45 ha	Littoral 7.45 ha
Pond 2 (2006)	Brook Trout	2.63 ha	Littoral 2.20 ha Non-Littoral 0.43 ha
Pond 3 (2006)	Brook Trout	1.47 ha	Littoral 1.47 ha
Pond 7 (2007)	Brook Trout Threespine Stickleback Atlantic Salmon	1.25 ha	Littoral 1.25 ha
Pond 8 (2007)	Brook Trout Threespine Stickleback Atlantic Salmon	5.78 ha	Littoral 5.78 ha
Stream T1 (2006)	Brook Trout American Eel	26.75 units	Brackish 4.82 u Steady 3.83 u Riffle 12.78 u Run 4.04 u Rapid 0.61 u Pool 0.67 u
Stream T1-1 (2006)	Brook Trout	1.04 units	Riffle 0.84 u Steady .20 u
Stream T2 (2006)	Brook Trout Threespine Stickleback Atlantic Salmon	2.94 units	Pool 1.52 u Riffle 0.72 u Run 0.70 u
Stream T2-1 (2007)	Brook Trout Threespine Stickleback Atlantic Salmon	1.77 units	Riffle 1.21 u Cascade 0.56 u
Stream T2-2 (2007)	Brook Trout Threespine Stickleback Atlantic Salmon	3.00 units	Riffle 1.61 u Pool 1.39 u
Stream T2-3 (2007)	Brook Trout Threespine Stickleback Atlantic Salmon	65.04 units	Riffle 46.87 u Run 8.19 u Steady 9.98 u
Stream T3 (2006)	Brook Trout	2.55 units	Riffle 2.55 u

Ponds 4, 5, 6, 9, 10 and streams T5, T6 were also sampled/surveyed (See Figure 4-1), however, the results of the sampling/surveys indicated that none of the above contained fish habitat. In addition, a stream survey was also conducted on sample stream T4 (see

Appendix A), however, as this stream lies outside the project footprint the detailed results of the survey are not been presented herein.

The following streams were all survey during the 2006 field season (See Appendix A).

Sample Stream T1 (Holletts Stream) & T1-1

Sample stream T1 and its tributary, stream T1-1 are located on the southwest side of Southern Head. T1 flows south and drains into Holletts Cove, Placentia Bay. Sample streams T1 and T1-1, when combined, measured a total of 2,412 m in length (all within the project footprint).

The Beak Habitat Classification quantified stream T1 as having a total of 5.94 units of Type I (spawning), 11.05 units of Type II (rearing), 4.27 units of Type III (migratory), 0.67 units of Type IV (pool) habitat and 4.82 units of Type IV (brackish pool) habitat. The total amount of habitat units within the stream was 26.75 units. In addition to the identified fish habitat 0.45 units of overland flow was also recorded. Under the Beak classification system T1-1 was estimated to contain a total of 1.04 units of Type IV (pool) habitat, with an additional 3.14 units identified as overland flow. The total fish habitat for T1-1 was 1.04 units. It should be noted that although the amount of overland flow encountered in each stream has been identified it is not considered fish habitat and therefore does not appear in any of the totals.

The new proposed habitat classification system by DFO (McCarthy *et al*. 2007) identified a total of 4.82 units of Brackish, 4.04 units of Run, 12.78 units of Riffle, 3.83 units of Steady, 0.61 units of Rapid and 0.67 units of Pool habitat. Stream T1-1 was identified as containing 0.84 units of Riffle and 0.20 units of Steady.

In T1 both brook trout (*Salvelinus fontinalis*) and American eel (*Anguilla rostrata*) were captured during the electrofishing surveys and it has been calculated that approximately 16.55 and 17.44 Habitat Equivalent Units (HEU's) exist for brook trout and American eel respectively. T1-1 identified an additional 0.95 HEU's for American eel.

As previously mentioned, during the quantitative and index electrofishing of both streams, brook trout and American eel were caught within T1. The electrofished sites yielded an estimated population of 14 to 36 brook trout per unit. American eel were too few to generate a population estimate.

Sample Stream T2

Sample stream T2 is part of the drainage basin for Watson's Brook and flows from a small pond (P7) on the southeastern edge of the project footprint into Pond 1. The stream measured 409.1 m in length (all within the project footprint) and contained a considerable amount of overland flow (1.29 units). Under the Beak Habitat Classification System the stream was identified as having a total of 0.4 units of Type I (spawning), 0.7 units of Type II (rearing), 0.32 units of Type III, and 1.52 units of Type IV (pool) habitat. The total amount of fish habitat identified within the stream was 2.94 units and under the new proposed habitat classification system (McCarthy *et al*. 2007) 1.52 units of pool, 0.72 units of riffle and 0.70 units of run were identified. The calculated HEU's for brook

trout, Atlantic salmon (*Salmo salar*) and threespine stickleback (*Gasterosteus aculeatus*) are 1.28, 1.27 and 0.51 respectively.

The electrofished sites yielded population estimates of 5 to 15 brook trout and 10-13 threespine sticklebacks per unit.

Sample Stream T3

Sample Stream T3 flows from sample Pond 3 and drains northwest into North Harbour. The total stream length was 862.8 m; however the last 650 m was classified as overland flow. The Beak Habitat Classification quantified the stream as having a total of 2.29 units of Type I (spawning), and 0.26 units of Type II (rearing). The total amount of habitat units within the stream was 2.55 units and under the new Classification System (McCarthy *et al*. 2007) this was all classified as riffle (2.55 units of riffle).

Brook trout were identified within the drainage basin of T3 and it was calculated that 1.67 HEU's exist for brook trout.

The electrofished sites yielded population estimates of 12 brook trout per unit.

Additional streams were also surveyed in 2007 (See Appendix A) and are presented below; however, due to the shallow depths and low velocities encountered during most of the stream surveys, the 2007 surveyed streams have only been classified under the new proposed habitat classification system (McCarthy *et al*. 2007).

Sampled stream T2-1 (Outcrop Stream)

Sampled stream T2-1 is part of the Watson Brook drainage basin. It originates outside the project footprint and empties into Pond 7. The stream itself measured approximately 343.0 m in length, however only about 37 m of the stream lies within the project footprint.

The total amount of fish habitat identified within the stream was 1.77 units. In addition, 0.29 units of overland flow (Reach 5) was also present. Under the proposed new riverine classification system (McCarthy *et al*. 2007) 1.21 units of riffle and 0.56 units of cascade was identified. This stream was not quantitatively or qualitatively electrofished, however, yoy and juvenile salmonids were observed in the stream during the 2007 stream survey. In addition, brook trout, Atlantic salmon and threespine stickleback are all known to occur within the Watson Brook drainage basin; the calculated HEU's for all three species are 1.27, 1.22 and 0.86 respectively.

Sampled stream T2-2 (Big Pond Stream)

Sample stream T2-2 flows from Pond P8 into Pond P1 and occurs within the boundary of the Watson Brook watershed and the stream had a total length of 363.0 m. Under the proposed new riverine classification system (McCarthy *et al*. 2007) 1.61 units of riffle and 1.39 units of pool habitat was identified for a total of 3.00 units of fish habitat. Brook trout, Atlantic salmon and threespine stickleback are all known to occur within the Watson Brook drainage basin and the calculated HEU's for all three species are 2.70, 1.87 and 2.05 units respectively.

The electrofished sites yielded population estimates of 56 brook trout and 445 threespine sticklebacks per unit. No Atlantic salmon were captured.

Watson's Brook T2-3

The lower sections of Watson's Brook itself is not within the boundary of the project footprint; however, it is a scheduled salmon river and is one of the areas identified as a possible compensation option, the brook measured a total of 669.0 m. Under the new proposed riverine classification system (McCarthy *et al*. 2007) a total of 65.04 units of fish habitat was identified comprising 46.87 units of riffle, 8.19 units of run and 9.98 units of steady. Electrofishing surveys within Watson's Brook showed that brook trout, Atlantic salmon and threespine stickleback all occur within this stream and the calculated HEU's for each species are 55.19, 53.31 and 30.71 respectively.

The electrofished sites yielded population estimates of 0 to 2 brook trout, 9 to 18 Atlantic salmon and 2 to 3 threespine sticklebacks per unit.

Sample Stream T4 (Fault Stream)

A stream survey was completed (see Appendix A), however as this stream does not lie within the project footprint a detailed summary is not presented below.

Sample Stream T5 (Pear Pond)

A stream survey was completed (see Appendix A); however, no fish were captured during the electrofishing surveys and therefore is not considered to contain fish habitat.

Sample Stream T6 (Steep Stream)

A stream survey was completed (see Appendix A); however, subsequent visits (late June) to this stream since the time of the stream survey have shown the stream to be intermittent at best. Therefore the stream is not considered fish habitat.

Sample Pond 1

The southern half of this pond was sampled (See Figure 4-1) as it lies within the proposed footprint of the Project. The total area of Pond 1 which lies within the project footprint was 7.45 ha (all littoral). A combination of fyke nets and baited minnow traps were all set for a total of 2 nights each; yielding a total catch of 56 brook trout, 40 threespine and 3 juvenile Atlantic salmon. Habitat equivalent units were calculated at 5.01 ha, 7.42 ha and 0.53 ha respectively.

Sample Pond 2

Pond 2 is located approximately 800 m northwest of Pond 1 and lies within the project footprint. The total area of the pond is 2.6 ha, of which 2.20 ha is littoral and 0.43 ha is non-littoral. A combination of fyke nets and baited minnow traps were all fished for 3

nights, yielding a total catch of 66 brook trout. The calculated HEU's for brook trout was 2.17ha.

Sample Pond 3

Pond 3 is located approximately 100 m north of Pond 2 and is the headwaters for Sample stream T3. The total area of the pond is 1.47 ha (littoral habitat). A combination of fyke nets and baited minnow traps were all set for 2 nets, and yielded a catch of 24 brook trout. The calculated HEU's for brook trout was 1.08 ha.

Sample Pond 4

Pond 4 is located on the northwest end of the project footprint and had a total area of 17,751.24 m^2. There was no visible inflow located for this pond and no fish species were present.

Sample Pond 5

Pond 5 is one of a cluster of small, interconnected ponds located on the northwest side of the Project footprint. All of the ponds were evaluated for depth, and littoral substrate. Of the four ponds clustered together, Pond 5 was the only one deep enough to sample. The ponds' outflow was located on the south end and the inflow was located at the north end. The total area of the pond was 4,895.61 m^2. The pond was sampled for fish using a single bag fyke net set for 24hr's. No fish were caught during sampling and therefore the pond is considered not to contain any fish habitat.

Sample Pond 6

Pond 6 is located on the southeast end of the Project footprint and the total area of the pond was 2,415.63 m^2. One single bag fyke net was set near the mouth of the outflow along with two minnow traps for approximately 2.5 hr. The pond was also angled (one rod) for 1.5 hr's using baited lures. No fish were caught in the net, traps or from angling and no fish were observed in the pond during the shoreline survey. As such, the pond is considered not to contain any fish habitat.

Sample Pond 7

Pond 7 is located approximately 200 m northeast of Pond 6 and lies on the southeast boundary of the Project footprint and the total area of Pond 7 measured 12,492.06 m^2.

Two single bag fyke nets and two minnow traps were set throughout the pond and fished for approximately 18 hrs over night. A total of 38 three spine stickleback and 1 Atlantic salmon were caught, weighed, measured and then released back into the pond. The pond is part of the Watson Brook drainage basin, which is known to support Atlantic salmon, brook trout and stickleback. Therefore HEU's have been calculated for Atlantic salmon, brook trout and threespine stickleback and was 0.29 ha, 0.92 ha and 1.24 ha respectively.

Sample Pond 8

Pond 8 is located approximately 300 m northwest of Pond 1 and had a total area of 57,804.68 m^2.

Two single bag fyke nets and two minnow traps were set throughout the pond for two sets. The first set averaged 18 hours over night and yielded a total of 14 Brook trout and 55 Three Spine sticklebacks. The second set averaged 123 hours (6 nights) and yielded a total of 41 brook trout (two of which where recaptures), 26 three spine sticklebacks and 1 Atlantic salmon.

The HEU's calculated for Atlantic salmon, brook trout and three spine stickleback was 0.10 ha, 3.91 ha and 5.75 ha respectively.

Sample Pond 9

Pond 9 is located approximately 200 m north of Pond 8, within the northeast section of the Project footprint, and had a total area of 3,573.15 m^2. One double bag fyke net and one minnow trap were set in the pond for a 17 hour, overnight set. Neither the minnow trap nor the fyke net yielded any fish; there was however tadpoles and water beetles caught in the fyke net. The pond is not considered fish habitat.

Sample Pond 10

Pond 10 is located approximately 200 m south of Pond 9 and had a total area of 3,677.36 m^2. Fish sampling gear was not set in the pond due to shallow water levels. The pond is not considered to contain fish habitat.

TABLE OF CONTENTS

1.0 INTRODUCTION 1
2.0 OBJECTIVES 2
3.0 STUDY TEAM 3
4.0 SAMPLING PROGRAM 4
4.1 Quality Assurance 7
4.2 Data Collection 7
4.3 Nomenclature 7
4.4 Geo-referencing 8
5.0 METHODS 9
5.1 Lacustrine Habitat Classification/Quantification 9
5.1.1 Bathymetric Profile 10
5.1.2 Habitat Quantification 10
5.2 Riverine Habitat Classification/Quantification 10
5.3 Electrofishing 16
6.0 RESULTS 18
6.1 Riverine Habitat Classification/Quantification 18
6.1.1 Stream T1 & T1-1(2006) 18
6.1.2 Stream T2 (2006) 19
6.1.3 Stream T3 (2006) 26
6.1.4 Stream T2-1 (2007) 29
6.1.5 Stream T2-2 (2007) 31
6.1.6 Stream T2-3 (2007) 33
6.2 Productivity Estimate 35
6.3 Lacustrine Habitat Classification/Quantification 36
6.3.1 Pond 1 (2006/2007) 38
6.3.2 Pond 2 (2006) 41
6.3.3 Pond 3 (2006) 45
6.3.4 Pond 4 (2007) 49
6.3.5 Pond 5 (2007) 49
6.3.6 Pond 6 (2007) 50
6.3.7 Pond 7 (2007) 51
6.3.8 Pond 8 (2007) 54
6.3.9 Pond 9 (2007) 57
6.3.10 Pond 10 (2007) 58
7.0 REFERENCES 60

LIST OF TABLES

Table 4.1 Summary of sample sites, type of sampling and coordinates, Southern Head, 2006/2007.....4
Table 5.1 Habitat classifications of Beak (1980).....12
Table 5.2 Descriptions of riverine habitat classifications.....14
Table 6.1 Summary of habitat types using the Beak and new Classification systems...18
Table 6.2 Summary of Habitat information and classification for stream T1 Southern Head, NL.....21
Table 6.3 Summary of Habitat information and classification for stream T1-1 Southern Head, NL.....22
Table 6.4 Summary of Brook trout and American eel habitat suitability by life stage for stream T1. Bolded values are those brought forward to HEU calculations.....23
Table 6.5 Summary of Brook trout and American eel habitat suitability by life stage for stream T1-1. Bolded values are those brought forward to HEU calculations.....23
Table 6.6 Summary habitat suitability information and habitat equivalent units (HEU) for species captured in sample stream T1.....24
Table 6.7 Summary habitat suitability information and habitat equivalent units (HEU) for species captured in sample stream T1-1.....24
Table 6.8 Summary of Habitat information and classification for stream T2, Southern Head, 2006.....25
Table 6.9 Brook trout, Atlantic salmon and three spine stickleback habitat suitability summary by life stage for stream T2. Bolded values are those brought forward to HEU calculations.....25
Table 6.10 Summary habitat suitability information and habitat equivalent units (HEU) for species present within T2.....26
Table 6.11 Summary of Habitat information and classification for stream T3, Southern Head, 2006.....27
Table 6.12 Brook trout habitat suitability summary by life stage for stream T3. Bolded values are those brought forward to HEU calculations.....28
Table 6.13 Summary habitat suitability information and habitat equivalent units (HEU) for brook trout in sample stream T3.....28
Table 6.14 Summary of Habitat information and classification for stream T2-1, Southern Head, 2007.....30
Table 6.15 Brook trout, Atlantic salmon and Three Spine Stickleback habitat suitability summary by life stage for stream T2-1. Bolded values are those brought forward to HEU calculations.....30
Table 6.16 Summary habitat suitability information and habitat equivalent units (HEU) for species present in sample stream T2-1.....31
Table 6.17 Summary of Habitat information and classification for stream T2-2, Southern Head, 2007.....32
Table 6.18 Brook trout, Atlantic salmon and Three Spine Stickleback habitat suitability summary by life stage for stream T2-2. Bolded values are those brought forward to HEU calculations.....32
Table 6.19 Summary habitat suitability information and habitat equivalent units (HEU) for species present in sample stream T2-2.....33
Table 6.20 Summary of Habitat information and classification for stream T2-3 Southern Head, 2007.....34
Table 6.21 Brook trout, Atlantic salmon and Three Spine Stickleback habitat suitability summary by life stage for stream T2-3. Bolded values are those brought forward to HEU calculations.....34

Table 6.22 Summary habitat suitability information and habitat equivalent units (HEU) for species present in sample stream T2-3. 35
Table 6.23 Summary of all electrofished streams, productivity estimates per unit of each sampled area and species present. 35
Table 6.24 Water quality measurement summary of the sample ponds including light penetration and water quality factors measured with the Hydrolab 37
Table 6.25 Summary of Pond 1 habitat values used to calculate bottom areas. 40
Table 6.26 Habitat suitabilities for species present within Pond 1. 41
Table 6.27 Habitat equivalent units for species present within Pond 1, measured in m^2. 41
Table 6.28 Summary of Pond 2 habitat values used to calculate aerial extents. 44
Table 6.29 Habitat suitabilities for possible species present within Pond 2. 45
Table 6.30 Habitat equivalent units for possible species present within Pond 2, measured in m^2. 45
Table 6.31 Summary of Pond 3 habitat values used to calculate aerial extents 47
Table 6.32 Habitat suitabilities for possible species present within Pond 3. 48
Table 6.33 Habitat equivalent units for possible species present within Pond 3, measured in m^2. 48
Table 6.34 Summary of Pond 7 habitat values used to calculate aerial extents 53
Table 6.35 Habitat suitabilities for species present within Pond 7. 54
Table 6.36 Habitat equivalent units for species present within Pond 7, measured in m^2. 54
Table 6.37 Summary of Pond 8 habitat values used to calculate aerial extents 56
Table 6.38 Habitat suitabilities for species present within Pond 8. 57
Table 6.39 Habitat equivalent units for species present within Pond 8, measured in m^2. 57

LIST OF FIGURES

Figure 4-1 Location of the proposed Refinery Operations facility in Southern Head, NL. The Project area is indicated. 6
Figure 5-1 Descriptions of riverine habitat classifications. 13
Figure 5-2 Quantitative and qualitative electrofishing stations, September 2006 and June 2007, Southern Head, NL. 17
Figure 6-1 Southern section of Pond 1 surveyed during the 2006 and 2007 field programs. Green line denotes the northern boundary of the surveyed area. 39
Figure 6-2 Bathymetric contours for Pond 2 November, 2006, Southern Head, NL. 42
Figure 6-3 Pond 2 littoral zone (<2.0 m) and non littoral zone (>2.0 m), Southern Head, NL, November, 2006. 43
Figure 6-4 Pond 2 43
Figure 6-5, Pond 3 46
Figure 6-6, Pond 4 49
Figure 6-7, Pond 5 50
Figure 6-8, Pond 6 51
Figure 6-9, Pond 7 52
Figure 6-10, Pond 8 55
Figure 6-11, Pond 9 58
Figure 6-12, Pond 10 59

APPENDICES

APPENDIX A Stream Survey Data 61
APPENDIX B Stream Survey Photographs 67
APPENDIX C Electro fishing Habitat Data Sheets (Data Unavailable) 98
APPENDIX D Water Quality Results 99
APPENDIX E Sediment Quality Results 100

1.0 INTRODUCTION

The Newfoundland and Labrador Refining Corporation has proposed to construct an oil refinery in Southern Head, Placentia Bay, NL. The operation will refine petroleum products such as: gasoline, kerosene/jet fuel, ultra-low sulphur diesel and refining by-products, with an estimate production of 300,000 barrels per day. The proposed site is on undeveloped land, consisting of bedrock and bog, as well as shallow ponds and one major drainage basin (the Watson's Brook watershed) to the north. The Project site will consist of a processing facility, crude and production storage tanks, an access road, utilities and a marine terminal off Come By Chance Point.

The footprint for this Project is being designed to minimize potential impacts on the environment; however, there is aquatic habitat within the footprint of the facility and as such the habitat was surveyed for fish species presence and classified/quantified as per existing DFO standards and Methods. The majority of the ponds and steams within the Project footprint may be altered due to the construction of the processing facility and its components, and therefore could likely result in the harmful alteration, disruption and destruction of fish habitat (HADD) as per Section 35 of the Fisheries Act. The HADD will require authorization by the Minister of Fisheries and Oceans Canada (DFO).

In addition to providing the information required as part of the HADD determination process, the freshwater fish and fish habitat resources of the Project have been identified as requiring a Component Study by the Assessment Committee. Component studies are required to gather baseline information in order to assist the proponent in predicting impacts to Valued Ecosystem Components (VECs), to assist the Assessment Committee and the Minister in determining the significance of impacts and to describe baseline conditions for any required Environmental Effects Monitoring (EEM) Programs.

This report not only provides the results of the 2006/2007 freshwater baseline data collection program conducted to support the HADD determination of the proposed refining facility site location, it also submitted as the Freshwater Resources Component Study.

2.0 OBJECTIVES

The freshwater resources component study adds data to Newfoundland and Labrador Refining Corporation's regional baseline information on the freshwater fish and fish habitat within the potential footprint and addresses information requirements related to habitat characterization suitable for quantification in the context of DFO HADD requirements, as well as aquatic habitat characterization in compliance with EA Guidelines. The specific work scopes were as follows:

1. Determine baseline water quality within selected watersheds;
2. Determine baseline sediment quality within selected watersheds;
3. Identify fish species present and population estimates in existing streams within the Project footprint;
4. Determine baseline habitat classification and quantification of ponds and streams potentially affected within the Project footprint to fulfill DFO's information requirements for quantifying the HADD of fish habitat potentially resulting from the project.

3.0 STUDY TEAM

The study team for the field project was a group that has extensive experience conducting fisheries surveys and habitat classification. Key team members are outlined below. Members of the study team have conducted each task during various past projects.

Mr. James McCarthy, M.Sc. is Project Manager and Associate Biologist with the St. John's office who has over 15 years experience in fisheries research and environmental assessment. Mr. McCarthy has acted as senior biologist and assessor for numerous projects throughout Newfoundland and Labrador and North America. Mr. McCarthy acted as senior technical biologist and project manager for this work scope.

Mr. Andrew Peach, B.Sc., CCEP is an Intermediate Biologist with over nine years of direct field experience related to the scope of work for this project. Mr. Peach conducted field data collection, analysis and interpretation for this program. Mr. Peach also acted as field data manager.

Ms. Suzanne Gouveia, B.Env. Studies (Honours) is a Junior Environmental Scientist with the St. John's office. Ms. Gouveia has over six years of direct field experience related to the scope of work for this project. Ms. Gouveia conducted field data collection and analysis for this program.

Mr. Eric Deitch, M.Sc. is an intermediate Biologist with the St. John's office specializing in environmental assessment and protection plans. Mr. Deitch has over four years of field experience involving fish health and habitat. Mr. Deitch conducted field data collection for this program.

Mr. Ben Hammond and **Mr. Zack Bartlett** are Environmental Technicians with at least two years experience in data collection and field surveys. Both were field team members for various tasks associated with the program.

Mr. Mike Bannister and **Mr. Matt Gosse** are Environmental Technicians with less than two years experience in data collection and field surveys. Both were field team members for various tasks associated with the program.

4.0 SAMPLING PROGRAM

The sampling program for this project followed the Standard Methods Guide for the classification/quantification of lacustrine habitat in Newfoundland and Labrador (Bradbury *et al.* 2001) for all sampled ponds. Similarly, stream sampling followed the Standard methods guide for freshwater fish and fish habitat surveys in Newfoundland and Labrador: rivers and streams (Sooley *et al*. 1998 and McCarthy *et al*. 2007). The work comprised a set of clearly defined tasks which were carried out in accordance with the scope of work provided in the Request for Proposal.

Sample locations are provided in the table below (Table 4-1), with a map of the sample locations provided in Figure 4.1.

Table 4.1 Summary of sample sites, type of sampling and coordinates, Southern Head, 2006/2007.

Site ID	WGS 84 UTM		Sampling type
	N	E	
Stream T1	5298286 (Start)	720456 (Start)	Stream survey Quantitative Electrofishing
	5299278 (End)	719440 (End)	
Stream T1-1	5299077 (Start)	719956 (Start)	Stream survey
	5299662 (End)	720003 (End)	
Stream T2	5299327 (Start)	720804 (Start)	Stream survey Quantitative Electrofishing
	5298960 (End)	720962 (End)	
Stream T3	5300677 (Start)	719276 (Start)	Stream survey Quantitative & Qualitative Electrofishing
	5300048 (End)	719689 (End)	
Stream T2-1	5298863 (Start)	721063 (Start)	Stream survey
	5298846 (End)	721388 (End)	
Stream T2-2	5299596 (Start)	720651 (Start)	Stream survey Semi-Quantitative
	5299887 (End)	720462 (End)	
Stream T2-3	5301702 (Start)	719877 (Start)	Stream survey Quantitative Electrofishing
	5301334 (End)	720264 (End)	
Stream T4	5297794 (Start)	721223 (Start)	Stream survey
	5298230 (End)	721296 (End)	
Stream T5	5300298 (Start)	719082 (Start)	Stream survey Qualitative Electrofishing
	5300081 (End)	719311 (End)	
Stream T6	5299919 (Start)	718924 (Start)	Stream survey
	5299663 (End)	719154 (End)	
Pond 1	5299195	720625	Fish presence/habitat quantification
Pond 2	5299521	719847	Fish presence/habitat quantification
Pond 3	5299744	719686	Fish presence/habitat quantification
Pond 4	5299730	719321	Fish presence/habitat quantification
Pond 5	5299365	719284	Fish presence/habitat quantification

Site ID	WGS 84 UTM		Sampling type
	N	E	
Pond 6	5298606	720706	Fish presence/habitat quantification
Pond 7	529706	720906	Fish presence/habitat quantification
Pond 8	5300005	720323	Fish presence/habitat quantification
Pond 9	5300240	720068	Fish presence/habitat quantification
Pond 10	5299909	720020	Fish presence/habitat quantification

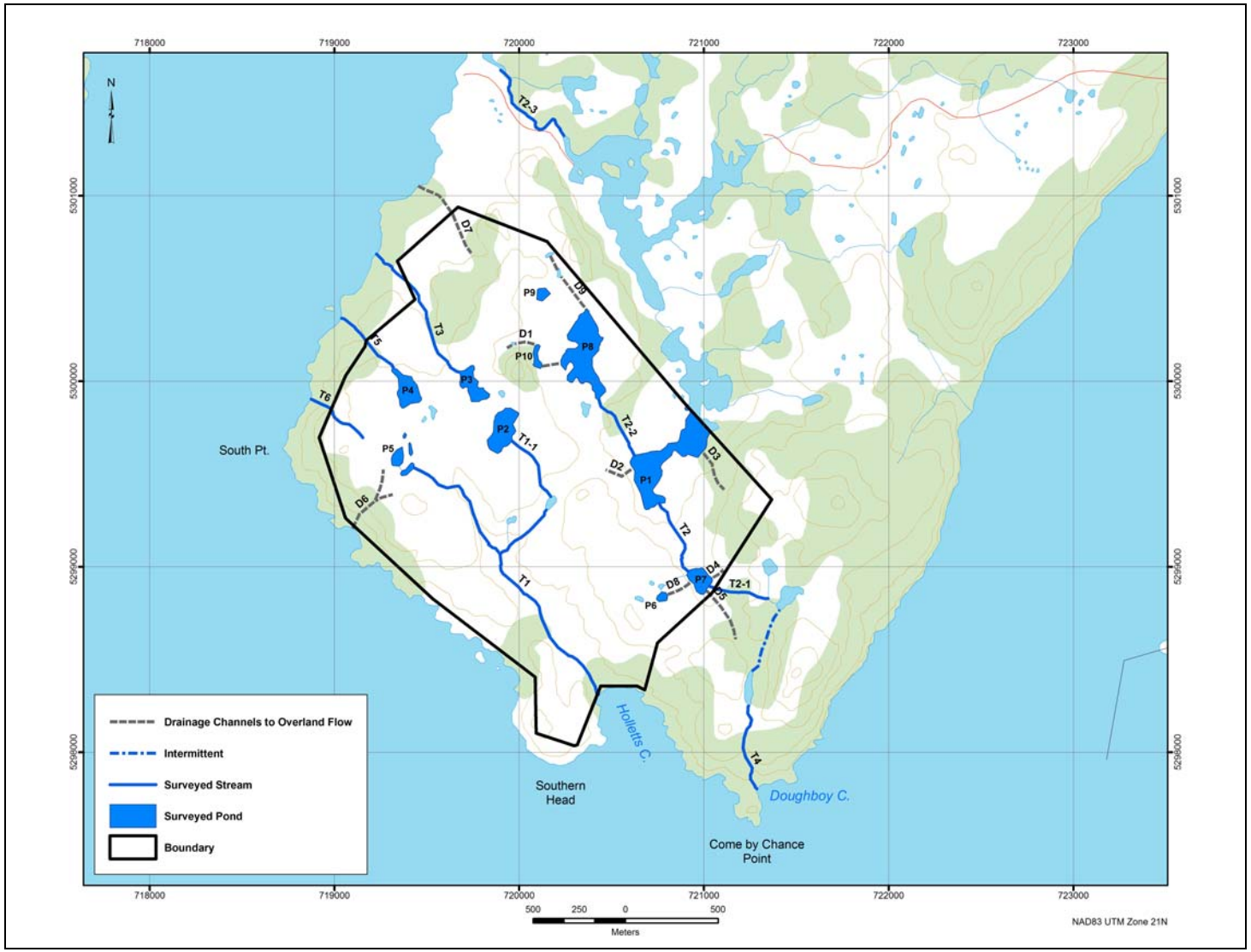

Figure 4-1 Location of the proposed Refinery Operations facility in Southern Head, NL. The Project area is indicated.

4.1 Quality Assurance

Standard Operating Procedures (SOPs) developed by AMEC Earth & Environmental for conducting biological studies were implemented during the current program. These included:

- Fish Sampling
- Electrofishing
- Bathymetry
- Water and Sediment Sampling
- Fyke net and minnow trap use
- Stream Surveys
- Field Data Management and transfer

SOPs serve as established plans and procedures for conducting a series of tasks ensuring that the work is completed to an acceptable standard and in a prescribed manner. The SOPs used by AMEC are on file. SOPs were reviewed in the field by all team members to ensure consistency of sample collection. In addition, as part of each team's Job Safety Assessment (JSA), was included a list of contact numbers for senior biologists and a call-in procedure to ensure that each day's data collection was consistent and accurate. This was referenced if any confusion arose in the field. In addition to SOP's, QA/QC forms were completed and tracked for all data transfers from field to digital format, or during any aspect of the project where data validation was deemed necessary. These forms are an integral part of AMEC's QA/QC for data entry.

4.2 Data Collection

The field Data Manager was responsible for ensuring that SOPs were followed during the collection of data and also for the daily transcription of field notes for subsequent computer entry. At least weekly, all data transcribed onto data forms was reviewed by the Data Manager and cross referenced with field notebooks. Any discrepancies were noted on field data forms and a review of procedure was conducted.

Technical quality assurance, extending from field data collection to data review and reporting, was provided by field supervisors and senior scientists. Their role included reviewing the data entered for computer analysis and all subsequent reports for accuracy. A Data Validation, QA/QC Form was completed each time data was transferred (e.g. from field data forms to digital spreadsheets). These forms outline QA procedures and, when filled out, illustrate what QA reviews were completed on the data.

4.3 Nomenclature

The naming of the stream, ponds and landmarks was standardized for field teams and reporting purposes by utilizing a priority protocol for naming. In order to reduce confusion, all ponds and streams have been labeled by a unique identification number without any reference to any local naming or maps. For example, all ponds have been numbered and are represented by the code P#. Similarly, the stream sample location has been identified using the code S#. Each stream was named using the standard

tributary structure outlined in Scruton *et al*. (1992). All names are provided in the appropriate sections of the report.

4.4 Geo-referencing

All sample locations were geo-referenced using handheld Global Positioning Systems (GPS) (Lowrance models). The position of each set was recorded on an internal SD chip and also recorded in field notebooks. Unless otherwise indicated, all field positions were gathered using WGS84 datum and recorded in UTM's. Where greater accuracy was required (i.e. during bathymetric surveys), Differential Global Positioning Systems (DGPS) were used (WGS 84 datum and UTM's). These systems used one of two methods to correct for position accuracy; integration of Canadian Coast Guard differential correction data or by integration of OMNIstar differential correction data. Tests on both systems prior to deployment indicated accuracies of 1m or less.

5.0 METHODS

The sampling schedule for this Project occurred over a two year period and each year the scheduled work was divided into two phases. During 2006 Phase I involved stream electrofishing during September, while Phase II involved stream surveys, pond sampling, habitat quantification and fish sampling during October/November. Due to the remote location of the site, AMEC field crews gained access to the site by helicopter, boat, and/or over-land by a Go-Track all-terrain carrier (commonly known as a Muskeg). Three streams were surveyed (T1, T2 & T3), along with the three larger ponds (P1, P2 & P3). In 2007 Phase 1 involved stream surveys, pond sampling, habitat quantification and fish sampling during May/June, while Phase II involved stream electrofishing during July. During the 2007 field program six streams were surveyed (T2-1, T2-2, T2-3, T4, T5 & T6) and seven ponds (P4, P5, P6, P7, P8, P9 & P10) were surveyed. Access to the site was obtained via helicopter. The remaining smaller ponds, that were either too shallow to sample (less than 0.5 m) or were not connected by above ground inflows or outflows, were analyzed in the air (via helicopter) while on-route to the main sample ponds.

5.1 Lacustrine Habitat Classification/Quantification

Ponds 1 (south section), 2 and 3 were sampled between October 27 – November 4, 2006. Ponds 1 (middle section), 4, 5, 6, 7, 8, 9, 10 were sampled between May 11 – June 1, 2007. Sampling in each pond consisted of a water profile analysis, collection of water and sediment samples, Secchi depth determination, fyke net and minnow trap fishing, and bathymetry using an integrated GPS and sonar mapping system.

An in-situ water profile was also recorded at each sample location. A Hydrolab Mini-Sonde probe was used to gather a profile of water temperature, pH, conductivity and dissolved oxygen at one meter intervals (or at half meter intervals, if shallow) between the surface and bottom.

Water clarity, measured at the deepest location of the pond, was determined using a Secchi disc. The disc was lowered in the water column using a calibrated line on the shaded side of the boat. The distance when the disc disappeared from sight as it descended was recorded as well as the distance when the disc re-appeared as it ascended. The average of the two was calculated and the number recorded.

Both single and double bag fyke nets were used to determine fish species presence in each of the ponds. The nets where set for 24 hrs, hauled and their contents analyzed and reset in alternate locations over a period of 2-3 days in order to cover the majority of the pond. Nets were generally set perpendicular to the shore. Four minnow traps were baited and also set from shore within the littoral zone of the ponds and allowed to fish for 24 hours per set. In some instances, i.e., unable to access the job site due to adverse weather conditions, the Fyke nets and minnow traps where set for a much longer period.

5.1.1 Bathymetric Profile

As part of lacustrine habitat quantification, a bathymetric profile of all identified ponds was completed using sonar equipment. The unit used to map the bathymetric profiles was linked to a GPS and external sonar; this allowed the coordination of pond depths and locations (differential GPS capable) with a set of digital maps. The unit collects a position and water depth every second. A suitable boat (Zodiac) was used with the digital sonar to appropriately traverse the pond habitat. The data was mapped upon completion of the surveys using existing mapping of the study area (1: 50,000) and contour mapping software. The pond boundary was extracted from existing digital base maps of the area provided by the Province and was used as the boundary for all contour modeling. Bathymetric plots were generated using the 3Dfield software package, which plots the data using simple linear equations with grid intervals of 1 m. All completed bathymetric contours were then exported to ARCGIS™ for analysis.

5.1.2 Habitat Quantification

The number of hectares of productive lacustrine fish habitat within each pond was quantified. The approach used for the quantification of lacustrine habitat was conducted as per the Standard Methods Guide for the Classification/Quantification of Lacustrine Habitat in Newfoundland and Labrador (Bradbury *et al*. 2001). The approach involved the completion of both littoral and non-littoral habitat mapping and sampling for species presence and habitat utilization. Secchi disc depth was used to discriminate between littoral and non-littoral habitat types.

Fish presence was determined through the use of fyke nets and minnow traps set throughout each pond. All fish species captured were considered indicative of that species utilizing the habitat for life processes, an exception to this occurred in the sampled ponds that are a part of the Watson's Brook drainage basin. For example, Atlantic salmon, brook trout and three spine stickleback are all known to occur within the watershed, therefore, HEU's for all there species were calculated.

5.2 Riverine Habitat Classification/Quantification

The footprint of the Project overlays eight sections of stream (Figure 4-1). Stream sections T1 (Holletts) and T1-1 (tributary of Holletts) drained into Holletts Cove, Placentia Bay, on the south side of the site. Stream T2 was located to the east of the Project footprint, flowing north into Pond 1, and then out to the Watson's Brook watershed. Sample stream T3 was located north of the project footprint and drained from Pond 3 into North Harbour. T5 was located southwest of T3 and drains west, from P4 into North Harbour. T6 was located southwest of T5 and empties into North Harbour; T5 does not have a pond as its headwaters and instead drains a portion of bog. T2-2 is part of the Watson Brook drainage basin and flows southeast from P8 into P1. A small portion of T2-1 is located within the Project footprint; it is part of the Watson Brook drainage basin and flows west into P7.

All stream reaches were sampled on the ground and were identified and delineated with a series of habitat measurements completed within each stream reach. (see Scruton *et al*. 1992 and Sooley *et al.* 1998). Habitat measurements included slope, water velocity,

stream wetted width and channel width, substrate type and size, and aquatic and riparian vegetation. Measurements of water depth and mean water column velocity were conducted at minimum intervals of ¼, ½ and ¾ of the stream wetted width. Water depth was recorded using a meter-stick and mean water velocity was measured using a velocity meter (Global flow Probe model FP101) or equivalent field method as outlined in Sooley *et al.* (1998). The substrate composition of each reach was also recorded as the percentage of each substrate size classification. Based on these measurements, each reach was classified into various habitat types

Two habitat classification systems were used; the Beak (1980) and a new classification system soon to be implemented by DFO (McCarthy *et al*. 2007). The Beak habitat classification system uses a total of four habitat types based on salmonid life-cycle stages and habitat suitabilities (Table 5-1).

The new classification system is still in draft; therefore a brief description of the method is outlined below. The proposed new classification system takes into account the suitability of the habitat for each species using the habitat by life-cycle stage (spawning, young-of-year, juvenile and adult). Habitat classes should be defined in an ecologically meaningful way (i.e., taking into account how fish utilize their habitat) that can be easily recognized by both field staff and habitat managers. Figure 5-1 provides an outline of the new habitat classification system, while Table 5-2 provides a description of each habitat type along with the range of parameter values associated with each.

The system is based on easily identifiable habitat characteristics that are not unlike many of the descriptive summaries provided in previous North American and Newfoundland and Labrador documents. It is comprised of a series of three levels, each providing progressively more detail about the habitat. This three-level hierarchical system provides the level of resolution needed for many habitat management purposes. Although the third level doesn't provide a further breakdown in habitat characterization, it does add significant information regarding site-specific species utilization of the Intermediate Level habitat types, which may be required for more detailed assessments.

Each habitat type has a discrete range of water velocities, substrate types, depths and gradients as possible which have been determined using the described biological 'preferences' outlined in Grant and Lee (2004). While not a defined habitat requirement, gradient is listed as a parameter which can be used in various levels of the system to distinguish between habitat types. It should be noted that not all habitat parameter descriptions are exclusive of all others (e.g., water depth); however, the combined parameters should offer a reasonable designation of most habitat types encountered.

Table 5.1 Habitat classifications of Beak (1980).

Habitat Classification	Habitat Description
Type I	Good salmonid spawning and rearing habitat: often with some feeding poois for larger age classes: **flows:** moderate riffles; **current:** 0.1-0.3 m/s; **depth:** relatively shallow, 0.3-1.0 m; **substrate:** gravel to small cobble, some large rocks, boulders; **general habitat types:** primarily riffle, pool.
Type II	Good salmonid rearing habitat with limited spawning usually only in isolated gravel pockets, good feeding and holding areas for larger fish in deeper pools, pockets or backwater eddies: **flows:** heavier riffles to light rapids; **current:** 0.3-1.0 m/s; **depth:** variable from 0.3-1.5 m; **substrate:** Larger cobble/rubble size rock to boulders, bedrock, some gravel pockets between larger rocks; **general habitat types:** run, riffle, pocketwater, pool.
Type III	Poor rearing habitat with no spawning capabilities, used for migratory purposes: **flows:** very fast, turbulent, heavy rapids, chutes, small falls; **current:** 1.0 m/s or greater; depth: variable, 0.3-1.5 m; **substrate:** Large rock and boulders, bedrock; **general habitat types:** run, pocketwater, cascades.
Type IV	Poor juvenile salmonid rearing habitat with no spawning capability, provides shelter and feeding habitat for larger, older salmonid (especially brook trout): **flows:** sluggish; **current:** 0.15 m/s; **depth:** variable but often 1 m; **substrate:** Soft sediment or sand, occasionally large boulders or bedrock, aquatic macrophytes present in many locations; **general habitat types:** flat, pool, glide.

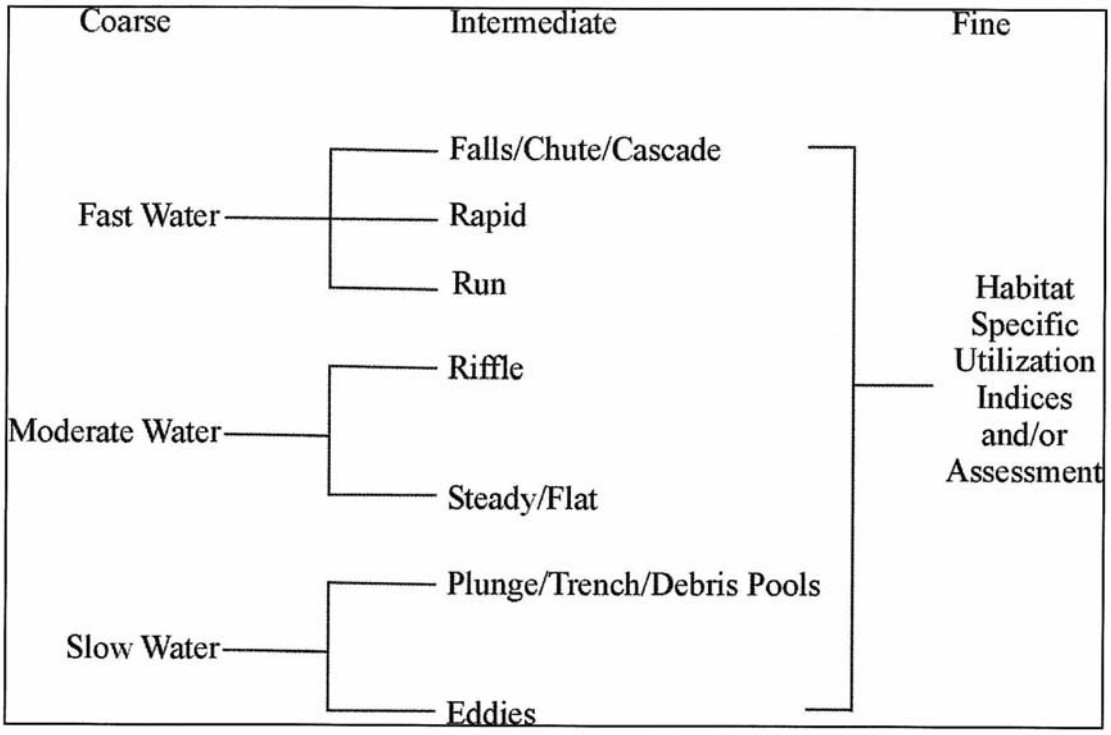

Figure 5-1 Descriptions of riverine habitat classifications.

Table 5.2 Descriptions of riverine habitat classifications.

Habitat Type	Habitat Parameter	Description
Fast Water	**Mean Water Velocity** **Stream Gradient**	**> 0.5m/s** **Generally > 4%.**
Rapid	General Description Mean Water Velocity Mean Water Depth Substrate Stream Gradient	Considerable white water[1] present. > 0.5 m/s < 0.6 m Usually dominated by boulder (Coarse[2]) and rubble (Medium[2]) with finer substrates (Medium and Fine[2]) possibly present in smaller amounts. Larger boulders typically break the surface. Generally 4-7%
Falls/ Chute/ Cascade	General Description Mean Water Velocity Mean Water Depth Substrate Stream Gradient	Mainly white water present. The dominating feature is a rapid change in stream gradient with most water free-falling over a vertical drop or series of drops. > 0.5 m/s Variable and will depend on degree of constriction of stream banks. Dominated by bedrock and/or large boulders (Coarse). > 7% and can be as high as 100%.
Run	General Description Mean Water Velocity Mean Water Depth Substrate Stream Gradient	Relatively swift flowing, laminar[3] and non-turbulent. > 0.5 m/s > 0.3 m Predominantly gravel, cobble and rubble (Medium) with some boulder (Coarse) and sand (Fine) in smaller amounts. Typically < 4% (exception to gradient rule of thumb)
Moderate Water	**Mean Water Velocity** **Stream Gradient**	**0.2-0.5m/s** **>1 and < 4%**
Riffle	General Description Mean Water Velocity Mean Water Depth Substrate Stream Gradient	Relatively shallow and characterized by a turbulent surface[4] with little or no white water. 0.2 – 0.5 m/s < 0.3 m Typically dominated by gravel and cobble (Medium) with some finer substrates present, such as sand (Fine). A small amount of larger substrates (Coarse) may be present, which may break the surface.[5] Generally >1 and < 4%
Steady/ Flat	General Description Mean Water Velocity Mean Water Depth Substrate Stream Gradient	Relatively slow-flowing, width is usually wider than stream average and generally has a flat bottom. 0.2 - 0.5 m/s >0.2 m Predominantly sand and finer substrates (Fine) with some gravel and cobble (Medium). > 1 and < 4%
Slow Water	**Mean Water Velocity** **Stream Gradient**	**Generally < 0.2m/s (some eddies can be up to 0.4m/s).** **< 1%.**
Plunge / Trench / Debris Pools	General Description Mean Water Velocity Mean Water Depth Substrate Stream Gradient	Generally caused by increased erosion near or around a larger, embedded object in the stream such as a rock or log or created by upstream water impoundment resulting from a complete, or near complete, channel blockage. These pool types may be classified as an entire reach (e.g., pools greater than 60% of the stream width) or as sub-divisions of a fast water habitat. < 0.2 m/s > 0.5 m depending on stream size (e.g., may be shallower in smaller systems). Highly variable (i.e., coarse, medium or fine substrates) Generally < 1%

Habitat Type	Habitat Parameter	Description
Eddy	General Description	Relatively small pools caused by a combination of damming and scour: however scour is the dominant forming action. Formation is due to a partial obstruction to stream flow from boulders, roots and/or logs. Partial blockage of flow creates erosion near obstruction. It is typically < 60% of the stream width and hence will be a sub-division of a faster-water habitat type (e.g., Run with 20% eddies).
	Mean Water Velocity	Typically < 0.4 m/s, but can be variable.
	Mean Water Depth	> 0.3 m. May vary depending on obstruction type, orientation, streambed and bank material and flows experienced.
	Substrate	Predominantly sand, silt and organics (Fine) with some gravels (Medium) in smaller amounts.
	Stream Gradient	Variable

1 White water is present when hydraulic jumps are sufficient to entrain air bubbles which disturb the water surface and reduces visibility of objects in the water.

2 Coarse, Medium and Fine substrate types are classified according to the Standard Methods Guide for the Classification/Quantification of Lacustrine Habitat in Newfoundland and Labrador (Bradbury *et al*. 2001).

3 Laminar describes the surface of the water as smooth and glass-like with no reduced visibility of objects in the water.

4 Turbulence is present if there are local patches of white water or if water movement disturbs a portion of the surface.

5 Pocket water often constitutes an important component of riffles in Newfoundland and Labrador and is characterized by a predominance of larger substrates (e.g., boulders) breaking the surface. The result is a riffle with many eddies around the boulders.

The quantification of potentially affected riverine habitat within the identified streams was completed using both classification systems during the 2006 surveys; however, during the 2007 surveys only the new habitat classification system (McCarthy *et al.* 2007) was utilized.

Under the proposed system, an Intermediate Level Assessment would be used for both medium and high risk developments where a HADD of fish habitat is likely to occur. This level of assessment uses the typical preference ranges contained within Grant and Lee (2004) and the measured habitat parameter ranges to derive a more detailed habitat utilization estimate of each habitat type present.

To calculate final utilization values, both substrate and velocity ratings are taken into consideration. The preferred range of water velocity listed in Grant and Lee (2004) and the ranges measured within each habitat are compared to determine the suitable habitat available to each species life-cycle stage. A similar exercise is also conducted using the preferred substrate ranges and the proportions estimated from each habitat type. In order to keep final suitability calculations similar to the Lacustrine Quantification Methodology (Bradbury *et al.* 1999), the mean of both values is used to derive a final suitability value unless an unsuitable rating (i.e., 0.00) is present for either. In this case, the habitat suitability would be 0.00. These calculations would be completed for all species and life stages present. As a precautionary approach, the highest suitability value of the four life stages would then be used as the species-specific value for that habitat type in an attempt to ensure that any 'critical' habitat requirements that a species/life stage might have would be protected to the best extent possible. Using the final habitat suitability values and the overall area of each habitat type, the total Habitat Equivalent Units (HEU) of each habitat type can be calculated for each species.

It should be noted that Grant and Lee (2004) does not provide any velocity preferences for American eels for use in habitat quantification. In order to remain conservative, only

substrate preference values were used (i.e. habitat equivalent values were not reduced/adjusted due to unsuitable velocity values).

5.3 Electrofishing

Quantitative electrofishing surveys (Figure 5-2) were completed on T1 (two sites), T2 (two sites), T2-2 (one site), T3 (one site) and T2-3 (two sites) for the purposes of fish species presence and quantification. In addition, qualitative electrofishing surveys were completed on T1 (one site), T3 (one site) and T5 (one site). Data collected from quantitative sampling was used to estimate fish population(s) within the stream and the biomass of fish within the habitat. Electrofishing procedures were followed in accordance with AMEC's Standard Operating Procedures (SOP's) for stream electrofishing and Scruton and Gibson (1995).

Quantitative electrofishing is the least selective method of fish sampling within a river system (Lagler 1978). A measured area within a stream is assessed by isolating the habitat from any incoming or outgoing fish passage with barrier nets. One barrier net was set downstream of the selected section, and another placed upstream, with little to no disruption to the selected section of stream between the two nets. The nets were stretched across the stream from one bank to the other and anchored to shore. The base of each net was weighted with rocks and sealed with smaller-sized stones. The electrofisher operator and one or two dip-netters entered the blocked off section of stream and fished the section from the downstream end to the upstream end. Each fish captured was placed in a bucket of stream water until the entire reach was completed.

Once a pass through the entire section was complete, the operator and dip-netter(s) exited the water and sampled the captured fish on shore. Fish were measured and weighed, and scale samples were taken (for purposes of age interpretation). The fish were then released downstream of the sampling station and at least three additional sweeps within the netted section were completed until the catch of the most abundant specie(s) from the last sweep was 50% or less of the total number of this species caught in the previous sweep. A habitat survey of each section of electrofished stream was also completed. This survey followed the same outline as the full stream survey, measuring: wetted width, channel width, length of the section, water depth, velocity, substrate, riparian vegetation, cover and slope.

Productivity was estimated using standard quantitative electrofishing (*see* Scruton and Gibson 1995). Representative habitat types were surveyed and population estimates established (with confidence limits).

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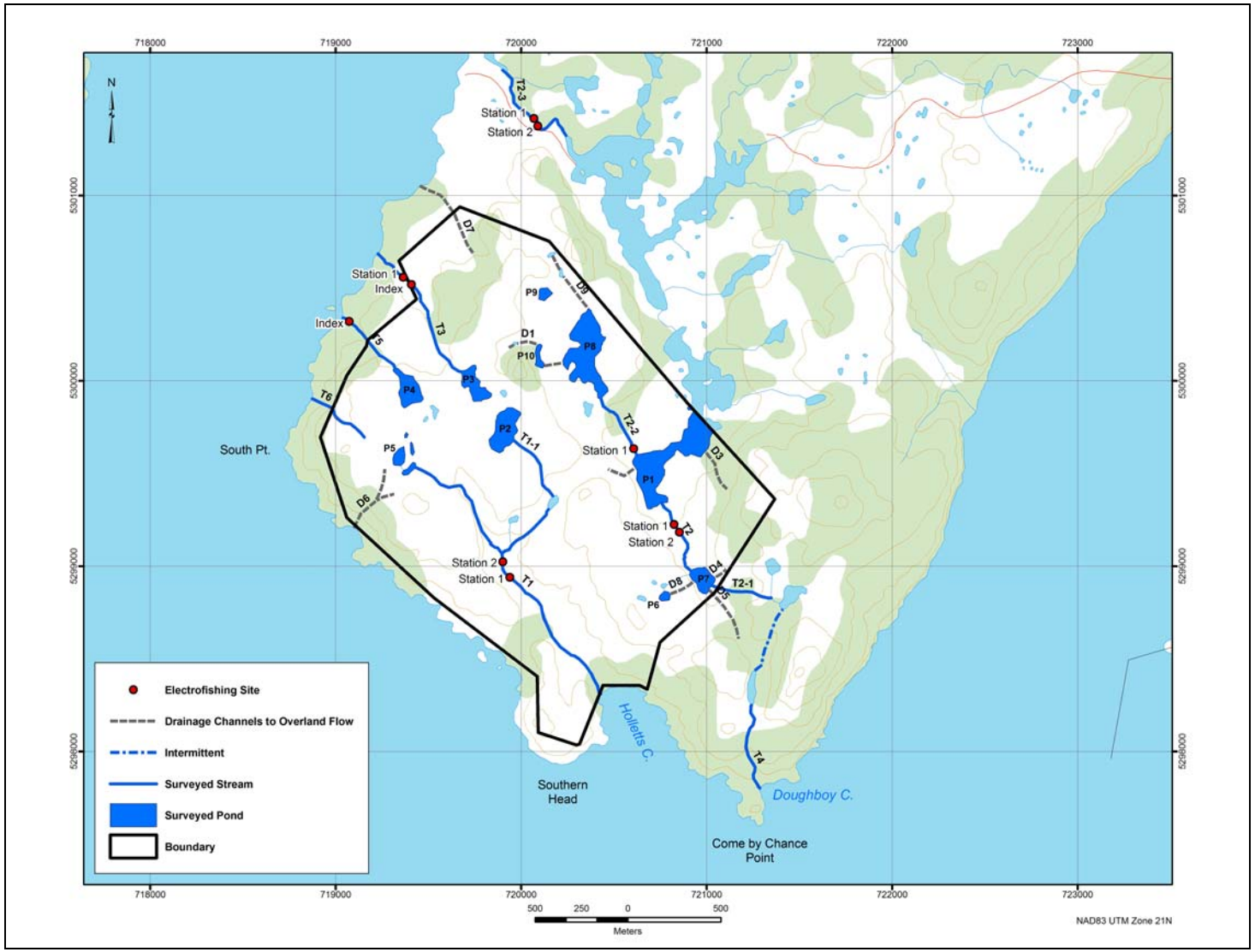

Figure 5-2 Quantitative and qualitative electrofishing stations, September 2006 and June 2007, Southern Head, NL.

6.0 RESULTS

The results of available fish habitat in both the sampled ponds and streams are presented below.

6.1 Riverine Habitat Classification/Quantification

All streams that were surveyed and sampled are located in the Project footprint and/or adjacent to it with the likelihood of being affected by the proposed changes to the site. A summary of habitat information and classifications are presented in Table 6-1 below. The designation as to what species is used to represent the final HEU is not specifically outlined in the system; however, HADD determination is typically conducted for a species of value as a fishery. Photos of each stream are presented in Appendix B.

The proposed system applies species habitat suitability indices to available habitat so that Habitat Equivalent Units (HEU) can be calculated. Species captured from the stream are included in habitat quantification, as well as species known to occur within the system.

Table 6.1 Summary of habitat types using the Beak and new Classification systems.

1 unit=100m^2.

	T1	T1-1	T2	T2-1	T2-2	T2-3	T3
New Classification							
Brackish	4.82	-	-	-	-	-	-
Run	4.04	-	0.70	-	-	8.19	-
Riffle	12.78	0.84	0.72	1.21	1.61	46.87	2.55
Steady	3.83	0.20	-	-	-	9.98	-
Rapid	0.61	-	-	-	-	-	-
Pool	0.67	-	1.52	-	1.39	-	-
Cascade	-	-	-	0.56	-	-	-
Beak							
I	5.94	-	0.4	-	-	-	2.29
II	11.05	-	0.7	-	-	-	0.26
III	4.27	-	0.32	-	-	-	-
IV	0.67	1.04	1.52	-	-	-	-
IV (Brackish)	4.82	-	-	-	-	-	-

6.1.1 Stream T1 & T1-1(2006)

Holletts stream was surveyed on the ground from the mouth of Holletts Cove at the south end of the site up to a small unnamed headwater pond (southeast corner of the footprint). Tributary T1-1 forking off of stream T1 mid way up (at reach 12) was also surveyed up to Pond 2, a total measuring 744 m. Stream T1 measured a total of 1,668m.

A summary of collected habitat data by reach and stream classification are presented in Tables 6-2 and 6-3. Detailed habitat measurements are presented in Appendix A. Tables 6-4 and 6-5 show a summary of species present and their suitability at each life stage for each identified stream reach. The highest value for each life-stage (per species) in each reach of the stream is bolded indicating the value used in calculating the total habitat equivalent units for each reach (Tables 6-6 and 6-7).

Holletts stream and the tributary stream contained sections of open bog and overland flow; the shorelines of both streams were vegetated predominantly with gramminoids and conifers. The substrate composition of stream T1 was mostly bedrock and gravel. The substrate composition of tributary T1-1 was predominantly detritus and rubble. The main stream and tributary both followed the surficial contours of the bog and for the most part flowed down average gradients between 0.14 – 7.0% and had average flows ranging from 0.0 – 0.29 m/s. The lower reaches of stream T1 were influenced by tidal action and hence were classified as brackish pools.

Habitat Quantification

The Beak Habitat Classification quantified stream T1 as having a total of 5.94 units of Type I (spawning), 11.05 units of Type II (rearing), 4.27 units of Type III (migratory), 0.67 units of Type IV (pool) habitat and 4.82 units of Type IV (brackish pool) habitat. The total amount of habitat units within the stream was 26.75 units. In addition to the identified fish habitat 0.45 units of overland flow was also recorded. Under the Beak classification system T1-1 was estimated to contain a total of 1.04 units of Type IV (pool) habitat, with an additional 3.14 units identified as overland flow. The total fish habitat for T1-1 was 1.04 units. It should be noted that although the amount of overland flow encountered in each stream has been identified it is not considered fish habitat and therefore does not appear in any of the totals.

The new proposed habitat classification system by DFO (McCarthy *et al*. 2007) identified a total of 4.82 units of Brackish, 4.04 units of Run, 12.78 units of Riffle, 3.83 units of Steady, 0.61 units of Rapid and 0.67 units of Pool habitat within T1. Stream T1-1 was identified as containing 0.84 units of Riffle and 0.20 units of Steady. Habitat suitabilities and total HEU's are presented in Tables 6-6 and 6-7. It was calculated that within T1 16.55 and 17.44 units exist for brook trout (*Salvelinus fontinalis*) and American eel (*Anguilla rostrata*) respectively. Within T1-1 an addition 0.95 units of habitat was identified for American eel.

6.1.2 Stream T2 (2006)

Stream T2 is part of the drainage basin for Watson's Brook and flows from a small pond (P7) on the southeastern edge of the Project footprint into Pond 1. The stream measured 409.1 m in length (all within the Project footprint) and contained a considerable amount of overland flow (1.29 units). The substrate was predominantly rubble and boulder and the average gradient ranged between 1.2 – 2.21%. Average flows ranged between 0.00 – 0.24 m/s. The stream flowed through sections of bog and areas of overland flow; the shoreline vegetation consisted mostly of gramminoids and conifers.

A summary of collected habitat data by reach and stream classifications are presented in Table 6-8. Detailed habitat measurements are presented in Appendix A. Table 6-9 shows a summary of species present and their suitability at each life stage for each identified stream reach. The highest value for each life-stage (per species) in each reach of the stream is bolded indicating the value used in calculating the total habitat equivalent units for each reach (Table 6-10).

Habitat Quantification

Under the Beak Habitat Classification System the stream was identified as having a total of 0.4 units of Type I (spawning), 0.7 units of Type II (rearing), 0.32 units of Type III, and 1.52 units of Type IV (pool) habitat. The total amount of fish habitat identified within the stream was 2.94 units and under the new proposed habitat classification system (McCarthy *et al*. 2007) 1.52 units of pool, 0.72 units of riffle and 0.70 units of run were identified. Brook trout, Atlantic salmon and threespine stickleback are all known to occur within the Watson's Brook drainage basin. Therefore, HEU's for all three species have been calculated, even though threespine stickleback and brook trout were the only two fish species captured in this stream during the electrofishing surveys. The calculated HEU's for brook trout, Atlantic salmon (*Salmo salar*) and threespine stickleback (*Gasterosteus aculeatus*) were 1.28, 1.27 and 0.51 respectively

Table 6.2 Summary of Habitat information and classification for stream T1 Southern Head, NL.

Reach #	Length (m)	Mean wet width (m)	Units ($100m^2$)	Mean Slope (%)	Mean Depth (m)	Mean Velocity (m/s)	Substrate (% coverage)[1]							Classification	
							Be	B	R	C	G	S	D	Beak	New
1	14.0	3.0	0.42	>10	0.29	Tidal	15	15	5	30	35			IV	Brackish
2	44.0	10.0	4.40	>3.2	>1.0m	Tidal		5	5	15	25	15	35	IV	Brackish
3	58.0	6.60	3.83	0.14	0.15	0.07		15	15	15	30	15	10	I	Steady
4	111.0	1.89	2.11	0.88	0.12	0.19		5	10	20	40	15	10	I	Riffle
5	16.0	2.38	0.38	5.40	0.29	0.29	30	70						II	Run
6	25.0	1.3	0.33	23.30	0.15	0.11	85			10	5			III	Rapid
7	11.0	2.5	0.28	6.4	0.27	0.14	100							III	Rapid
8	21.0	3.2	0.67	-	0.23	0.000		10	10	20	35		25	IV	Pool
9	99.0	3.7	3.66	4.05	0.14	0.11	65	10	17.5	5	2.5			III	Run
10	659.0	1.21	7.91	-	0.34	0.20		7	5	4	28	30	27	II	Riffle
11[2]	460.0	0.63	2.76	-	0.13	0.12		13	20	9	24	17	17	II	Riffle

[1] Be-Bedrock, B-Boulder, R-Rubble, C-Cobble, G-Gravel, S-Sand, D-Detritus
[2] This reach also contained 150.0 m of overland flow.

Table 6.3 Summary of Habitat information and classification for stream T1-1 Southern Head, NL

Reach #	Length (m)	Mean wet width (m)	Units ($100m^2$)	Mean Slope (%)	Mean Depth (m)	Mean Velocity (m/s)	Substrate (% coverage)[1]							Classification	
							Be	B	R	C	G	S	D	Beak	New
12[2]	70.0	1.2	0.84	-	0.19	0.00			75				25	IV	Riffle
13	130.0	0.8	1.04	7.0	0.19	0.12			40	3			57	N/A	Overland Flow
14	120.0	-	-	-	-	-								N/A	Pond
15	300.0	0.7	2.10	-	0.35	0.16							100	N/A	Overland Flow
16	14.0	1.4	0.20	-	0.46	0.00			30	40	10		20	IV	Steady

[1] Be-Bedrock, B-Boulder, R-Rubble, C-Cobble, G-Gravel, S-Sand, D-Detritus
[2] This reach also contained 110.0 m of Overland Flow

Table 6.4 Summary of Brook trout and American eel habitat suitability by life stage for stream T1. Bolded values are those brought forward to HEU calculations.

T1		Brook Trout				American Eel
Reach	**Habitat**	**Spawning**	**YOY**	**Juvenile**	**Adult**	**Juvenile**
1	Brackish	0.00	0.00	0.00	0.00	**0.43**
2	Brackish	0.00	0.00	0.00	0.00	**0.72**
3	Steady	0.52	0.60	**0.70**	0.64	**0.70**
4	Riffle	0.79	0.77	**0.90**	0.81	**0.62**
5	Run	0.00	0.69	**0.85**	0.79	**0.70**
6	Rapid	0.41	0.41	0.41	**0.70**	**0.03**
7	Rapid	0.00	0.00	0.00	**0.59**	**0.00**
8	Pool	0.00	0.00	0.00	0.00	**0.68**
9	Run	0.21	0.34	0.34	**0.56**	**0.29**
10	Riffle	0.72	0.55	**0.86**	0.70	**0.50**
11	Riffle	0.65	0.73	**0.87**	0.78	**0.77**

Table 6.5 Summary of Brook trout and American eel habitat suitability by life stage for stream T1-1. Bolded values are those brought forward to HEU calculations.

T1-1		Brook Trout				American Eel
Reach	**Habitat**	**Spawning**	**YOY**	**Juvenile**	**Adult**	**Juvenile**
12	Riffle	0.00	0.00	0.00	0.00	**1.00**
13	Overland Flow	N/A	N/A	N/A	N/A	N/A
14	Pond	N/A	N/A	N/A	N/A	N/A
15	Overland Flow	N/A	N/A	N/A	N/A	N/A
16	Steady	0.00	0.00	0.00	0.00	**0.57**

Table 6.6 Summary habitat suitability information and habitat equivalent units (HEU) for species captured in sample stream T1.

Reach	Units	Brook trout		American Eel[a]		Habitat Classification	
		Habitat Suitability Value	HEU	Habitat Suitability Value	HEU	Beak	New
1	0.42	0.00	0.00	0.43	0.18	IV	Brackish
2	4.40	0.00	0.00	0.72	3.17	IV	Brackish
3	3.83	0.70	2.68	0.70	2.68	I	Steady
4	2.11	0.90	1.90	0.62	1.31	I	Riffle
5	0.38	0.85	0.32	0.70	0.27	II	Run
6	0.33	0.70	0.23	0.03	0.10	III	Rapid
7	0.28	0.59	0.17	0.00	0.00	III	Rapid
8	0.67	0.00	0.00	0.68	0.46	IV	Pool
9	3.66	0.56	2.05	0.29	1.06	III	Run
10	7.91	0.86	6.80	0.50	6.09	II	Riffle
11	2.76	0.87	2.40	0.77	2.13	II	Riffle
Total	**26.75**		**16.55**		**17.44**		

[a] Only substrate values were used to calculate Habitat Suitability values.

Table 6.7 Summary habitat suitability information and habitat equivalent units (HEU) for species captured in sample stream T1-1.

Reach	Units	Brook trout		American Eel[a]		Habitat Classification	
		Habitat Suitability Value	HEU	Habitat Suitability Value	HEU	Beak	New
12	0.84	0.00	0.00	1.00	0.84	IV	Riffle
13	N/A	N/A	N/A	N/A	N/A	N/A	Overland Flow
14	N/A	N/A	N/A	N/A	N/A	N/A	Pond
15	N/A	N/A	N/A	N/A	N/A	N/A	Overland Flow
16	0.20	0.00	0.00	0.57	0.11	IV	Steady
Total	**1.04**		**0.00**		**0.95**		

[a] Only substrate values were used to calculate Habitat Suitability values.

Table 6.8 Summary of Habitat information and classification for stream T2, Southern Head, 2006.

Reach #	Length (m)	Mean wet width (m)	Units ($100m^2$)	Mean Slope (%)	Mean Depth (m)	Mean Velocity (m/s)	Substrate (% coverage)[1]							Classification	
							Be	B	R	C	G	S	D	Beak	New
1	1.1	2.1	0.02	Flat	0.34	0.00		10	50	35	5			IV	Pool
2	19.0	2.1	0.40	Flat	0.13	0.23			10	20	65		5	I	Riffle
3	70.0	1.0	0.70	2.21	0.16	0.24		40	55	5				II	Run
4	180.0	0.8	1.29	Flat-	0.16	0.19		20	27	23	3		27	II	Overland Flow
5	15.0	10.0	1.50	Flat	-	-								IV	Pool
6	124.0	0.9	0.32	1.23	0.11	0.13		50	50					III	Riffle

[1] Be-Bedrock, B-Boulder, R-Rubble, C-Cobble, G-Gravel, S-Sand, D-Detritus

Table 6.9 Brook trout, Atlantic salmon and three spine stickleback habitat suitability summary by life stage for stream T2. Bolded values are those brought forward to HEU calculations.

T2 (2006)		Brook Trout				Atlantic Salmon				Three Spine Stickleback			
Reach	Habitat	Spawning	YOY	Juvenile	Adult	Spawning	YOY	Juvenile	Adult	Spawning	YOY	Juvenile	Adult
1	Pool	0.00	0.00	**0.00**	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	**0.00**	0.00
2	Riffle	0.94	0.81	**1.00**	0.99	0.76	0.98	**0.98**	0.00	0.47	0.00	0.00	**0.69**
3	Run	0.46	0.86	0.86	**0.93**	0.46	0.93	**0.93**	0.63	**0.21**	0.00	0.00	0.00
4	Overland Flow	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5	Pool	0.00	0.00	**0.00**	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	**0.00**	0.00
6	Riffle	0.00	0.67	**0.71**	0.71	0.00	0.71	**0.71**	0.46	**0.25**	0.00	0.00	0.00

Table 6.10 Summary habitat suitability information and habitat equivalent units (HEU) for species present within T2.

Reach	Units	Brook Trout		Atlantic Salmon		Three Spine Stickleback		Habitat Classification	
		Habitat Suitability Value	HEU	Habitat Suitability Value	HEU	Habitat Suitability Value	HEU	Beak	New
1	0.02	0.00	0.00	0.00	0.00	0.00	0.00	IV	Pool
2	0.40	1.00	0.40	0.98	0.39	0.69	0.28	I	Riffle
3	0.70	0.93	0.65	0.93	0.65	0.21	0.15	II	Run
4	1.29	N/A	N/A	N/A	N/A	N/A	N/A	II	Overland Flow
5	1.50	0.00	0.00	0.00	0.0	0.00	0.00	IV	Pool
6	0.32	0.23	0.23	0.71	0.23	0.25	0.08	III	Riffle
Total	**4.23**		**1.28**		**1.27**		**0.51**		

6.1.3 Stream T3 (2006)

Sample Stream T3 flows from sample Pond 3 and drains northwest into North Harbour. The total stream length was 862.8 m, however, the last 650 m was classified as overland flow. Substrate composition was primarily gravel and cobble and average gradients and flows for each reach ranged between 2.8 – 7.8% and 0.13 – 0.439 m/s respectively

A summary of collected habitat data by reach and stream classifications are presented in Table 6-11. Detailed habitat measurements are presented in Appendix A. Table 6-12 shows a summary of species present and their suitability at each life stage for each identified stream reach. The highest value for each life-stage (per species) in each reach of the stream is bolded indicating the value used in calculating the total habitat equivalent units for each reach (Table 6-13).

Table 6.11 Summary of Habitat information and classification for stream T3, Southern Head, 2006.

Reach #	Length (m)	Mean wet width (m)	Units ($100m^2$)	Mean Slope (%)	Mean Depth (m)	Mean Velocity (m/s)	Substrate (% coverage)[1]							Classification	
							Be	B	R	C	G	S	D	Beak	New
1	28	1.6	0.46	5.8	0.13	0.03	5		5	30	60			I	Riffle
2	72.8	1.1	0.92	7.8	0.09	0.10	39	13	9	15	25			I	Riffle
3	26	1.0	0.26	2.8	0.10	0.44		10	15	40	35			II	Riffle
4	86	1.2	0.91	4.00	0.14	0.04		5	15	38	43			I	Riffle
5	50	0.8	0.40	-	0.27	0.01				10	5		85	N/A	Overland Flow
6	350	-	0.00	-	-	-								N/A	Overland Flow
7	250	-	0.00	-	-	-								N/A	Overland Flow

[1] Be-Bedrock, B-Boulder, R-Rubble, C-Cobble, G-Gravel, S-Sand, D-Detritus

Habitat Quantification

The Beak Habitat Classification quantified the stream as having a total of 2.29 units of Type I (spawning), and 0.26 units of Type II (rearing). The total amount of habitat units within the stream was 2.55 units and under the new Classification System (McCarthy *et al*. 2007) this habitat was all classified as riffle (2.55 units of riffle).

Brook trout was the only species identified within the drainage basin of T3 and it was calculated that 1.67 HEU's exist for brook trout and are presented in Table 6-14.

Table 6.12 Brook trout habitat suitability summary by life stage for stream T3. Bolded values are those brought forward to HEU calculations.

T3		Brook Trout			
Reach	**Habitat**	**Spawning**	**YOY**	**Juvenile**	**Adult**
1	Riffle	0.51	0.53	0.53	**0.55**
2	Riffle	0.41	0.52	0.52	**0.65**
3	Riffle	0.88	0.79	**1.00**	0.86
4	Riffle	0.51	0.61	**0.61**	0.61
5	Overland Flow	N/A	N/A	N/A	N/A
6	Overland Flow	N/A	N/A	N/A	N/A
7	Overland Flow	N/A	N/A	N/A	N/A

Table 6.13 Summary habitat suitability information and habitat equivalent units (HEU) for brook trout in sample stream T3.

Reach	Units	Habitat Suitability Value	HEU	Habitat Classification	
1	0.46	0.55	0.25	I	Riffle
2	0.92	0.65	0.60	I	Riffle
3	0.26	1.00	0.26	II	Riffle
4	0.91	0.61	0.56	I	Riffle
5	N/A	N/A	N/A	N/A	Overland Flow
6	N/A	N/A	N/A	N/A	Overland Flow
7	N/A	N/A	N/A	N/A	Overland Flow
TOTAL	**2.55**		**1.67**		

6.1.4 Stream T2-1 (2007)

Sampled stream T2-1 is part of the Watson Brook drainage basin. It originates outside the project footprint and empties into Pond 7. The stream itself measured approximately 343.0 m in length. Only about 37 m of the stream falls within the Project footprint, however, any alteration to the first 37 m of this stream will more than likely result in fish being unable to access the remainder of the stream. For instance, the headwater ponds feeding this stream drain through the upland bog for a distance before the stream begins to take shape; as such, fish are considered not to have access to the stream from the headwater ponds and therefore must gain access from below. The substrate composition was predominantly gravel and cobble. The shoreline vegetation was made up entirely of gramminoids and conifers. The stream for the most part was well defined and, with the exception of reach 4 (15.3%), had average gradients between <1.0 – 4.8% and average flows between 0.02 – 0.25 m/s.

A summary of collected habitat data by reach and stream classifications are presented in Table 6-14. Detailed habitat measurements are presented in Appendix A. Table 6-15 shows a summary of species present and their suitability at each life stage for each identified stream reach. The highest value for each life-stage (per species) in each reach of the stream is bolded indicating the value used in calculating the total habitat equivalent units for each reach (Table 6-16).

Habitat Quantification

The total amount of fish habitat identified within the stream was 1.77 units. In addition, 0.29 units of overland flow (Reach 5) were also present. Under the proposed new riverine classification system (McCarthy *et al*. 2007) 1.21 units of riffle and 0.56 units of cascade was identified. This stream was not quantitatively or qualitatively electrofished, however, young of the year (YOY) and juvenile salmonids were observed in the stream during the 2007 stream survey. In addition, brook trout, Atlantic salmon and threespine stickleback are all known to occur within the Watson Brook drainage basin; the calculated HEU's for all three species are 1.27, 1.22 and 0.86 respectively

Table 6.14 Summary of Habitat information and classification for stream T2-1, Southern Head, 2007.

Reach #	Length (m)	Mean wet width (m)	Units ($100m^2$)	Mean Slope (%)	Mean Depth (m)	Mean Velocity (m/s)	Substrate (% coverage)[1]							Classification	
							Be	B	R	C	G	S	D	Beak	New
1	31.0	0.49	0.152	3.4	0.12	0.25		20	25	20	5		30	N/A	Riffle
2	150.0	0.55	0.825	4.8	0.16	0.13		2.5	2.5	5	85		5	N/A	Riffle
3	34.0	0.69	0.235	4.5	0.08	0.02			10	30	60			N/A	Riffle
4	72.0	0.78	0.562	15.3	0.14	0.02		20	15	25	40			N/A	Cascade
5	56.0	0.52	0.291	Flat	0.13	0.10								N/A	Overland Flow

[1] Be-Bedrock, B-Boulder, R-Rubble, C-Cobble, G-Gravel, S-Sand, D-Detritus

Table 6.15 Brook trout, Atlantic salmon and Three Spine Stickleback habitat suitability summary by life stage for stream T2-1. Bolded values are those brought forward to HEU calculations.

T2-1 (2007)		Brook Trout				Atlantic Salmon				Three Spine Stickleback			
Reach	Habitat	Spawning	YOY	Juvenile	Adult	Spawning	YOY	Juvenile	Adult	Spawning	YOY	Juvenile	Adult
1	Riffle	0.68	0.85	**1.00**	0.90	0.63	**0.85**	0.85	0.60	0.00	0.00	0.00	**0.68**
2	Riffle	0.66	0.63	**0.70**	0.64	0.65	**0.68**	0.68	0.22	0.22	0.00	0.00	**0.65**
3	Riffle	0.65	**0.70**	0.70	0.70	0.00	**0.67**	0.67	0.00	**0.30**	0.00	0.00	0.00
4	Cascade	0.49	**0.67**	0.67	0.67	0.00	**0.67**	0.67	0.27	**0.27**	0.00	0.00	0.00
5	Overland Flow	0.33	0.00	**0.67**	0.33	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	**0.67**

Table 6.16 Summary habitat suitability information and habitat equivalent units (HEU) for species present in sample stream T2-1.

Reach	Units	Brook Trout		Atlantic Salmon		Three Spine Stickleback		Habitat Classification	
		Habitat Suitability Value	HEU	Habitat Suitability Value	HEU	Habitat Suitability Value	HEU	Beak	New
1	0.152	1.00	0.15	0.85	0.13	0.68	0.10	N/A	Riffle
2	0.825	0.70	0.58	0.68	0.56	0.65	0.54	N/A	Riffle
3	0.235	0.70	0.16	0.67	0.16	0.30	0.07	N/A	Riffle
4	0.562	0.67	0.38	0.67	0.38	0.27	0.15	N/A	Cascade
5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Overland Flow
Total	**1.77**		**1.27**		**1.23**		**0.86**		

6.1.5 Stream T2-2 (2007)

Sample stream T2-2 flows from Pond P8 into Pond P1 and occurs within the boundary of the Watson's Brook watershed. The stream had a total length of 363.0 m and the substrate was primarily aquatics (submergent and emergent vegetation), rubble and cobble. The average gradient ranged between 0.05 – 1.8% and average flows ranged between 0.05 – 0.56 m/s. The shoreline vegetation consisted largely of gramminoids and conifers.

A summary of collected habitat data by reach and stream classifications are presented in Table 6-17. Detailed habitat measurements are presented in Appendix A. Table 6-18 shows a summary of species present and their suitability at each life stage for each identified stream reach. The highest value for each life-stage (per species) in each reach of the stream is bolded indicating the value used in calculating the total habitat equivalent units for each reach (Table 6-19).

Habitat Quantification

Under the proposed new riverine classification system (McCarthy *et al*. 2007) 1.61 units of riffle and 1.39 units of pool habitat was identified for a total of 3.00 units of fish habitat. Brook trout, Atlantic salmon and threespine stickleback are all known to occur within the Watson Brook drainage basin and the calculated HEU's for all three species are 2.70, 1.87 and 2.05 units respectively

Table 6.17 Summary of Habitat information and classification for stream T2-2, Southern Head, 2007.

Reach #	Length (m)	Mean wet width (m)	Units ($100m^2$)	Mean Slope (%)	Mean Depth (m)	Mean Velocity (m/s)	Substrate (% coverage)[1]								Classification	
							Be	B	R	C	G	S	D	A	Beak	New
1	21.0	1.12	0.235	0.05	0.07	0.19		15	25	30	20			10	N/A	Pool
2	26.0	0.99	0.257	1.54	0.15	0.08		5	20	15				60	N/A	Pool
3	103.0	0.79	0.814	1.3	0.12	0.20		5	20	25	15			35	N/A	Riffle
4	18.0	0.53	0.095	0.1	0.35	0.05			5	5	5		15	70	N/A	Pool
5	52.0	0.55	0.286	0.7	0.07	0.50		5	15	5	10			65	N/A	Riffle
6	54.0	0.95	0.513	1.8	0.04	0.56		5	5	5	5			80	N/A	Riffle
7	47.0	0.93	0.437	1.3	0.10	0.13			10	10	15			65	N/A	Pool
8	42.0	0.86	0.361	0.6	0.19	0.09		5	15	15	20		20	25	N/A	Pool

[1] Be-Bedrock, B-Boulder, R-Rubble, C-Cobble, G-Gravel, S-Sand, D-Detritus, A-Aquatics

Table 6.18 Brook trout, Atlantic salmon and Three Spine Stickleback habitat suitability summary by life stage for stream T2-2. Bolded values are those brought forward to HEU calculations.

T2-2 (2007)		Brook Trout				Atlantic Salmon				Three Spine Stickleback			
Reach	Habitat	Spawning	YOY	Juvenile	Adult	Spawning	YOY	Juvenile	Adult	Spawning	YOY	Juvenile	Adult
1	Pool	0.77	0.95	**1.00**	0.97	0.75	**0.95**	**0.95**	0.58	0.61	0.00	0.00	**0.65**
2	Pool	0.51	0.54	**0.84**	0.64	0.24	**0.54**	**0.54**	0.36	**0.65**	0.00	0.00	0.47
3	Riffle	0.65	0.72	**0.89**	0.78	0.54	**0.72**	**0.72**	0.42	0.38	0.00	0.00	**0.59**
4	Pool	0.53	0.41	**0.84**	0.55	0.00	**0.41**	**0.41**	0.00	**0.77**	0.00	0.00	0.00
5	Riffle	0.68	0.34	**1.00**	0.62	0.58	**0.68**	**0.68**	0.36	0.00	0.00	0.00	**0.88**
6	Riffle	0.68	0.00	**1.00**	0.00	0.55	**0.60**	**0.60**	0.36	0.00	0.00	0.00	**0.93**
7	Pool	0.65	0.59	**0.92**	0.70	0.38	**0.51**	**0.51**	0.00	0.52	0.00	0.00	**0.65**
8	Pool	0.42	0.39	**0.67**	0.52	0.29	**0.44**	**0.44**	0.19	0.32	0.00	0.00	**0.44**

Table 6.19 Summary habitat suitability information and habitat equivalent units (HEU) for species present in sample stream T2-2.

Reach	Units	Brook Trout		Atlantic Salmon		Three Spine Stickleback		Habitat Classification	
		Habitat Suitability Value	HEU	Habitat Suitability Value	HEU	Habitat Suitability Value	HEU	Beak	New
1	0.235	1.00	0.24	0.95	0.22	0.65	0.15	N/A	Pool
2	0.257	0.84	0.22	0.54	0.14	0.65	0.17	N/A	Pool
3	0.814	0.89	0.72	0.72	0.59	0.59	0.48	N/A	Riffle
4	0.095	0.84	0.08	0.41	0.04	0.77	0.07	N/A	Pool
5	0.286	1.00	0.29	0.68	0.19	0.88	0.25	N/A	Riffle
6	0.513	1.00	0.51	0.60	0.31	0.93	0.48	N/A	Riffle
7	0.437	0.92	0.40	0.51	0.22	0.65	0.28	N/A	Pool
8	0.361	0.67	0.24	0.44	0.16	0.44	0.16	N/A	Pool
Total	**2.99**		**2.70**		**1.87**		**2.05**		

6.1.6 Stream T2-3 (2007)

Watson's Brook itself is not within the boundary of the project footprint; however, it is a scheduled salmon river and is one of the areas identified as a possible compensation option. Watson's Brook measured a total of 669.0 m and was classified as containing primarily bedrock and rubble substrate. The average gradient ranged between 0.1 – 2.1% and average flows ranged between 0.13 – 0.55 m/s. The shoreline vegetation was largely comprised of shrubs and conifers. Under the new proposed riverine classification system a total of 65.04 units of fish habitat were identified which was comprised of 46.87 units of riffle, 8.19 units of run and 9.98 units of steady. Electrofishing surveys within Watson's Brook showed that brook trout, Atlantic salmon and threespine stickleback all occur within this stream and the calculated HEU's for each species are 55.19, 53.31 and 30.71 respectively.

A summary of collected habitat data by reach and stream classifications are presented in Table 6-20. Detailed habitat measurements are presented in Appendix A. Table 6-21 shows a summary of species present and their suitability at each life stage for each identified stream reach. The highest value for each life-stage (per species) in each reach of the stream is bolded indicating the value used in calculating the total habitat equivalent units for each reach (Table 6-22)

Habitat Quantification

Under the new proposed riverine classification system (McCarthy *et al*. 2007) a total of 65.04 units of fish habitat were identified which was comprised of 46.87 units of riffle, 8.19 units of run and 9.98 units of steady. Electrofishing surveys within Watson's Brook showed that brook trout, Atlantic salmon and threespine stickleback all occur within this stream and the calculated HEU's for each species are 55.19, 53.31 and 30.71 respectively.

Table 6.20 Summary of Habitat information and classification for stream T2-3 Southern Head, 2007.

Reach #	Length (m)	Mean wet width (m)	Units ($100m^2$)	Mean Slope (%)	Mean Depth (m)	Mean Velocity (m/s)	Substrate (% coverage)[1]								Classification	
							Be	B	R	C	G	S	D	A	Beak	New
1	212.0	11.5	24.38	1.1	0.23	0.36	20	15	40	15	10				N/A	Riffle
2	163.0	8.0	13.04	1.9	0.34	0.35	70	15	10	2.5	2.5				N/A	Riffle
3	38.0	9.7	3.69	2.1	0.29	0.30	65	15	15	2.5	2.5				N/A	Riffle
4	75.0	13.3	9.98	0.1	0.35	0.13	10		10	45	30	5			N/A	Flat
5	64.0	9.0	5.76	0.2	0.22	0.32	20	15	35	20	10				N/A	Riffle
6	117.0	7.0	8.19	1.3	0.22	0.55	10	20	45	20	5				N/A	Run

[1] Be-Bedrock, B-Boulder, R-Rubble, C-Cobble, G-Gravel, S-Sand, D-Detritus, A-Aquatics

Table 6.21 Brook trout, Atlantic salmon and Three Spine Stickleback habitat suitability summary by life stage for stream T2-3. Bolded values are those brought forward to HEU calculations.

T2-3 (2007)		Brook Trout				Atlantic Salmon				Three Spine Stickleback			
Reach	Habitat	Spawning	YOY	Juvenile	Adult	Spawning	YOY	Juvenile	Adult	Spawning	YOY	Juvenile	Adult
1	Riffle	0.63	0.68	**0.90**	0.74	0.58	0.86	**0.90**	0.44	0.32	0.00	0.00	**0.51**
2	Riffle	0.49	0.40	0.62	**0.67**	0.42	0.58	**0.62**	0.51	0.14	0.00	0.00	**0.41**
3	Riffle	0.48	0.53	0.63	**0.75**	0.48	0.58	**0.63**	0.43	0.18	0.00	0.00	**0.47**
4	Flat	0.80	0.84	0.85	**0.88**	0.68	**0.83**	**0.83**	0.00	0.38	0.05	0.00	**0.48**
5	Riffle	0.65	0.70	**0.90**	0.82	0.60	0.80	**0.85**	0.38	0.24	0.00	0.00	**0.50**
6	Run	0.53	0.65	**0.95**	0.79	0.53	0.85	**0.95**	0.40	0.00	0.00	0.00	**0.43**

Table 6.22 Summary habitat suitability information and habitat equivalent units (HEU) for species present in sample stream T2-3.

Reach	Units	Brook Trout		Atlantic Salmon		Three Spine Stickleback		Habitat Classification	
		Habitat Suitability Value	HEU	Habitat Suitability Value	HEU	Habitat Suitability Value	HEU	Beak	New
1	24.38	0.90	21.94	0.90	21.94	0.51	12.43	N/A	Riffle
2	13.04	0.67	8.74	0.62	8.08	0.41	5.35	N/A	Riffle
3	3.69	0.75	2.77	0.63	2.32	0.47	1.73	N/A	Riffle
4	9.98	0.88	8.78	0.83	8.28	0.48	4.79	N/A	Flat
5	5.76	0.90	5.18	0.85	4.90	0.50	2.88	N/A	Riffle
6	8.19	0.95	7.78	0.95	7.78	0.43	3.52	N/A	Run
Total	**65.04**		**55.19**		**53.31**		**30.71**		

6.2 Productivity Estimate

Table 6-23 presents the mean standing stock estimates of all species from the representative electrofishing stations in the Project area. Appendix C presents all completed electrofishing survey sheets.

Table 6.23 Summary of all electrofished streams, productivity estimates per unit of each sampled area and species present.

Station Habitat type	Area (m^2)	Species	Pop. Est./Unit (N/unit)	N (standardized to 100 m^2 = 1 habitat unit)		Biomass/area estimate (gm/unit)
				LCL[1]	UCL[2]	
T-1 Quantitative Station 1	88.4	Brook trout	14	11.41	15.74	289.1
T-1 Quantitative Station 2	100.0	Brook trout	36	31.06	40.94	401.4
T-1 Index Station	86.5	Brook trout	7[a]	- -	- -	- -
		American eel	1[a]	- -	- -	- -
T-2 Quantitative Station 1	100.0	Brook trout	15	10.15	19.45	61.5
		Three Spine Stickleback	10	3.74	16.26	15.0
T-2 Quantitative Station 2	100.0	Brook trout	5	4.40	5.60	27.5
		Three Spine Stickleback	13	11.15	14.85	14.3

Station Habitat type	Area (m^2)	Species	Pop. Est./Unit (N/unit)	N (standardized to 100 m^2 = 1 habitat unit)		Biomass/area estimate (gm/unit)
				LCL[1]	UCL[2]	
T-2-2 Quantitative Station 1	100.0	Brook trout	56	53.92	58.08	268.8
		Three Spine Stickleback	445	286.20	603.80	623.0
T-2-3 Quantitative Station 1	100.0	Brook trout	2	0	22.90	9.2
		Atlantic salmon	9	7.17	10.83	126.0
		Three spine stickleback	2	0	4.35	1.6
T-2-3 Quantitative Station 2	100.0	Brook trout	2 [a]	- -	- -	- -
		Atlantic salmon	18	11.32	24.68	255.6
		Three spine stickleback	3	0	5.56	16.8
T-3 Quantitative Station 1	116.3	Brook trout	12	10.90	13.10	144
T-3 Index Station	48.3	Brook trout	3	--	--	- -

[1] 95%Lower Confidence Limit
[2] 95%Upper Confidence Limit
[a] Total number of fish caught
-- No calculations due to sample size or type

6.3 Lacustrine Habitat Classification/Quantification

All ponds sampled within the Project area were quantified for lacustrine habitat, netted for fish presence, and a bathymetric profile was completed. Ponds 1, 2, 3, 7, and 8 all contained fish, meanwhile, fyke net sets and baited minnow traps within ponds 4, 5, 6, 9, and 10 did not yield any fish. Ponds were all shallow (with the exception of a localized 5.6 m area in Pond 2) and most of them were surrounded predominantly by open bog.

Both Secchi and Hydorolab measurements are presented in Table 6-24. In addition to *in situ* Hydrolab measurements, water samples were taken from Ponds 1, 4, 5, 6, 7, 8, 9 and 10 during the 2007 sampling program and sent to AMEC's Mississauga Lab where the samples were tested for general chemistry and metals, plus hydrides. The lab results can be found in Appendix D. Water samples were also collected and analyzed for BTEX (Benzene, Toluene, Ethylbenzene and Xylenes) and TPH (Total Petroleum Hydrocarbons) from Ponds 1, 2 and 4, and from North Harbour River (above bridge), Watson's Brook (reach 5) and Come By Chance River (above power lines) during the 2007 sampling program. Results are also presented in Appendix D.